Conservation and Recovery Plan
for Oregon Steelhead Populations in the
Middle Columbia River Steelhead Distinct Population Segment

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Our hope is that this plan will serve as a roadmap and a vehicle to facilitate the continuation of the sound work already underway as well as accelerate improvement in habitat conditions and steelhead management. Successful plan implementation will lead to abundant, diverse, and productive steelhead populations that provide significant ecological, social, and cultural benefits.

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ACRONYMS AND ABBREVIATIONS

AHA	All-H analyzer
A/P	Abundance/productivity
ACEC	Area of Critical Environmental Concern
AgWQM	Agricultural water quality management
BACI	Before-after-control-impact
BIA	Bureau of Indian Affairs
BiOp	Biological opinion
BLM	Bureau of Land Management
BMPs	Best management practices
BOR	Bureau of Reclamation
BPA	Bonneville Power Administration
cfs	Cubic feet per second
CAFO	Confined animal feeding operations
CBFWA	Columbia Basin Fish and Wildlife Authority
CCRP	Continuous Conservation Reserve Program
CDs	Conservation districts
CHART	Critical Habitat Assessment Review Team
CI	Confidence interval
CREP	Conservation Reserve Enhancement Program
CRFPO	Columbia River Fisheries Program Office
CRITFC	Columbia River Inter-tribal Fish Commission
CRP	Conservation Reserve Program
CSMEP	Collaborative Systemwide Monitoring and Evaluation Project
CSP	Conservation Security Program
CSS	Comparative survival study
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CTWSRO	Confederated Tribes of the Warms Springs Reservation of Oregon
CWA	Clean Water Act
CWT	**C**oded-wire tag
DART	Data access in real time
DBLT	Deschutes Basin Land Trust
DSL	Oregon Department of State Lands
DPS	Distinct population segment
DRC	Deschutes River Conservancy
EDT	Ecosystem Diagnosis and Treatment
EIS	Environmental impact statement
EMAP	Environmental monitoring and assessment protocol
EPA	Environmental Protection Agency
EQUIP	Environmental Quality Incentive Program
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FCRPS	Federal Columbia River Power System
FEIS	Final environmental impact statement
FERC	Federal Energy Regulatory Commission
FMEP	Fisheries Management and Evaluation Plan
FPC	Fish Passage Center
FPP	Fish per pound
FS	Forest Service
FSA	Farm Service Agency
FWC	Oregon Fish and Wildlife Commission
FY	Fiscal year
GFID	Gardena Farms Irrigation District #13
GM	Geometric mean
GMA	Growth Management Act
GRP	Grassland Reserve Program
HBDIC	Hudson Bay District Improvement Company
HFRP	Healthy Forest Reserve Program
HGMP	Hatchery and Genetics Management Plan
HID	Hermiston Irrigation District
HPV	Historical Precipitation Variation
HUC	Hydrologic unit code
ICTRT	Interior Columbia Technical Recovery Team
IFIM	Instream flow incremental methodology
IFP	Integrated fruit production
IHNV	Infectious Hematopoietic Necrosis Virus
IMW	Intensively monitored watershed

IRMP	Integrated Resource Management Plan
ISRP	Independent Scientific Review Panel
LBC	Lake Billy Chinook
LCREP	Lower Columbia River Estuary Partnership
LIDAR	Light detecting and ranging
LFH	Lyons Ferry Hatchery
LWD	Large woody debris
MaSA	Major spawning area
MiSA	Minor spawning area
MMPA	Marine Mammal Protection Act
MNF	Malheur National Forest
MOA	Memorandum of agreement
MPG	Major population group
MU	Management unit
NBD	Nursery Bridge Dam
NCDC	National Climatic Data Center
NEPA	National Environmental Policy Act
NFCP	Native Fish Conservation Policy
NGO	Non-government agency
NHD	National Hydrography Dataset
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration-Fisheries
NPMP	Northern Pikeminnow Management Program
NPCC	Northwest Power and Conservation Council
NRCS	Natural Resources Conservation Service
NTU	Nephelometric turbidity unit
NWFP	Northwest Forest Plan
ODA	Oregon Department of Agriculture
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
ODEQ	Oregon Department of Environmental Quality
OHV	Off highway vehicle
OPSW	Oregon Plan for Salmon and Watersheds
ORV	Outstandingly remarkable values
OSU	Oregon State University
OWEB	Oregon Watershed Enhancement Board
OWRD	Oregon Water Resources Department
PACFISH	Pacific Anadromous Fish Strategy
PCEs	Primary constituent elements
PCR	Polymerase chain reaction
PCSRF	Pacific Coastal Salmon Recovery Fund
PGE	Portland General Electric
PIT	Passive integrated transponder
PNAMP	Pacific Northwest Aquatic Monitoring Partnership
PRBC	Pelton-Round Butte Complex
PTAGIS	PIT Tag Information System
PVA	Population viability analysis
QAR	Quantitative analytical report
RBH	Round Butte Hatchery
RC&D	Resource conservation and development
RHCAs	Riparian habitat conservation areas
RIOG	Regional Implementation and Oversight Group
RM	River-mile
RMEF	Rocky Mountain Elk Foundation
RPA	Reasonable and prudent alternative
RSTs	Rotary screw traps
RSW	Removable spillway weir
SAR	Smolt-to-adult return
SEPA	State Environmental Policy Act
SID	Stanfield Irrigation District
SLEDs	Sea lion excluder devices
SMP	Shorelines Master Plan
SMU	Species Management Units
SNPs	Single nucleotide polymorphisms
SS/D	Spatial structure/diversity
SSB	Substitute Senate Bill
STC	Summer temperature change
SURPH	Survival under proportional hazards
SWAC	Springtime water availability change
SWCD	Soil and water conservation district
SWW	Selective water withdrawal
TDG	Total dissolved gas
TDGS	Total dissolved gas supersaturation

TIR	Thermal infrared
TMDL	Total maximum daily loads
TMFD	Three Mile Falls Dam
TNC	The Nature Conservancy
TRT	Technical Recovery Team
TSID	Three Sisters Irrigation District
TSS	Tri-State Steelheaders
UBWC	Umatilla Basin Watershed Council
UNF	Umatilla National Forest
UPA	Updated proposed action
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USFS	U.S.D.A. Forest Service
USFWS	U.S. Fish and Wildlife Service
UWCIG	University of Washington Climate Impact Group
VARs	Variances
VSP	Viable salmonid population
WAC	Washington administrative code
WCC	Washington Conservation Commission
WDOE	Washington Department of Ecology
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WEID	West Extension Irrigation District
WHP	Wellhead Protection Program
WHIP	Wildlife Habitat Incentive Program
WID	Westland Irrigation District
W/LC TRT	Willamette/Lower Columbia Technical Recovery Team
WSNFH	Warm Springs National Fish Hatchery
WRIA	Water Resources Inventory Area
WRP	Wetlands Reserve Program
WWBWC	Walla Walla Basin Watershed Council
WY	Water years
YN	Yakama Nation

Section 1 Executive Summary

This plan serves as a blueprint for the recovery of ten Middle Columbia River (Mid-C) steelhead populations that occupy Oregon tributaries to the Columbia River. The steelhead populations spawn and rear in the Fifteenmile Creek, Deschutes, John Day, Umatilla and Walla Walla river basins and are part of the Mid-C steelhead (*Oncorhynchus mykiss)* Distinct Population Segment (DPS). The DPS, which is listed as threatened under the Endangered Species Act (ESA), includes all steelhead populations in Oregon and Washington tributaries to the Columbia River upstream of the Hood and Wind river systems, up to and including the Yakima River.

The plan seeks to remove or minimize threats to the long-term persistence of Oregon's Mid-C steelhead populations and improve their viability to levels that will allow removal of the DPS from the threatened and endangered species list. The long-term goals, however, reach well beyond achieving DPS delisting. They aim to recover the populations and their habitats to levels that are not only viable, but also provide sustainable fisheries and other ecological, cultural, social and economic benefits for future generations.

Improving the status of Oregon's Mid-C steelhead populations is critical to DPS recovery. The populations play essential roles in achieving viability for three of four major population groups within the DPS. Status of most of the populations needs to improve to achieve viability criteria. The plan's recovery strategies and actions seek to remove threats to the long-term persistence of the populations and improve biological status so the populations meet viability requirements and support DPS recovery. Strategies and actions focus primarily on addressing threats to the populations posed by tributary habitat degradation, out-of-DPS hatchery strays, and hydrosystem development and operations — considered the main obstacles to recovery.

The plan provides information required by NOAA's National Marine Fisheries Service (NMFS) to satisfy the requirements of section 4(f) of the ESA and the State of Oregon's Conservation Plan requirements. It describes: 1) recovery goals and objective, measurable criteria which, when met, will result in a determination that the species be removed from the threatened and endangered species list; 2) site-specific management actions necessary to achieve the plan's goals; 3) estimates of the time required and cost to carry out the actions needed to achieve the plan's goals; and 4) direction for monitoring and evaluation and adaptive management to fine-tune our course towards recovery when needed.

The document contains:

- The institutional framework and rationale for recovery plans
- How NOAA's National Marine Fisheries Service expects to use the plan
- The regional context within which recovery plans in the Columbia Basin are written
- The relation of this plan to other planning processes and other ESA mandates
- Desired status—delisting and broad sense recovery goals; viability criteria
- The current status of listed Oregon Mid-C steelhead populations
- Gaps between current status and viable status
- Limiting factors and threats
- Recovery strategies and actions for the Oregon portion of the Mid-C steelhead DPS
- Management action effectiveness and expected outcomes
- Cost analysis
- A framework for implementation, monitoring and evaluation, and adaptive management

Still, the plan is not a regulatory document. The ESA does not require any agency or entity to implement the recovery strategies or specific actions in the recovery plan unless otherwise legally mandated (NMFS 2006a). It depends on the social and regulatory structure that currently exists for habitat, hydropower, harvest, hatchery and predation management and models the existing and expected changes for these important factors in the future. The plan identifies actions deemed necessary to achieve recovery goals, focusing on where changes can be accomplished that build upon and adapt from the existing social and regulatory programs. This approach acknowledges the policy choices that have been made in the past to maintain hydropower in the Columbia Region as well as other choices to sustain social and economic interests, while identifying actions necessary to reach recovery goals. If and when there are major changes in the underlying policy choices, this plan will need to be updated to clearly reflect these changes. While this plan identifies needed actions and priority locations, it also gives implementing agencies and citizens the flexibility to design creative, yet scientifically sound approaches that reflect site-specific conditions and support local interests.

This conservation and recovery plan will be considered a "living document." As new information becomes available, such as the outcome of the Federal Columbia River Power System Biological Opinion process, or as new information reveals the need for adaptive change, revised and additional actions will be added to the plan.

1.1 Background and Regional Context

Historically, Mid-C steelhead spawned and reared throughout central Oregon and south-central Washington. They occupied nine major Columbia River tributaries draining the east side of the Cascades Mountains, as well as numerous smaller systems. Major river systems include the White Salmon, Deschutes, John Day, Klickitat, Umatilla, Walla Walla, and Yakima rivers and Fifteenmile, Rock, and Willow creeks (Figure 1-1).

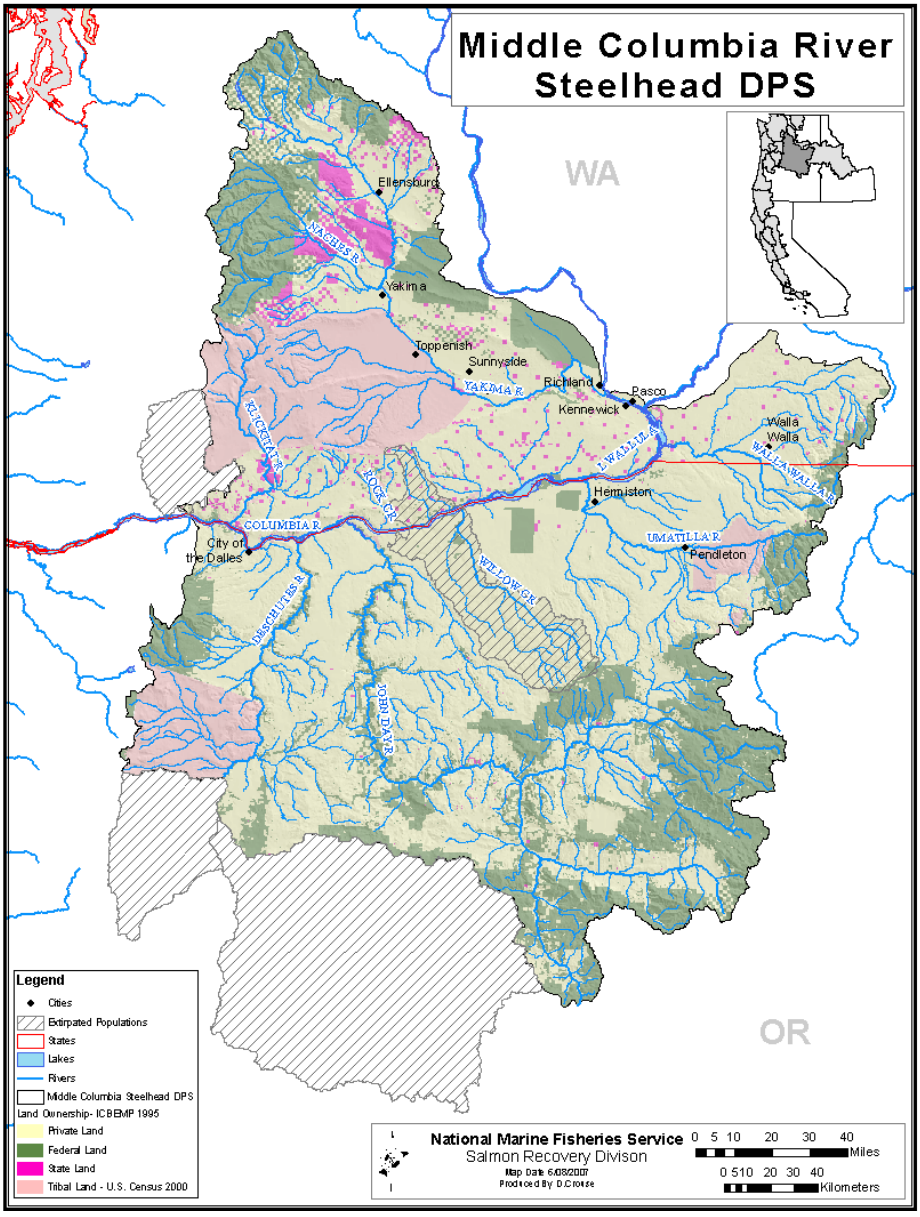


Figure 1-1. The Middle Columbia River Steelhead DPS. Areas marked as extirpated represent absence of only the anadromous form of *O. mykiss*.

By the late 1900s, Mid-C steelhead populations had experienced significant declines in abundance as a result of loss, damage or change to their natural environment. On March 25, 1999, NMFS listed Oregon's Mid-C steelhead populations as threatened under the Endangered Species Act as part of the Middle Columbia River steelhead Evolutionarily Significant Unit (ESU) (69 FR 33101). The ESU included both anadromous and resident forms of the biological species *Oncorhynchus mykiss (O.mykiss).* Recently, NMFS revised its species determinations for West Coast steelhead under the ESA, delineating anadromous, steelhead-only "distinct population segments" (DPS). NMFS listed the Middle Columbia River steelhead DPS as threatened on January 5, 2006 (71 FR 834). The DPS consists of all historical steelhead populations in Oregon and Washington tributaries of the Columbia River upstream of the Hood

and Wind river systems, up to and including the Yakima River. It is one of 17 ESUs and DPSs of salmon and steelhead in the Pacific Northwest listed under the ESA.

The populations remain highly valued by Native Americans and many other people in the Pacific Northwest. The steelhead populations have long had important tribal subsistence, ceremonial and commercial values for Native Americans, including the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes and Bands of the Yakama Nation, and the Confederated Tribes of the Warm Springs Reservation of Oregon. Native Americans continue to maintain strong cultural values for steelhead and salmon species. Northwest Indian tribes hold legally enforceable treaty rights reserving to them a share of the salmon harvest. Local communities and others in the region also treasure the steelhead populations and their habitats as important resources, and want to see them rebuilt to sustainable, harvestable levels. All of these rights and expectations will not necessarily be fully met by achieving only the basic purpose of the ESA and delisting of the species, although it will lead to major improvements in the current situation. The recovery plan's broad sense goals and objectives address these and other issues.

1.2 A Cooperative Effort

This conservation and recovery plan is one piece of a larger, integrated recovery plan for the entire DPS. It addresses factors limiting the viability of Mid-C steelhead populations within the State of Oregon (Figure 1-2). The DPS-level recovery plan also includes individual recovery plans for the other areas in the DPS.

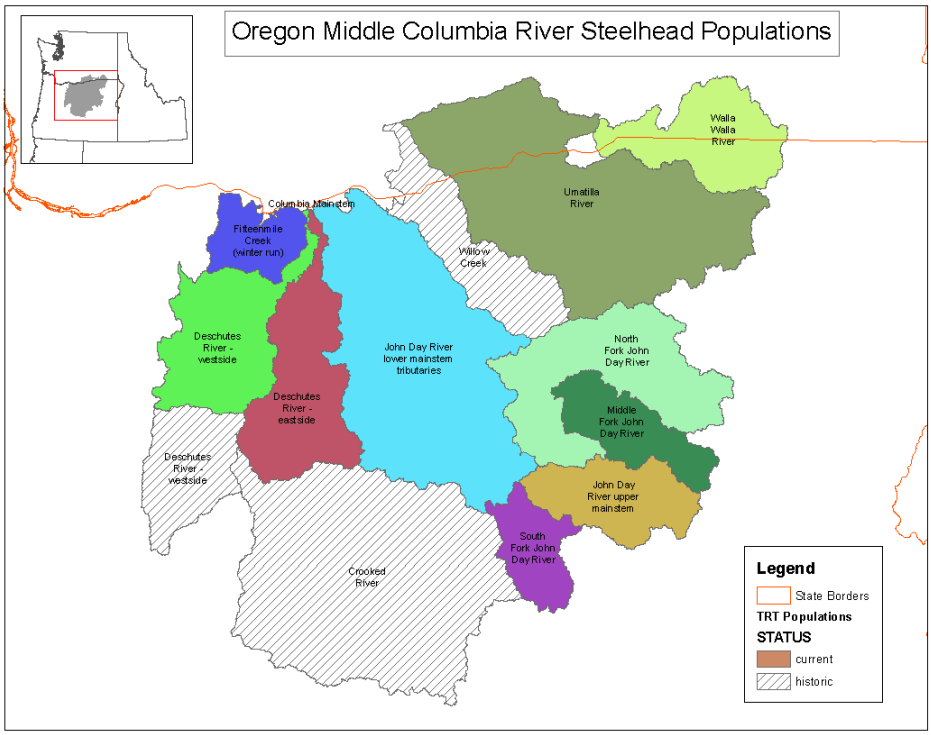


Figure 1-2. Oregon populations in the Mid-C Steelhead DPS.

State of Oregon Recovery Planning

The State of Oregon led the development of this recovery plan for Oregon Mid-C steelhead in partnership with NMFS, other natural resource agencies, the tribes, and local communities. The State's approach to recovery planning is grounded in an understanding that the challenges of steelhead recovery are immense—particularly in the face of growing human populations and demands for clean water and other precious resources. The recovery plan was developed to parallel and build from the Oregon Plan and the Oregon Conservation Strategy.

The Oregon Department of Fish and Wildlife facilitated the plan's development through a collaborative process with broad technical, stakeholder and public involvement. We have involved critical players at each stage in the decision-making process. Oregon's recovery planning forums include the Middle Columbia Sounding Board, the Mid-Columbia Recovery Planning Team, and Management Action Teams. We are relying heavily on these different players to make sure that our recovery strategy for Oregon Mid-C steelhead in scientifically sound and defendable. This involvement is vital for the plan's successful implementation.

- *Middle Columbia Sounding Board (MCSB).* The MCSB consists of representatives of local communities, agricultural and timber interests, land managers, governing bodies, tribes, and industry and environmental interests. The MCSB provides policy guidance in the development of all aspects of the plan and ensures selection of locally appropriate and locally supported recovery actions needed to achieve species recovery goals. The MCSB was particularly instrumental in the development of broad sense recovery goals, recovery scenarios, recovery strategies, strategic guidance for development and prioritization of management actions, and implementation planning.

- *Mid-Columbia Recovery Planning Team.* The recovery planning team includes state, Federal, Tribal, and watershed council technical representatives across the DPS. The team provided technical guidance and writing for all aspects of the plan.

- *Management Action Teams.* The three management action teams include local experts representing state and federal natural resource agencies, the tribes, watershed councils and Portland General Electric. The teams developed management actions for the ten steelhead populations.

Oregon recovery planners also incorporated findings from groups with broader areas of responsibility than the Mid-Columbia, including the Interior Columbia Technical Recovery Team and the Oregon Expert Panel.

- *Interior Columbia Technical Recovery Team (ICTRT).* The ICTRT, appointed by NMFS, provides geographic and species expertise for the entire Interior Columbia domain. The team includes biologists from NMFS, state, tribal and local entities, academic institutions, and private consulting firms. The ICTRT plays an important role in recovery planning, including developing ESU/DPS and population viability criteria that will be used, along with threats-based criteria, to determine whether a species has recovered sufficiently to be downlisted to threatened (if endangered) or delisted.

- *Oregon Expert Panel.* The Expert Panel was created by the Oregon Department of Fish and Wildlife for purposes of recovery planning and consisted of biologists with significant knowledge of the limiting factors and threats influencing Oregon's listed salmon and steelhead populations. Panelists identified common key and secondary threat themes for the populations.

Involvement by these different entities helps ensure that recovery goals and actions are consistent and compatible with the goals and direction adopted in related efforts. This integrated approach establishes partnerships that allow actions to be implemented effectively and efficiently.

1.3 Delisting the DPS

The overarching aim of this recovery plan is removal of the Middle Columbia River steelhead DPS from the threatened and endangered species list. Section 4(a) (1) of the ESA and NMFS implementing regulations (50 CFR part 424) establish procedures for listing species. According to this direction, the Secretary of Commerce must determine if a species is endangered or threatened because of any one or a combination of the following factors: (1) the present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; or (5) other natural or human-made factors affecting its continued existence.

Listing Factors

In its initial determination to list the species, NMFS found (1996, 1997) that all five listing factors had played a role in the decline of the West Coast salmon and steelhead ESUs. These factors may or may not still be limiting recovery in the future when NMFS reevaluates the status of the species to determine whether the protections of the ESA are no longer warranted and the species may be "delisted." Findings leading to the listing of West Coast salmon and steelhead, including Mid-C steelhead, include:

1. *The present or threatened destruction, modification, or curtailment of its habitat or range*. Salmon and steelhead have experienced declines in abundance over the past several decades as a result of loss, damage or change to their natural environment. Water diversions, forestry, agriculture, mining, and urbanization have eliminated, degraded, simplified, and fragmented habitat. Hydroelectric development on the mainstem Columbia River modified natural flow regimes and impaired fish passage. Tributary obstructions also restrict or block salmon and steelhead access to historical habitats.

2. *Overutilization for commercial, recreational, scientific, or educational purposes.* Overfishing in the early days of European settlement led to the depletion of many salmonid stocks before extensive modifications and degradation of natural habitats, and exploitation rates following the degradation of many aquatic and riparian ecosystems were higher than many populations could sustain. Today, steelhead harvest continues on

the Columbia River, tributaries and Pacific Ocean; however, fishery impacts have declined significantly because of changes in fishery management.

3. *Disease or predation.* Introductions of non-native species and habitat modifications have resulted in increased predator populations in numerous rivers. Predators on adult and juvenile steelhead include seabirds, such as Caspian terns, walleye and California sea lions.

4. *Inadequacy of existing regulatory mechanisms.* Various federal, state, county and tribal regulatory mechanisms are in place to reduce habitat loss and degradation caused by human use and development. Many of these mechanisms have been improved over the years to slow the habitat degradation and destruction. Protective efforts directed toward addressing the many factors that adversely impact Mid-C steelhead and habitat—water quality and quantity, safe migration, riparian vegetation, food, predation dynamics and complex stream channels, and floodplain connectivity—will aid in improving these factors.

5. *Other natural or human-made factors affecting its continued existence*. Variability in ocean and freshwater conditions can have profound impacts on the productivity of salmonid populations and, at different times, have exacerbated or mitigated the problems associated with degraded and altered riverine and estuarine habitats.

NMFS listed the Middle Columbia River ESU in response to a biological review that concluded that summer steelhead in the ESU were "likely to become endangered in the foreseeable future" (NMFS 1999). Prominent features leading NMFS to list the ESU included: (1) declines in abundance of wild steelhead populations, (2) levels of abundance well below historical levels, (3) large numbers of hatchery-origin steelhead entering the Deschutes River basin, and a lack of information regarding this phenomenon, (4) large numbers of hatchery steelhead relative to wild steelhead and a general lack of information regarding the impacts of hatchery steelhead on wild steelhead populations throughout the region, (5) a lack of information regarding the interactions between resident rainbow trout and anadromous steelhead, and (6) habitat alterations in the region resulting in a loss of spawning and rearing habitat for steelhead, including habitat changes that have exterminated some steelhead runs (Busby et al. 1996; NMFS 1999).

Critical Habitat

NMFS designated critical habitat for Mid-C steelhead and 12 other ESUs of salmon and steelhead in a final rule that took effect on January 2, 2006. Essential features of designated critical habitat include substrate, water quality, water quantity, water temperature, food, riparian vegetation, access, water, velocity, space, and safe passage. The Critical Habitat Assessment Review Team (CHART) has rated the conservation value of all 5th-field HUCs supporting populations of Mid-C steelhead. Section 3 of the draft recovery plan discusses the physical and biological primary constituent elements (PCEs) identified as essential to the conservation of the species and shows streams designated critical habitat for Mid-C steelhead.

1.4 DPS Structure — A Hierarchical Steelhead Organization

Our approach to recovery recognizes that a hierarchical steelhead organization structure exists in the DPS. This hierarchical structure extends from the DPS level to a level below the independent population, with individual steelhead in the DPS often sharing more genetic and life history similarities with their closest neighbors than with steelhead from other parts of the DPS. The homing propensity, distribution across the landscape, and the diverse genetic, life history and morphological characteristics that evolve contribute significantly to this hierarchical structure and the species long-term persistence.

The ICTRT has identified three levels in this hierarchy that reflect genetic, geographic (hydrographic) and habitat considerations in the DPS (ICTRT 2003). The State of Oregon adopted this biological hierarchy for purposes of Mid-C steelhead recovery planning.

- *Evolutionarily Significant Units and Distinct Population Segments* listed under the ESA must be substantially reproductively isolated from other nonspecific units, and represent an important component of the evolutionary legacy of the species (Waples 1991).

- *Major Population Groups (MPGs)* are independent populations in an ESU or DPS that share similar genetic, geographic (hydrographic and ecoregion), and/or habitat characteristics (ICTRT 2003). The ICTRT defined a grouping as a Major Population Group (MPG), which is analogous to "strata" as defined by the Lower Columbia-Upper Willamette TRT and "geographic region" described by the Puget Sound TRT.

- *Independent Population* as defined by McElhany et al. (2000) is "a group of fish of the same species that spawns in a particular lake or stream (or portion thereof) at a particular season and which, to a substantial degree, does not interbreed with fish from any other group spawning in a different place or in the same place at a different season. For our purposes, not interbreeding to a 'substantial degree' means that two groups are considered to be independent populations if they are isolated to such an extent that exchanges of individuals among the populations do not substantially affect the population dynamics or extinction risk of the independent populations over a 100-year time frame."

The ICTRT divided the Mid-Columbia steelhead DPS into four major population groups: Cascades Eastern Slope Tributaries MPG, Yakima River MPG, John Day River MPG and Umatilla/Walla Walla Rivers MPG (Figure 1-3). Three of these MPGs contain Mid-C steelhead from Oregon tributaries.

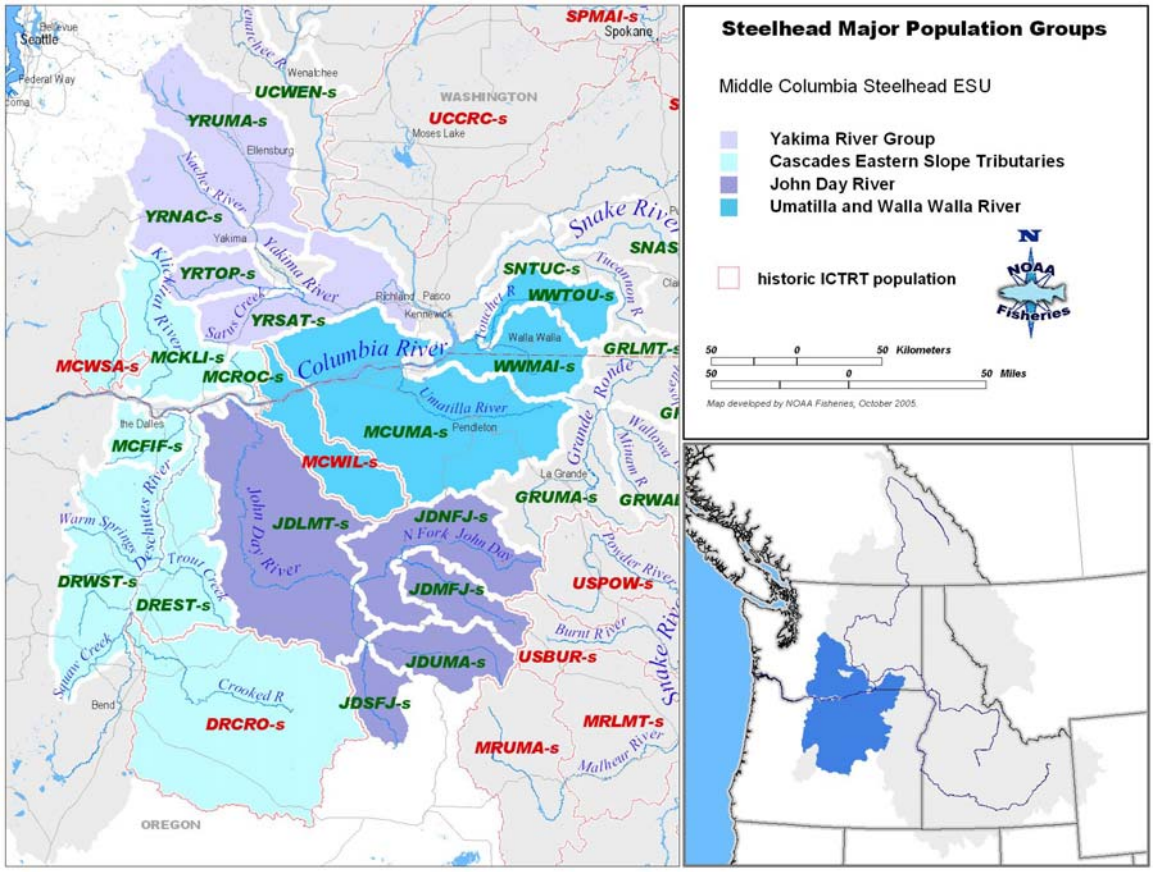


Figure 1-3. Mid-C Steelhead DPS major population groups and independent populations.

Major Population Groups and Oregon Populations

The three MPGs that support Oregon Mid-C steelhead, and the Oregon populations within them, are the focus of this recovery plan and are discussed below. Independent populations are the units that will be combined to form alternative recovery scenarios for MPG and DPS viability.

Cascades Eastern Slope Tributaries MPG

The Cascades Eastern Slope Tributaries MPG contains five extant populations (Fifteenmile Creek, Deschutes River Westside, Deschutes River Eastside, Klickitat and Rock Creek) and two extinct populations (White Salmon and Crooked River). Populations in this MPG are united primarily by geographic proximity. The Columbia River tributaries that support them generally drain the eastern slope of the Cascades and the dry Columbia Plateau, and display varied habitat conditions. The MPG supports summer and winter run life history forms of steelhead. It contains three extant and one extinct Oregon populations:

1. The *Fifteenmile Creek* population occupies Fifteenmile Creek and its tributaries, Fivemile, Eightmile and Ramsey creeks. It also includes five drainages outside of the Fifteenmile Creek watershed, Threemile, Mill, Chenoweth, Mosier, and Rock creeks, that flow directly into the Columbia River. Fifteenmile Creek steelhead are exclusively

winter run fish and are considered the easternmost distribution of winter steelhead in the Columbia basin.

2. The *Deschutes River Eastside* population encompasses the mainstem Deschutes River from its mouth to the confluence of Trout Creek and the tributaries entering the Deschutes from the east, including Buck Hollow, Bakeoven, and Trout creeks. Steelhead in this population are exclusively summer run fish.

3. The *Deschutes River Westside* population covers the mainstem Deschutes River upstream from the mouth of Trout Creek and tributaries entering the Deschutes from the west. Current steelhead access extends from Trout Creek to the Pelton Re-regulating Dam on the mainstem Deschutes and into the Warm Springs River, Shitike Creek and several smaller tributaries. Pelton Dam, a hydroelectric dam at RM 100 on the Deschutes River, blocks all anadromous fish passage to historical habitat above the dam, including areas in the Metolius River and Whychus Creek. The population is a summer run. It is separated from the eastside tributary population based on habitat and life history characteristics.

4. The *Deschutes Crooked River* population once occupied the Crooked River drainage, a major watershed in the Deschutes basin. The population is now extinct because of the lack of passage above Pelton Dam. A current management agreement and plan aim to re-establish steelhead production within the population's boundaries.

John Day River MPG

The John Day River MPG covers Oregon's John Day River drainage. The MPG contains five extant populations (Lower Mainstem John Day, North Fork John Day, Middle Fork John Day, South Fork John Day and Upper Mainstem John Day). Steelhead in these populations are exclusively summer steelhead. The MPG is one of the few remaining summer steelhead groups in the Interior Columbia basin that has had no intentional influence from introduced hatchery steelhead and that has recently been classified as strong or healthy (Lee et al. 1997; Huntington et al. 1994). Spawning is widely distributed across tributary and mainstem habitats.

1. The *Lower Mainstem John Day River* population includes tributaries to the John Day River downstream of the South Fork John Day River. This widespread population is the most differentiated ecologically from other populations, occupying the lower, drier, Columbia Plateau ecoregion.

2. The *North Fork John Day River* population occupies the highest elevation, wettest area in the John Day basin. Population boundaries include the main stem and tributaries of the North Fork John Day River. The population was defined based on habitat characteristics, basin topography, and demographic patterns.

3. The *Middle Fork John Day River* population resides in the Middle Fork John Day and all its tributaries. Spawning areas in the Middle Fork John Day River are separated substantially from all other spawning areas; except for those in the North Fork John Day, that exhibit different habitat characteristics.

4. The *South Fork John Day River* population occupies the South Fork John Day River drainage. The independent population was defined based on genetic information and basin topography.

5. The *Upper Mainstem John Day River* population includes the mainstem John Day River and tributaries upstream from the South Fork. It is separated from the lower mainstem based on habitat differences and from the South Fork because of topography.

Umatilla/Walla Walla Rivers MPG
This major group includes three extant populations (Umatilla River, Walla Walla River and the Touchet River, a tributary of the Walla Walla River in Washington State) and one extinct population (Willow Creek). The Umatilla and Walla Walla rivers drain the northwestern slopes of the Blue Mountains, with lower reaches in the warmer, drier habitats of the Columbia Plateau. Genetic information, distance between spawning aggregates and ecoregional classifications contributed to ICTRT population delineations within this major group. The entire Umatilla drainage and part of the Walla Walla lie within the State of Oregon's borders and are addressed in this plan.

1. The *Umatilla River* population spawns and rears in the Umatilla watershed and several small tributaries to the Columbia River in eastern Washington State. The population is separated from the Walla Walla River based on genetic analysis and distance.

2. The *Walla Walla River* population occupies much of the Walla Walla drainage. One major tributary to the Walla Walla River, the Touchet River, is considered a separate population based on genetic analyses.

3. The *Willow Creek* population is extinct. It was designated as an independent population based on geographic distance from other populations and capacity sufficient to support an independent population.

1.5 Desired Status — Delisting and Broad Sense Recovery

The desired status for Oregon's Mid-C steelhead populations is two-tiered. First, the populations must reach desired levels of biological viability to support removal of the DPS from the threatened and endangered species list. Second, the State of Oregon and the Middle Columbia Sounding Board seek to rebuild the populations to provide for sustainable fisheries and other ecological, cultural, social and economic benefits. The recovery goals, viability criteria and potential recovery scenarios described in the plan are summarized below.

Delisting Goal

Our primary goal is to support removal of the Mid-C steelhead DPS from the threatened and endangered species list. This requires that the populations must reach the levels of biological viability defined by the ICTRT and adopted by the State of Oregon in this plan as delisting criteria. In the context of recovery, delisting criteria and viability criteria are considered

synonymous. Achieving ICTRT biological viability status at the population and MPG levels is needed before the DPS can be considered at low risk of extinction and a candidate for delisting.

To attain viability at the MPG level, the populations included in the viable MPG-level scenarios must be at or above viable status as defined by the ICTRT's viability criteria (ICTRT 2006). In addition, the criteria require that other extant populations within a MPG must be maintained at sufficient levels to provide for ecological functions and to preserve options for DPS recovery so that overall MPG productivity does not fall below replacement. Further, this plan recommends a staged, adaptive approach to recovery planning and implementation. Such an approach gives highest priory initially to implementing actions within currently occupied areas and, thus, to improving the status of extant populations and MPGs.

Broad Sense Recovery Goal

After achieving steelhead recovery under the ESA, the State of Oregon aims to rebuild Oregon's Mid-C steelhead populations to levels that will provide for sustainable fisheries and other ecological, cultural and social benefits consistent with achievement of the goals of the Oregon Plan for Salmon and Watersheds. Although broader than the definition of delisting provided by the ESA, these broad sense goals incorporate many of the traditional uses, as well as rural and Native American values, deemed important in the Pacific Northwest.

Oregon's broad sense recovery goal for Mid-C steelhead is founded on a belief that citizens throughout the region value and enjoy the substantial ecological, cultural, social, and economic benefits that are derived from having healthy, diverse populations of steelhead. The Middle Columbia Sounding Board (2006) identified the following broad sense recovery goal:

> *Oregon's Mid-Columbia River natural steelhead populations are sufficiently abundant, productive, and diverse (in terms of life histories and geographic distribution) so that they provide significant ecological, social, cultural, and economic benefits.*

Recovery of Mid-Columbia steelhead populations will require actions that preserve, enhance and restore healthy watershed conditions where ecosystem functions, processes and dynamics are intact, including instream conditions, riparian habitat diversity and complexity, and upland watershed health, in concert with complementary management of harvest, hatcheries and hydropower. Recovery is a process that leads to steelhead populations that are not only viable, but that also provide a harvestable surplus for the treaty tribes and for all other citizens of the region.

This vision for broad-sense recovery incorporates ESA delisting goals in the sense that delisting would be achieved *first* during an extended and stepwise process of achieving broad sense recovery goals. ESA delisting criteria are entirely science-based and establish the biologically-based standards required to sustain the DPS. In contrast, broad-sense recovery represents a level of population and DPS performance that will considerably exceed the delisting level.

Recovery Objectives

By the year 2050, proponents of Oregon's Mid-Columbia River Steelhead Recovery Plan intend to achieve the following objectives:

1. Middle Columbia steelhead are viable throughout the historical range and no longer need protection under the ESA;
2. All currently extant Middle Columbia steelhead populations are highly viable;
3. Extirpated populations (e.g. Willow Creek, Crooked River) are restored in a manner that engages landowner cooperation and does not subject landowners to ESA regulation based on the presence of previously extirpated populations until the introduced populations are self-sustaining and become part of the listed DPS;
4. All extant populations of Middle Columbia steelhead are capable of contributing ecological, social, cultural, and economic benefits on a regular and sustainable basis;
5. Working in concert with existing agreements and collaboratively with landowners and resource managers NOAA will define a suite of additional land and water resource management principles and practices that when followed will alleviate liability for possible ESA regulatory consequences to landowners and resource managers;
6. Out-of-basin limiting factors are addressed equitably and in concert with in-basin limiting factors;
7. Landowners, land managers and agencies are provided with guidance on the protection and management of habitats to promote the recovery of Mid-C steelhead; and,
8. Land and resource managers work with communities and other interests in a coordinated manner to achieve broad sense recovery through a shared vision of conservation where options and choices are preserved for future generations.

Viability Criteria and Approach

The ICTRT's biologically based viability criteria provided the stepping stones for assessing the status of populations in the DPS and identifying future conditions that, when met, would describe viable populations. The State of Oregon adopted the ICTRT's viability criteria as its delisting criteria.

Under the approach, viability assessments are first conducted for the independent populations. The population-level assessments provide the basis for evaluating viability at the next hierarchical level, the MPG. The MPGs then need to meet viability criteria for the DPS to be rated as viable. This approach is consistent with the Viable Salmonid Populations (VSP) guidelines (McElhany et al. 2000), as well as related applications by the Puget Sound and Willamette/Lower Columbia TRTs and the Upper Columbia QAR, and information reviewed for listed Interior Columbia ESU and DPS populations. Section 5.1 describes the ICTRT's viability criteria that address these abundance, productivity, spatial structure and diversity considerations. The ICTRT recommends that the criteria be met to remove the DPS from its listed status under the ESA.

Population-level Viability Criteria

According to McElhany et al. (2000): "*A viable population should be large enough to: 1) have high probability of surviving environmental variation observed in the past and expected in the future; 2) be resilient to environmental and anthropogenic disturbances; 3) maintain genetic diversity; and, 4) support/provide ecosystem functions.*"

The viability criteria address four VSP parameters at the population level:

- *Abundance* – the average number of spawners in a population over a generation or more,
- *Productivity* – the performance of a population over time in terms of recruits produced per spawner,
- *Spatial Structure* – a population's geographic distribution and the processes that affect that distribution, and
- *Diversity* – the distribution of genetic, life history and phenotypic variation within and among populations.

The ICTRT grouped these parameters into two categories: measures addressing abundance and productivity, and measures addressing spatial structure and diversity. The viability of an independent population is determined by integrating risks across the four VSP parameters.

Population Abundance and Productivity Parameters

The ICTRT's objective for abundance and productivity criteria is that: abundance should be high enough that 1) in combination with intrinsic productivity, declines to critically low levels would be unlikely assuming recent historical patterns of environmental variability; 2) compensatory processes provide resilience to the effects of short term perturbations; and, 3) subpopulation structure is maintained (e.g., multiple spawning tributaries, spawning patches, life history patterns) (ICTRT 2007).

The ICTRT used the viability curve concept (e.g., LC/W TRT 2003) as a framework for defining population-specific abundance and productivity levels to meet the objective. A viability curve shows the extinction risks posed by different combinations of abundance and productivity. The ICTRT generated viability curves for each population to identify the combinations of abundance and productivity corresponding to a range of extinction risks—1% (very low), 5% (low), and 25% (moderate) over a 100-year period (Figure 1-4). It targeted population level recovery strategies to achieve less than a 5% (low) risk of extinction in a 100-year period. This is consistent with the VSP guidelines and conservation literature (McElhany et al. 2000; NRC 1995).

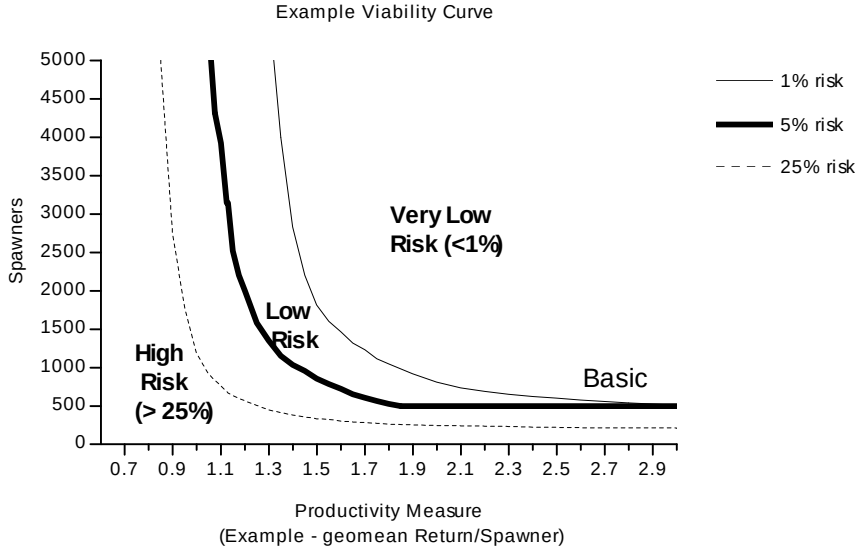


Figure 1-4. Example of Abundance/Productivity viability curve.

The ICTRT established a minimum abundance threshold of 500 individuals for a Basic size population based on its determination that abundance levels below 500 individuals for any population would pose unacceptable risk for inbreeding depression and other genetic concerns. It established higher minimum abundance thresholds incrementally for the three larger population sizes — Intermediate (1,000 spawners), Large (1,500 spawners) and Very Large (2,250 spawners). Viability curves for all four size categories were truncated at the minimum abundance threshold level. The ICTRT also categorized the populations by historical spatial distribution pattern and complexity (Table 1-1).

Table 1-1. Population characteristics and minimum abundance and productivity (at the threshold abundance level) values that represent levels needed to achieve a 95% probability of persistence over 100 years for Oregon Mid-C steelhead populations.

Population	Extant/ Extinct	Life History	Size	Spatial Category	Threshold Abundance	Minimum Productivity
Cascades Eastern Slope Tributaries MPG						
Fifteenmile Creek	Extant	Winter	Basic	C-Trellis	500	1.56
Deschutes River E.	Extant	Summer	Intermediate	B-Dendritic	1,000	1.35
Deschutes River W.	Extant	Summer	Large (Inter.) [a]	B-Dendritic	1,500 (1,000)	1.35
Deschutes/Crooked	Extinct	Summer	Very Large	B-Dendritic	2,250	1.19
John Day River MPG						
L. Main John Day R.	Extant	Summer	Very Large	B-Dendritic	2,250	1.19
NF John Day R.	Extant	Summer	Large	B-Dendritic	1,500	1.26
MF John Day R.	Extant	Summer	Intermediate	B-Dendritic	1,000	1.35
SF John Day R.	Extant	Summer	Basic	B-Dendritic	500	1.56
U. Main John Day R.	Extant	Summer	Intermediate	B-Dendritic	1,000	1.35
Umatilla/Walla Walla Rivers MPG						
Willow Creek	Extinct	Summer	Intermediate	B-Dendritic	1,000	1.35
Umatilla River	Extant	Summer	Large	B-Dendritic	1,500	1.26
Walla Walla River	Extant	Summer	Intermediate	B-Dendritic	1,000	1.35

[a] Large size category is for historically accessible area; intermediate size category is for currently accessible area.

Spatial Structure and Diversity Parameters

The ICTRT identified two primary goals that spatial structure and diversity criteria should address: 1) maintain natural rates and levels of spatially mediated processes, and 2) maintain natural patterns of variation. It also identified mechanisms, factors and metrics for assessing a population's spatial structure and diversity. Mechanisms are biological or ecological processes that contribute to achieving the goals, factors are characteristics of a population or its environment that influence mechanisms, and metrics are conditions that can be measured and assessed at regular intervals to determine whether a population has achieved goals or to evaluate its current risk level.

Goal 1: *Maintain natural rates and levels of spatially-mediated processes.*
Metrics:

a. Number and distribution of spawning areas
b. Spatial extent and range relative to historical
c. Changes in gaps between spawning areas

Goal 2: *Maintain natural levels of variation.*
Metrics:

a. Changes and loss of major life history strategies
b. Variation and loss of phenotypic traits, run timing
c. Genetic variation
d. Spawner composition, proportion and origin of natural spawning hatchery fish
e. Changes in use of major habitat types (ecoregions)
f. Selective mortality factors: Hydrosystem, Hatcheries, Harvest, Habitat

Section 5.1 provides a more detailed discussion of these goals and the mechanisms, factors and metrics for rating spatial structure and diversity risks.

Integrating the Four Parameters

The ICTRT's population level criteria allowed us to identify populations performing at Viable or Highly Viable levels. We identified these populations by using a simple matrix approach that integrates all four viable salmonid population parameters. The abundance/productivity (A/P) risk level combines the abundance and productivity criteria using a viability curve. The spatial structure/diversity (SS/D) risk level integrates across the measures of spatial structure and diversity.

Under this approach, Viable and Highly Viable populations are rated directly as specific combinations of A/P and SS/D risk ratings (Figure 1-5). Populations with a Very Low rating for A/P and at least a Low rating for SS/D are considered to be Highly Viable. Population rated at Moderate or High risk for A/P, or High risk for SS/D have a risk of extinction greater than 5% and are not considered Viable. These individual population ratings are then integrated to determine viability at the MPG level. ICTRT criteria require a minimum number of populations within an MPG to be at or above viable status, with additional MPG populations maintained at sufficient levels to provide for ecological functions and to preserve options for DPS recovery.

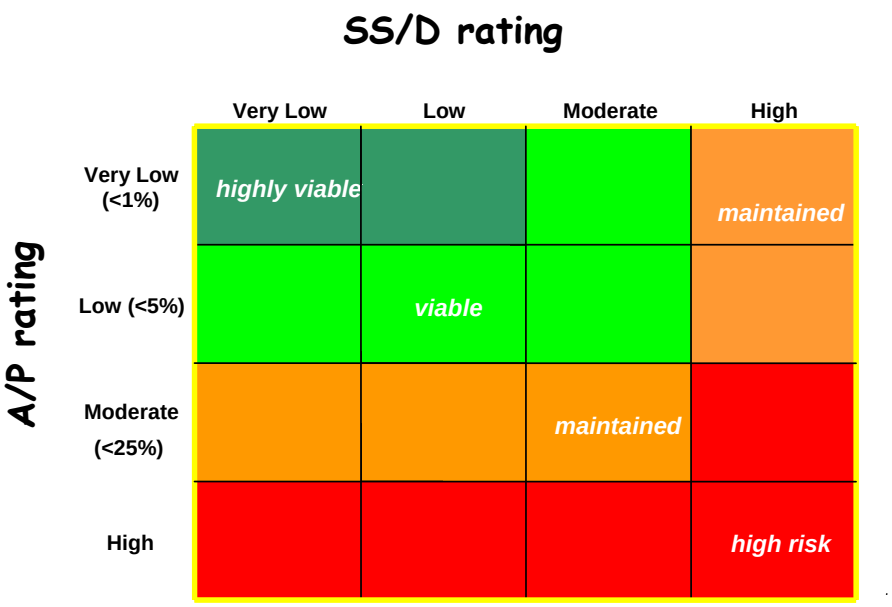


Figure 1-5. Matrix used to integrate Viable Salmonid Population parameter risk ratings and determine overall viability level.

DPS and MPG-level Viability Criteria

The ICTRT framed its ESU/DPS and MPG-level viability criteria to ensure preservation of basic historical metapopulation processes within the DPS, including 1) genetic exchange across populations over a long time frame; 2) the opportunity for neighboring populations to serve as source areas in the event of local population extirpations; 3) population distribution so that they are not all susceptible to a specific localized catastrophic event (ICTRT 2007). Its ESU/DPS-level viability criterion recognizes that MPGs within the DPS likely functioned historically as metapopulations.

DPS-level viability criteria

The ICTRT provided the following criterion to describe the biological characteristics of a viable ESU or DPS:

> All extant MPGs and any extirpated MPGs critical for proper functioning of the ESU or DPS should be at low risk.

MPG-level viability criteria

The ICTRT defined five criteria that a MPG must meet to be regarded as at low risk:

1. At least one-half of the populations historically within the MPG (with a minimum of two populations) must meet viability standards.
2. At least one population must be categorized as being "Highly Viable."
3. Viable populations within an MPG must include some populations classified (based on historical intrinsic potential) as "Very Large", "Large" or "Intermediate" generally

reflecting the proportions historically present within the MPG. In particular, Very Large and Large populations should be at or above their composite historical fraction within each MPG.

4. Populations not meeting viability standards should be maintained with a) sufficient productivity so the overall MPG productivity does not fall below replacement, and b) sufficient spatial structure and diversity demonstrated by achieving Maintained standards.
5. All major life history strategies (e.g., summer and winter run-timing) that were present historically within the MPG must be represented in populations meeting viability requirements.

The population level assessments provide the basis for evaluating viability at the MPG level and, in turn, the DPS as a whole. The combined effects of requiring each MPG to sustain a minimum number of viable populations, a representation of larger size classes of populations and major life history patterns, and the maintenance requirement provide for a network of populations that would sustain the DPS. Revisiting population delineation and viability criteria when new information becomes available is considered an essential element of the adaptive management plan that guides implementation.

Threats Criteria

The listing factor (threats) criteria are the measures that NMFS will use to reevaluate the status of the Mid-C steelhead DPS. They are based on the features that were evaluated under section 4(a)(1) when the initial determination was made to list the species for protection under the ESA. Recovery plans are required to contain these criteria. At the time of a delisting decision, NMFS will use the criteria to determine whether the section 4(a)(1) listing factors have been adequately addressed, i.e., whether the underlying causes of decline have been addressed and mitigated and are not likely to re-emerge. The listing factor (threats) criteria, which will be used to reevaluate the status of Oregon's Mid-C steelhead, are included in the DPS-level recovery plan for Mid-C steelhead and are not repeated in this plan. Threats criteria are described in detail in NOAA's Mid-C DPS Recovery Plan.

Potential MPG-level Recovery Scenarios

Several scenarios or combinations of populations would satisfy the MPG level viability criteria for the three MPGs containing Oregon Mid-C steelhead populations. The populations included in each of these scenarios were selected based on unique characteristics (e.g. run timing, population size, genetic characteristics), major production areas in the MPG, and spatial distribution of the populations.

The State of Oregon aims to improve more than the minimum number of populations identified in the recovery scenarios for viability. We acknowledge that targeting only the minimum number of populations would likely result in failure to achieve our goals. There is considerable uncertainty in the management actions and how effective they will be in improving population viability. This uncertainty will result in some targeted populations not achieving the desired status. To hedge against this uncertainty, more than the minimum number of populations must be targeted for viable status. Therefore, we also seek to improve all extant Oregon populations

in the MPGs to be maintained at sufficient levels to provide for ecological functions and to preserve options for DPS recovery. This is consistent with ICTRT criteria that recommend that more than the minimum number of populations be improved to a viable status.

Cascades Eastern Slope Tributaries MPG
The following recovery scenario exists for the Cascades Eastern Slope Tributaries MPG:

Population Characteristics:

Independent Populations	Size Category	Life History Type
White Salmon (extirpated)	Basic	Unknown
Klickitat River	Intermediate	Summer/winter
Deschutes River Eastside	Intermediate	Summer
Deschutes River Westside	Large	Summer
Crooked River (extirpated)	Very Large	Summer
Fifteenmile Creek	Basic	Winter
Rock Creek	Basic	summer

Recovery Scenario:

- Four populations must meet viability criteria, one of which must meet highly viable criteria.
- Fifteenmile Creek is the only winter population and thus must meet viability criteria.
- One Large or Very Large population must meet viability criteria. Deschutes River Westside is the only extant population that can meet this criterion.
- Two Intermediate populations must meet viability criteria. Deschutes River Eastside and Klickitat River are the only populations that can meet this criterion.

Recommendations: To achieve viable status in the Cascades Eastern Slope Tributaries MPG, the Fifteenmile Creek, Deschutes River Eastside, Deschutes River Westside, and Klickitat populations must all achieve viable status. One of these populations must be highly viable. The Rock Creek population must be maintained.

John Day River MPG
Recovery scenarios for the John Day River MPG are presented below:

Population Characteristics:

Independent Populations	Size Category	Life History Type
Lower Mainstem John Day River	Very Large	Summer
South Fork John Day River	Basic	Summer
Middle Fork John Day River	Intermediate	Summer
North Fork John Day River	Large	Summer
Upper Mainstem John Day River	Intermediate	Summer

Recovery Scenario:

- Three populations must meet viability criteria, one of which must meet highly viable criteria.

- Two Large or Very Large populations must meet viability criteria. Lower John Day and North Fork John Day are the only populations that can meet this criterion.
- One Intermediate population must meet viability criteria. The Upper Mainstem John Day or Middle Fork John Day populations could meet this criterion.

Recommendations: To achieve viable status in the John Day River MPG, the Lower Mainstem John Day River, North Fork John Day River, and either the Middle Fork John Day River or Upper Mainstem John Day River populations must achieve viable status. One of these populations must be highly viable. The South Fork John Day River population must be maintained.

Umatilla/Walla Walla Rivers MPG
The following recovery scenarios exist for the Umatilla/Walla Walla MPG:

Population Characteristics:

Independent Populations	Size Category	Life History Type
Willow Creek (extirpated)		
Umatilla River	Large	Summer
Walla Walla River	Intermediate	Summer
Touchet River	Intermediate	Summer

Recovery Scenario:
- Two populations must meet viability criteria, one of which must meet highly viable criteria.
- One Large or Very Large population must meet viability criteria. The Umatilla River is the only population that can meet this criterion.

Recommendations: To achieve viable status in the Umatilla/Walla Walla Rivers MPG, the Umatilla River population and either the Walla Walla River or Touchet River population must achieve viable status. One of these populations must be highly viable. All remaining extant populations must be maintained.

1.6 Current Population Status

Assessing the current status of the populations according to the viability criteria is a critical first step in determining a path towards MPG and DPS viability. Following ICTRT guidelines, we completed viability assessments for Oregon's ten extant Mid-C steelhead populations. The assessments describe the current status of the populations relative to the abundance/productivity and spatial structure/diversity viability criteria.

Overall, the viability assessments show that only three of Oregon's Mid-C steelhead populations currently meet the viability criteria. The North Fork John Day population is highly viable and the Fifteenmile Creek and Deschutes River Eastside populations are viable. The remaining populations rated as either maintained or extinct. Assessment findings are provided for each of the ten populations in the population summaries (later in this section-1.14) and in Section 6 of

the recovery plan. Appendix B contains the detailed individual population viability assessments, including population-specific data sources and methods used to estimate abundance.

We also completed viability assessments for the three MPGs containing the Oregon populations. The assessment findings indicate that the three MPGs are currently below viable status based on the status of the constituent populations. These findings are shown below in Tables 1-2 through 1-4.

Cascades Eastern Slope Tributaries MPG

Findings: The Cascades Eastern Slope Tributaries MPG is currently below viable status. The Fifteenmile Creek and the Deschutes River Eastside are viable. The Deschutes River Westside population does not meet viability criteria. The Deschutes Crooked River population is extinct.

Table 1-2. Viability assessment results for Mid-C steelhead populations in the Cascades Eastern Slope Tributaries MPG.

Population	Extant/ Extinct	Abundance		Productivity		A/P Risk	Goal A Natural Processes Risk	Goal B Diversity Risk	Integrated SS/D Risk	Overall Population Viability Rating
		Mean	Lower 90% CI	Mean	Lower 90% CI					
Fifteenmile Creek	Extant	703	481	1.82	1.23	Low	Very Low	Low	Low	Viable
Deschutes River Eastside	Extant	1,599	896	1.89	1.10	Low	Low	Moderate	Moderate	Viable
Deschutes River Westside	Extant	456	306	1.05	0.76	High	Low	Moderate	Moderate	High Risk
Deschutes Crooked River	Extinct	0	NA	0	NA	Extinct	NA	NA	NA	Extinct

John Day River MPG

Findings: The John Day River MPG is currently below viable status. The North Fork population is highly viable; however, all of the other John Day River populations were below viable status.

Table 1-3. Viability assessment results for Mid-C steelhead populations in the John Day River MPG.

Population	Extant/ Extinct	Abundance		Productivity		A/P Risk	Goal A Natural Processes Risk	Goal B Diversity Risk	Integrated SS/D Risk	Overall Population Viability Rating
		Mean	Lower 90% CI	Mean	Lower 90% CI					
Lower Mainstem John Day River	Extant	1,800	1,065	2.99	1.91	Moderate	Very Low	Moderate	Moderate	Maintained
North Fork John Day River	Extant	1,740	1,375	2.41	1.62	Very Low	Very Low	Low	Low	Highly Viable
Middle Fork John Day River	Extant	756	508	2.45	1.81	Moderate	Low	Low	Low	Maintained
South Fork John Day River	Extant	259	168	2.06	1.26	Moderate	Very Low	Low	Low	Maintained
Upper Mainstem John Day River	Extant	524	399	2.14	1.15	Moderate	Very Low	Moderate	Moderate	Maintained

Umatilla/Walla Walla Rivers MPG

Findings: The Umatilla/Walla Walla Rivers MPG is currently below viable status because the Umatilla and Walla Walla populations do not meet viability criteria.

Table 1-4. Viability assessment results for Mid-C steelhead populations in the Umatilla/Walla Walla Rivers MPG.

Population	Extant/ Extinct	Abundance		Productivity		A/P Risk	Goal A Natural Processes Risk	Goal B Diversity Risk	Integrated SS/D Risk	Overall Population Viability Rating
		Mean	Lower 90% CI	Mean	Lower 90% CI					
Willow Creek	Extinct	0	NA	0	NA	Extinct	NA	NA	NA	Extinct
Umatilla River	Extant	1,472	988	1.50	1.11	Moderate	Moderate	Moderate	Moderate	Maintained
Walla Walla River	Extant	650	459	1.34	1.05	Moderate	Low	Moderate	Moderate	Maintained

1.7 Gap Analysis

The viability assessment results were used to determine the "gap" between the current status and the status required to meet the viability criteria. The gap analysis addresses the four VSP parameters: abundance, productivity, spatial structure and diversity. This analysis allowed us to identify viability impairments at the population level and inform development of appropriate actions to address impairments and, thus, "close the gaps."

The ICTRT conducted the abundance/productivity gap analyses for Mid-Columbia steelhead populations. The ICTRT defined the abundance/productivity gap as the quantitative relative amount of change in survival or capacity that is required for a population to improve from current status to a specific viability level. The gap analysis provides estimates of the magnitude of survival or capacity change that are needed to reach viability criteria for 25%, 5% and 1% probability of extinction over a 100-year timeframe as defined by the viability curves.

Our recovery planners performed the spatial structure/diversity gap analyses for the Oregon populations. The analyses included several steps: 1) for each population, we identified all spatial structure and diversity metrics with ratings of moderate or high risk; 2) for the metrics rated moderate, we determined if the rating was a result of changed status from intrinsic conditions or if the rating was a result of an intrinsic moderate risk for the metric; and 3) we characterized spatial structure and diversity gaps for each population as those metrics that rated high risk and those metrics that rated moderate risk because the current status is impaired relative to the intrinsic condition.

Gap analysis results for individual populations are provided in the population summaries (later in this section-1.14) and in Section 7.

1.8 Limiting Factors and Threats

Section 8 describes limiting factors and threats to the viability of Mid-C steelhead in Oregon. The findings were identified based on many sources of information, including the Mid-C steelhead Expert Panel's report, subbasin plans, ODEQ reports, ICTRT reports, NOAA's limiting factors modules, ODFW reports, hydrosystem biological opinion remand documents, and numerous other sources. The limiting factors and threats analyses serve as an essential foundation for the development and prioritization of management actions across the entire lifecycle. We used the following definitions of limiting factors and threats for our assessment.

> *Limiting Factors*: The physical, biological, or chemical conditions of the environment and associated ecological processes and interactions (e.g., habitat connectivity, water quality, physical habitat quality, etc.) that influence Mid-C steelhead viable salmonid population parameters, including abundance, productivity, spatial structure, and diversity.
>
> *Threats:* Threats are human actions (e.g., fishing, operation of hatcheries, operation of hydrosystem, land use practices, etc.) or natural events (e.g., flood, drought, volcano, etc.) that cause or contribute to limiting factors. Threats may influence one or multiple life stages and may occur in the present or future or have occurred in the past.

Key findings are summarized below and population-specific limiting factors and threats are identified in the population summaries in Section 1.14. Section 8.1 provides a broad level perspective of the primary limiting factors and threats across and within Oregon's Mid-C steelhead populations. This broader look is followed by more detailed, in-depth discussions of limiting factors and threats in Section 8.2 (Tributary Habitat), 8.3 (Hydrosystem), 8.4 (Estuarine and Plume Habitat), 8.5 (Harvest), 8.6 (Hatchery), and 8.7 (Predation and Competition).

Land Use

Tributary habitat degradation from past and/or present land use remains a key concern for all populations. Steelhead have been adversely affected by modified and reduced streamflows, impaired water quality due to elevated water temperatures and agricultural chemicals, impaired upstream and downstream fish passage, degraded channel structure and complexity (including riffles, pools and large woody debris), loss of riparian vegetation, reduced floodplain connectivity, and excessive levels of fine sediments caused by altered sediment routing. Threats contributing to these factors include agricultural, forestry and grazing practices that negatively impact steelhead growth and survival, dams and other barriers, water withdrawals, roads and channel manipulations. The Mid-C Expert Panel identified land use as having the most key concerns of any of the threat categories because, for most populations, the greatest impairment to viability has resulted from changes to the tributary spawning, rearing, and migration habitats.

We examined seven general types of tributary habitat limiting factors during our analysis. The factors are often interrelated.

- *Degraded floodplain connectivity and function*: Loss, impairment or degradation of floodplain connectivity; access to previously available habitats (seasonal wetlands, off-

channel habitat, side channels); and a connected and functional hypotheic zone. Includes reduced overwinter habitat and channel habitat. Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

- *Degraded channel structure and complexity*: Loss, impairment or degradation of channels; a suitable distribution of riffles and functional pools; functional amounts and sizes of large woody debris or other channel structure. Includes reduced summer rearing habitat, degraded spawning habitat, reduced diversity and structure (wood, boulders, etc.), inadequate quantity or depth of pools, loss of side and braided channels. Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

- *Degraded riparian areas and LWD recruitment*: Loss, degradation or impairment of riparian conditions important for production of food organisms and organic material, shading, bank stabilizing by roots, nutrient and chemical mediation, control of surface erosion, and production of large-sized woody material. Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

- *Altered hydrology*: Changes in the hydrograph that alter the natural pattern of flows over the seasons, causing inadequate flow, scouring flow, or other flow conditions that inhibit the development and survival of salmonids. Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

- *Degraded water quality*: Degraded or impaired water quality due to abnormal temperature, or levels of suspended fine sediment, dissolved oxygen, nutrients from agricultural runoff, heavy metals, pesticides, herbicides and other contaminants (toxics). Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

- *Altered sediment routing*: Altered sediment routing leading to an overabundance of fine-grained sediments, excess of course-grained sediments, inadequate course-grained sediments and/or contaminated sediment. Includes excessive fine sediment that reduces spawning gravel or increases embeddedness. Life stages affected: egg-to-parr survival.

- *Impaired fish passage*: The total or partial human-caused blockage to previously accessible habitat that eliminates or decreases migration ability or alters the range of conditions under which migration is possible. This may include seasonal or periodic total migration blockage. Includes dams, culverts, seasonal push up dams, unscreened diversions, and entrainment in irrigation diversions. Life stages affected: smolt migration, adult migration, juvenile upstream migration due to thermal blockage or water availability.

Climate change is expected to increase the loss and degradation of steelhead habitat. Many of the environmental attributes that will be influenced by climate change (temperature and hydrograph) are those that have already been influenced significantly by past land use and are currently considered key limiting factors. Environmental changes associated with climate change that pose particular threats to salmonid viability include: increased air and stream

temperatures; reduced snow pack and a shift in precipitation from snow to rain; altered hydrographs with earlier and higher peak flows, and lower summer-fall flows; more frequent extreme storm events; increased periods of drought; changing ocean temperatures and current patterns; and more frequent and severe fire events (O'Neal 2002; Mote et al. 2003; ISAB 2007a; Michael and O'Brien 2008). Such environmental changes will impact all life stages of Oregon's Mid-Columbia River steelhead. The magnitude of environmental change will vary considerable across ecoregions; however, habitats at lower elevations east of the Cascade Mountains in the southern portion of the Columbia River basin will generally experience the greatest level of change (ISAB 2007a).

Hydrosystem

The mainstem Columbia River hydrosystem is considered a primary threat to the viability of Oregon's Mid-C steelhead populations. Specific viability concerns identified by the Mid-C Expert Panel related primarily to effects of delayed upstream passage (adults), direct and indirect mortality on downstream migrants (juveniles), alteration of the hydrograph (mainstem and estuary flow regime), depletion of historically available nutrients, and degraded rearing and food resources for both presmolts and smolts in the Columbia River.

Results of the BiOp Framework Work Group support this conclusion. NMFS created the work group to provide scientific expertise during development of its Biological Opinion (BiOp) evaluating effects of operations of the FCRPS — including estimating the relative magnitude of human-caused mortality factors influencing Mid-C steelhead and other Interior Columbia River salmon and steelhead populations. During this evaluation, the work group found that the FCRPS hydrosystem had the greatest relative impact on the Mid-C steelhead populations compared with other human-induced mortality effects (Step 4 Report 2006) (Table 8-1). The ICTRT reached a similar conclusion in September 2006, when members rated the mainstem Columbia River hydrosystem as a major limiting factor for all populations in the DPS. Oregon's recovery planning team also determined that the mainstem hydropower system represents a primary threat to the viability of Oregon Mid-C steelhead populations. The Expert Panel's findings were generally consistent with the BiOp Framework Work Group's findings on magnitude of human-induced mortality, however, the Expert Panel considered the mainstem Columbia hydrosystem a threat of moderate concern to the populations and generally considered legacy and current land use as a greater threat than the hydrosystem.

Impacts from the mainstem Columbia River hydrosystem increase somewhat for each of the populations in direct relation to the number of dams the fish must pass during their migration to and from the Pacific Ocean. Mid-Columbia steelhead populations pass one to four Columbia River dams: the Fifteenmile Creek population passes one dam; Deschutes River populations pass two dams; John Day River and Umatilla River populations pass three dams; and the Walla Walla River population passes four dams.

Several hydroelectric dams on Columbia River tributaries also pose significant threats to the viability of specific populations. The Pelton-Round Butte Complex on the Deschutes River at RM 100 significantly affects the Deschutes Westside population and to a lesser extent the Deschutes Eastside population. It blocks all passage to historical habitat above the dam,

particularly in Whychus Creek, Metolius River and Crooked River. The Boyd Hydro Project on the Umatilla River and Twin Reservoirs Hydro Project on Mill Creek, a tributary to the Walla Walla River affect the Umatilla and Walla Walla steelhead populations.

Estuarine and Plume Habitat

The Columbia River estuary and plume have changed considerably over the last 200 years. The estuary tidal prism is now about 20% smaller, due mostly to dike and filling practices used to convert the floodplain to agricultural, industrial, commercial, and residential uses. Instream flows entering the estuary also have changed dramatically—there has been a 44% decrease in spring freshets or floods, and the annual timing, magnitude, and duration of flows no longer resemble those of the historical hydrograph in the Columbia River (Jay and Kukulka 2002).

Scientists generally believe that steelhead and other stream-type salmonids are particularly affected by changes in plume habitat conditions and by predation in the estuary and plume (Lower Columbia River Estuary Partnership (LCREP) 2006). The plume is believed to function as habitat, as a transitional saltwater area, and as refugia for juvenile salmonids as they prepare for ocean life (Fresh et al. 2005; LCREP 2006). Changes in the Columbia River hydrograph alter both the size and structure of the plume during the spring and summer months (NPCC 2000). Changes in the hydrograph also affect plume habitat by reducing fine-sediment inputs leaving the estuary.

Harvest

Steelhead are affected by harvest during several life stages from pre-smolts taken in trout fisheries to adults taken in commercial, recreational and tribal fisheries primarily in the mainstem Columbia River and tributaries. However, given current management regulations for mainstem Columbia River and tributary fisheries, harvest is not considered a primary or secondary threat due to the low impact on viability. The ICTRT identified harvest-related effects as a secondary level limiting factor and the Mid-C Expert Panel did not identify harvest as either a key or secondary concern for Oregon's Mid-C steelhead populations. The panel, however, did express concerns over the impact that mortality associated with catch and release fisheries have on Westside and Eastside Deschutes populations.

Hatcheries

Out-of-DPS hatchery strays pose significant risk to many of Oregon's Mid-C steelhead populations, particularly to the Eastside and Westside Deschutes and John Day populations. Viability assessments, summarized in Section 6 of this document and presented in Appendix B, identified that a significant proportion of spawners in the Deschutes River and John Day River populations were out-of-DPS strays. In addition, these populations were rated at high risk for spawner composition due to the abundance of strays. Biologists remain especially concerned regarding the continuing detrimental impact of stray out-of-DPS hatchery fish in natural spawning areas on the genetic traits and productivity of these natural populations. Hatchery programs operated within the Mid-C steelhead DPS — including the Umatilla, Walla Walla and Westside Deschutes subbasins — also create some risks. The Mid-C Expert Panel ranked the

impact of hatchery strays as a key concern to the Eastside and Westside Deschutes and Lower John Day populations, and as a secondary concern to the Umatilla and Walla Walla populations.

Predation

The Expert Panel listed predation is a primary concern for juvenile and adult steelhead in the Columbia River estuary and plume. Estuary habitat modifications have increased the number and/or predation effectiveness of Caspian terns, cormorants, and gull species (Fresh et al. 2005). The increasing abundance of native pinnipeds has resulted in increased predation on adult salmonids to a point of concern. Panelists identified predation by non-native piscivorous fish on pre-smolts and smolts in the mainstem Columbia as a secondary concern for all Mid-C steelhead populations.

Climate Change

Climate change will alter environmental conditions across the entire life cycle for all life stages of Oregon's Mid-Columbia River steelhead. There remains considerable uncertainty regarding the magnitude of loss and degradation of salmonid habitat in the Columbia Basin that will result from climate change. The magnitude of environmental change will vary considerable across ecoregions and thus will have different impacts on viability of steelhead populations within the Mid-C DPS. In general, habitats at lower elevations east of the Cascade Mountains in the southern portion of the Columbia River basin, which encompasses the Oregon Mid-C area, will experience the greatest level of change (ISAB 2007a).

Many of the environmental attributes that will be influenced by climate change (temperature and hydrograph) are those that have already been influenced significantly by past land use and are currently considered key limiting factors. The degree to which climate change will impact a given population is partially dependent on the degree to which natural processes have already been altered. A number of reviews have recently been completed that characterize potential climate change impacts in the Pacific Northwest (O'Neal 2002; Mote et al. 2003; ISAB 2007a; Michael and O'Brien 2008). The environmental changes most often described as significant threats to salmonid viability include:

- Increased air and stream temperatures
- Reduced snow pack and a shift in precipitation from snow to rain
- Altered hydrographs with earlier and higher peak flows, and lower summer-fall flows
- More frequent extreme storm events
- Increased periods of drought
- Changing ocean temperatures and current patterns
- More frequent and severe fire events

We conducted an analysis to assess population-specific vulnerability to climate change impacts. We developed a climate change potential vulnerability risk index based on projected future springtime water availability, projected future stream temperatures, and historical variation in precipitation. Our analysis indicates that few of the HUC6s in Oregon's Mid-C populations are at low or very low risk. Many populations have the entire geographic area within the population

boundaries rated as moderate or high risk. The combination of environmental characteristics that are forecasted to change under future climate scenarios will threaten capacity, productivity, diversity, and spatial structure from both lower elevations upward and higher elevations downward. Temperature changes will influence lower elevation areas significantly while higher elevation areas will be influenced most by hydrograph changes.

1.9 Recovery Strategies and Actions

Achieving recovery for the DPS will depend on restoring the viability of extant populations in major population groups to levels that support the proper functioning of the DPS. Recovery strategies for Oregon's Mid-C steelhead populations involve substantial reductions in the threats across all categories (tributary habitat, hydrosystem, estuary and plume habitat, harvest, hatcheries, and predation and competition).

An Integrated Approach

The delisting and broad sense recovery goals, assessments of current status and viability gaps, and limiting factors and threats analysis served as essential building blocks for identifying recovery strategies and actions. The plan's strategies and actions address the multiple limiting factors and threats that affect steelhead viability throughout their life cycle:

- Tributary habitat strategies and actions (Section 9.3) call for the protection of the highest quality habitats, maintenance of existing unimpaired habitats and ecosystem functions that support population viability, and habitat restoration through passive and active measures. Restoration strategies are linked directly to the limiting factors and aim to improve tributary spawning, rearing and migration conditions by restoring instream, riparian and upland habitat conditions, providing passage and floodplain connectivity, and addressing water quality and flow concerns. Actions identified under each strategy define the specific work needed to fill the gap between current conditions and what is needed in the long term to fully achieve the strategy. Actions differ from strategies in that they address specific needs for a specified geographic area, program deficiencies, as well as biophysical habitat impairments and threats. Together, the strategies and actions represent a complete list of needs, somewhat unconstrained by logistic and financial concerns.

- Hydrosystem strategies and actions (Section 9.4) primarily address configurations and operations of the Columbia River hydropower system. They range from improving juvenile and adult steelhead passage and survival at particular dams to addressing flow and temperature issues. These strategies and actions may be revised before completion of the final recovery plan to be consistent with adopted revisions of the 2004 FCRPS BiOp Remand.

  The section also identifies strategies and actions to adjust hydropower operations and facilities in the Umatilla and Walla Walla river systems, and to increase the quantity of spawning and rearing habitat available to Deschutes River Westside steelhead, and to a lesser extent Deschutes River Eastside steelhead, by restoring passage to historical

habitats in the middle and upper Deschutes drainage. Strategies and actions will also restore steelhead access to blocked historical habitats in the Crooked River area.

- Estuarine and plume habitat strategies and actions (Section 9.5) improve steelhead rearing conditions and survival in the Columbia River estuary and plume by restoring estuarine riparian conditions, removing dikes and protecting off-channel habitats.

- Harvest strategies and actions (Section 9.6) protect steelhead in the ocean, mainstem Columbia River and tributaries by maintaining low impact fisheries and attempting to increase harvest of stray hatchery spawners, thus reducing abundance of out-of-DPS hatchery strays.

- Hatchery strategies and actions (Section 9.7) address ecological and genetic effects on Oregon Mid-C steelhead from hatchery management programs in and outside the DPS. They include reducing the abundance and proportion of out-of-DPS hatchery strays spawning naturally in Oregon's Mid-C steelhead populations. They also help restore natural production in historically utilized habitats of the Deschutes Westside, Crooked River, and Umatilla River population areas.

- Predation and competition strategies and actions (Section 9.8) seek to reduce predation by pinnipeds, birds, and piscivorous fish on salmon and steelhead in the Columbia River estuary and mainstem.

Together, the strategies and actions are framed to close viability gaps, reach delisting status, and progress toward broad sense recovery goals. Table 1-5 shows the strategies and types of actions that will be implemented to address all factors limiting recovery of Oregon Mid-C steelhead populations throughout their lifecycle. The highest priority tributary-level strategies, actions and priority areas are also identified for each population (later in this section-1.14).

Table 1-5. Integrated approach to address all factors limiting recovery of Oregon's Mid-C steelhead populations.

Strategies	Populations Addressed	Types of Actions	Limiting Factors and Threats Addressed
Tributary Habitat			
Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.	All populations	Protect highest quality habitats through acquisition and conservation. Adopt and manage Cooperative Agreements. Conserve rare and unique functioning habitats. Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	Degradation of tributary habitat-forming processes and functions (loss of channel structure, floodplain connectivity, riparian vegetation, and LWD recruitment)
Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.	All populations	Provide passage at Pelton-Round Butte Complex. Remove or replace barriers blocking passage such as dams, road culverts and irrigation structures. Provide screening at 100% of irrigation diversions. Replace screens that do not meet criteria.	Loss of historical habitat because of blocked or impaired fish passage (dams, culverts, unscreened diversions)
Maintain and restore floodplain connectivity and function.	All populations	Reconnect side channels and off-channel habitats to stream channels. Restore wet meadows. Reconnect floodplain to channel.	Degraded floodplain connectivity and function (loss of off-channel habitat, side channels, connected hypotheic zone)

Strategies	Populations Addressed	Types of Actions	Limiting Factors and Threats Addressed
Restore degraded and maintain properly functioning channel structure and complexity.	All populations	Place stable wood and other large organic debris in streambeds. Stabilize streambanks. Restore natural channel form.	Degraded channel structure and complexity (loss of spawning and rearing habitat, LWD, pools)
Restore riparian condition and LWD recruitment and maintain properly functioning conditions.	All populations	Restore natural riparian vegetative communities. Develop grazing strategies that promote riparian recovery.	Degraded riparian condition (native riparian vegetative communities, LWD recruitment)
Restore natural hydrograph to provide sufficient flow during critical periods	All populations	Implement agricultural water conservation measures. Improve irrigation conveyance and efficiency. Lease or acquire water rights and convert to instream.	Altered hydrology (low flow, scouring peak flows due to degraded watershed conditions, streamflow alterations and/or withdrawals for irrigation and other uses)
Improve degraded water quality and maintain unimpaired water quality	All populations	Reduce chemical pollution inputs. Apply BMPs to animal feeding operations. Restore natural functions and processes through above remediation actions.	Degraded water quality (high temperatures, nutrients, pesticides and other chemicals)
Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.	All populations	Achieve 95% conversion to no till farming. Upgrade or remove problem forest roads. Restore native upland plant communities. Employ BMPs to forest practices, livestock grazing, road management and agricultural practices.	Altered sediment routing and runoff patterns due to upland management activities.
Estuarine and Plume Habitat			
Restore degraded estuarine and plume habitats and associated ecological processes.	All populations	Protect/restore riparian areas Remove pile dikes Protect remaining high-quality off-channel habitat Breach or lower dikes and levees Identify and reduce sources of pollutants Monitor and restore contaminated sites	Degraded estuarine and nearshore marine habitat reduces refugia available to juvenile steelhead in Columbia River estuary and plume as they prepare for ocean life.
Hydropower Systems			
Operate the FCRPS to more closely approximate the shape of the natural hydrograph to enhance flows and water quality to improve juvenile and adult fish survival.	All populations	Draft storage reservoirs (Libby, Hungry Horse, Grand Coulee, and Dworshak) in attempt to meet seasonal and weekly flow objectives in the lower Columbia River during July and August. Pursue negotiations with Canada to provide 1 million acre feet of storage to augment summer flows. Meet Non-Treaty storage refill responsibilities and pursue a new long-term agreement on use of non-treaty space in Canadian reservoirs. Implement drafts and other measures to improve flows during the lowest 20th percentile years. Implement Water Quality Plan for Total Dissolved Gas and Water Temperature in the Mainstem Columbia and Snake rivers.	Altered steelhead migration conditions and delayed passage due to hydrosystem development and operations in mainstem Columbia River.
Modify Columbia and Snake River dams to maximize juvenile and adult survival.	All populations.	Implement project specific configurations and operations at the eight mainstem dams on the lower Snake and Columbia rivers.	Altered juvenile and adult steelhead migration conditions due to mainstem Columbia River hydrosystem.
Implement spill and juvenile transportation improvements at Columbia and Snake rivers dams.	All populations.	Provide spill to improve juvenile fish passage. Implement interim transportation program to improve survival of transported fish.	Altered juvenile and adult steelhead migration conditions due to mainstem Columbia River hydrosystem.
Operate and maintain juvenile and adult fish passage facilities at Corps mainstem projects to maintain biological performance.	All populations.	Corps will operate juvenile and adult passage facilities year around with the regionally coordinate Fish Passage Plan.	Altered juvenile and adult steelhead migration conditions due to mainstem Columbia River hydrosystem.
Restore sustainable natural steelhead production to	Deschutes Westside Deschutes Eastside	Develop downstream collection and passage through Pelton-Round Butte Complex.	Tributary hydrosystem operations and configurations block access

Strategies	Populations Addressed	Types of Actions	Limiting Factors and Threats Addressed
blocked habitats in the Deschutes River Westside, Deschutes River Eastside and extinct Crooked River populations.	Crooked River	Improve flow patterns through reservoir for juvenile migration. Modify hydro operations to restore water quality.	to historical habitats and alter habitat conditions.
Improve hydrosystem operations and facilities to enhance steelhead survival and viability.	Umatilla River Walla Walla River	Modify bypass flows at Boyd Project as needed to mimic instream water right. Modify fish passage facilities at Boyd Project to meet current standards. Remove weir panels from diversion dam at Boyd Project during non-operation. Maintain trash racks at Boyd Project. Modify fishway at Twin Reservoirs Project to meet juvenile fish passage standards.	Tributary hydrosystem operations and configurations impair passage and alter habitat conditions.
Harvest			
Manage to maintain current low impact fisheries and reduce harvest-related adverse effects in those fisheries that have significant impacts.	All populations	Maintain current low impact fisheries and reduce harvest-related adverse effects in those fisheries that have significant impacts.	Commercial, recreational and tribal fisheries in ocean, mainstem Columbia River and tributaries
Utilize tributary harvest to reduce abundance and proportion of stray hatchery spawners.	Deschutes Westside Deschutes Eastside John Day MPG	Develop educational outreach program to promote use of selective recreational fisheries to reduce the number of out-of-basin hatchery strays.	Straying of out-of-DPS hatchery spawners into tributary spawning grounds.
Reduce catch and release mortality on natural-origin fish in John Day Basin.	John Day MPG	Promote voluntary curtailment of fishing at higher water temperatures (above 21°C) to reduce hook-and-release mortality	Adverse effects of tributary harvest on natural steelhead.
Improve quality of harvest information and impacts on natural-origin fish in John Day Basin.	John Day MPG	Expand the creel surveys to monitor fisheries effort and catch.	Adverse effects of tributary harvest on natural steelhead.
Hatchery			
Reduce uncertainty of origin of hatchery strays and increase ability to recognize hatchery-origin fish.	Potential risk for all populations. Significant risk for Deschutes Eastside, Deschutes Westside and Lower John Day populations.	Implement representative coded-wire-tagging program so all hatchery stocks have adequate CWT groups released annually.	Straying of out-of-DPS hatchery fish into natural spawning grounds.
Reduce uncertainty in abundance and proportion of hatchery strays spawning naturally.	Fifteenmile Creek Deschutes Eastside All John Day populations	Increase efforts to monitor incidence of hatchery fish on spawning grounds through additional stream surveys and other methods.	Straying of out-of-DPS hatchery fish into natural spawning areas.
Reduce abundance and proportion of stray hatchery fish that spawn naturally.	Deschutes Eastside Deschutes Westside Umatilla River Walla Walla River	Construct, improve trapping facilities and expand operations to remove strays. Eliminate adult hatchery strays above Nursery Bridge Dam. Recommend development of alternative broodstocks to reduce stray rates for programs that contribute significantly to stray problem.	Straying of out-of-DPS hatchery fish into natural spawning areas.
Reduce genetic risks associated with Round Butte Hatchery Program.	Deschutes Westside	Investigate opportunities and risks associated with incorporating naturally produced Deschutes River summer steelhead into RBH broodstock.	Inside-DPS hatchery genetic risks
Restore natural production into historically utilized habitats.	Deschutes Westside Crooked River Umatilla River	Develop plan for steelhead reintroduction into historical habitat above Pelton-Round Butte Complex when passage is restored. Re-establish natural production in Little Butter and Butter creeks and some minor spawning areas.	Risks related to steelhead reintroductions to historical habitat using inside-DPS hatchery fish.
Reduce genetic influence of hatchery fish in hatchery	Umatilla River	Eliminate use of hatchery produced adults in the broodstock.	Potential divergence in genetic and phenotypic traits between

Strategies	Populations Addressed	Types of Actions	Limiting Factors and Threats Addressed
broodstock.			hatchery and natural-origin steelhead.
Reduce interactions between residual hatchery steelhead and natural steelhead.	Umatilla River	Assess degree of impact.	Risk of hatchery fish competing with and preying on natural steelhead juveniles
Reduce potential negative ecological interactions between coho salmon and natural steelhead.	Umatilla River	Reduce number of hatchery coho released in Umatilla River and relocate releases downstream to areas not currently important to steelhead production.	Potential for coho smolts to compete with juvenile steelhead for prey resources and space
Predation and Competition			
Reduce predation and competition in the Columbia River mainstem, estuary and plume.	All populations	Reduce predation by pinnipeds Redistribute Caspian terms Redistribute cormorants	Increased predation on steelhead due to degraded estuarine and plume habitats, and to hydrosystem development and operations in mainstem Columbia River.

Building on Current Efforts

We recognize that reversing the decline of populations, life histories and habitats requires use of well-formulated, scientifically sound approaches. In many areas, effective steps have already been taken or are currently underway that will improve the status of different Oregon Mid-C steelhead populations. In tributary watersheds state and federal natural resource managers, tribes, local governments, watershed councils, soil and water conservation districts, non-profit organizations, local land owners and others continue to improve stream conditions to enhance steelhead populations throughout their freshwater life stages. They are also improving land use practices on uplands and floodplains that are allowing natural ecosystem functions and processes to recover.

Similar efforts are underway to address other threats. In the Columbia River estuary, various parties are working to improve estuarine and plume habitat conditions and reduce predation. In the mainstem Columbia River, hydrosystem managers and fish resource managers continue to refine hydropower system operations to address some needs for survival and recovery of the Mid-C steelhead DPS and other ESA-listed salmon and steelhead. Hatchery programs operated within the DPS have also been modified over the past 10 years to reduce threats and improve contribution to recovery. In addition, extensive harvest management changes in both the mainstem and tributaries have been implemented to reduce the impacts of fisheries.

This plan is designed to build on these past and current efforts. Section 9 identifies many of these efforts along with their sufficiency and areas in need of improvement so that future actions expand from and improve their effectiveness. Spreading the responsibility among a range of parties lessens the cost to any one group, increases the certainty of success, and compounds the benefits of moderate improvements in each factor.

Strategic Guidance and Prioritization Considerations for Plan Implementation

Achieving recovery for the Mid-C steelhead DPS will require intensive effort by individuals at the regional, watershed and local levels. Many recovery efforts will need to be conducted in concert to address overlapping causes that impair population viability and disrupt ecosystem functions.

Unfortunately, all of the management actions needed to reach recovery goals cannot be implemented at the same time due to various constraints. In addition, setting priorities can often be difficult because of the scientific complexity and diverse policy strategies. Although priorities must be science based, they are ultimately policy choices. Section 9.1 provides guidance for the development and implementation of management strategies and actions to recover Oregon's Mid-C steelhead populations. This guidance was adopted by Oregon's Middle Columbia Sounding Board. The characteristics of highest priority actions are identified below. Section 9.1 identifies other high priority actions, though less than highest, as well as other prioritization considerations.

Highest Priority Actions

- Provide long-term protection of habitat conditions and conservation of natural ecological processes that support the viability of priority extant populations and their primary life history strategies throughout their entire life cycle. A population is considered a priority if it is critical for MPG or DPS viability.

- Protect or enhance viability of multiple steelhead populations.

- Support conservation of unique and rare functioning habitats, habitat diversity, life histories and genetic attributes.

- Target the key limiting factors and that contribute the most to closing the gap between current status and desired future status of priority populations.

- Provide critical information needed for assessing success and making adaptive management decisions.

1.10 Management Action Effectiveness

Section 10 presents an analysis of the effects of the proposed actions on the performance of Oregon populations in the Mid-Columbia River steelhead DPS. The analysis was performed in sequential steps, first by projecting outcomes for tributary actions alone, then sequentially adding in hatchery fish genetic effects, then types of out-of-subbasin actions, and finally actions to manage stray hatchery fish. The results at each step provided a means for comparing relative benefits of the proposed actions.

Approach

The analysis of action effectiveness was performed using two modeling platforms, Ecosystem Diagnosis and Treatment (EDT) and the All-H-Analyzer (AHA), that address different types of

limiting factors affecting salmonid population performance during the life cycle. Linking the two models provided a way of projecting benefits measured at the end of the life cycle for a wide range of potential actions, regardless of what life stage an action affects. We made a number of changes to both models to improve the application to our analyses.

Modified EDT Model

The EDT model was used to analyze the potential benefits of tributary habitat actions. The model is designed to estimate salmonid population performance based on characteristics of the aquatic habitat. Four scenarios were modeled using the EDT model, reflecting two priorities for where actions would be implemented at two future times: 1) High priority actions and locations only at 25 years in the future; 2) High priority actions and locations only at 100 years in the future; 3) All actions and locations at 25 years in the future; and 4) All actions and locations at 100 years in the future. In addition, the Deschutes Westside population was modeled with and without passage/reintroduction at the Pelton-Round Butte Complex to illustrate the added benefit of providing passage.

A two-part process was used to determine action effectiveness. Part 1 asked the question: What stream reaches would be affected by each of the actions? This was answered by linking stream reaches in each of the five subbasins to the actions. Part 2 consisted of explicitly defining distinct elements—or factors—that are used to compose the overall effectiveness value applied in the analysis. Five elements of action effectiveness were recognized, each acting as a scalar to determine how effective an action would be in moving an attribute's current baseline rating back toward the undeveloped state: *Effect*, the potential effectiveness of action; *Intensity,* the scale at which an action is to be applied; *Lag,* how much of the potential effectiveness of an action will be achieved at a time in the future (25 or 100 years in the future); *Schedule,* an implementation schedule effect, i.e., whether implementation is delayed to some point in the future, whereby the amount of the potential effectiveness of an action would be reduced at a time in the future; and A*ttribute,* the potential effectiveness of an action due to an attribute effect.

Modified AHA Model

The AHA model linked the analyses of tributary habitat actions to prospective recovery actions involving hatchery fish and the mainstem Columbia River; integrating the effects of various types of actions over the full life cycle. A set of scenarios was modeled using AHA, representing baseline conditions, current conditions, and combinations of actions aimed at tributary habitat, mainstem Columbia River factors, and hatchery fish management. AHA scenarios were run in a stepwise fashion, starting with baseline, then current condition, then adding in actions sequentially, each being added to the previous scenario.

Importantly, the AHA model allowed incorporation of potential effects of hatchery programs on the genetic fitness of the natural populations. The model incorporates key concepts and assumptions about the effects of genetic interactions between hatchery and natural fish built on the work of Lynch and O'Hely (2001) and Ford (2002), with further development of those ideas by geneticists working with the Hatchery Scientific Review Group (HSRG)(Mobrand – Jones & Stokes 2005). Fitness is computed in the model using Ford's (2002) modeling equations. It was used to evaluate potential genetic effects on the natural populations due to interactions between out-of-DPS stray hatchery fish and from the Umatilla supplementation hatchery program.

Several prospective actions to be taken in the mainstem Columbia River were also modeled using AHA, including: predator management – aimed at reducing predation rates caused by terns and northern pikeminnow; downstream juvenile passage improvements – measures to improve survival at each of the mainstem dams; Columbia estuary habitat improvements – measures to enhance habitat conditions within the Columbia estuary; and harvest – regulatory measures to reduce or hold harvest impacts in the mainstem Columbia River to current levels. We used survival improvement estimates provided in the recent BiOp (NOAA Fisheries 2007a) for predation, hydrosystem, and estuary actions. The use of these values in no way implies endorsement of the validity of the estimates or the adequacy of the actions. At this time, these are the only estimates available for the proposed actions.

The output from AHA, also expressed as Beverton-Holt population parameters, represents the expectation for population performance when all actions are integrated together. These parameters were then converted to the percent change in each parameter value compared to baseline conditions and multiplied by the ICTRT's baseline population measures to compute expected ICTRT-equivalent parameter values reflecting the effects of all actions.

Summary of Findings

Overall, analysis results show that population performance, as measured by both productivity and spawner abundance, increases markedly for all populations under the recovery action scenarios.

Results of All-H integration analysis are summarized below for each population and presented in Section 10. Changes in performance measures associated with each action scenario are presented for intrinsic productivity and equilibrium spawner abundance. The results are comparable to population metrics presented in Section 6 for baseline performance, as derived empirically by the ICTRT, and to minimum productivity (at the threshold abundance level) and abundance viability thresholds at the 5% risk level.

Fifteenmile Creek Population
Population performance is increased markedly for all scenario combinations analyzed. By far, the largest contribution to performance improvements results from tributary habitat actions. Relatively small increases are attributable to mainstem actions. Viability thresholds are exceeded for all scenarios.

Deschutes River Eastside Population
Population performance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements result from tributary habitat actions, with greatest benefits accruing for the 100 year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions. Very substantial benefits to both population productivity and natural-origin spawner abundance also occur as a result of reducing the number of stray hatchery fish spawning with natural-origin fish. Viability thresholds are exceeded for all scenarios.

Deschutes River Westside Population
The largest increases in population performance associated with the range of scenario combinations analyzed occur as a result of decreasing the number of stray hatchery fish and/or by providing passage at the Pelton-Round Butte Complex (includes passage at Whychus Creek barriers). In the absence of the removal of strays or passage, benefits are much reduced. For those scenario combinations lacking removal of strays and passage, beneficial effects of tributary actions are greatest, though beneficial cumulative effects of adding in mainstem actions are clearly evident. The viability threshold for productivity is exceeded for all action scenarios. The minimum abundance threshold was not achieved for any scenario.

Lower Mainstem John Day River Population
Population performance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements result from tributary habitat actions, with greatest benefits accruing for the 100 year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions. Viability thresholds are exceeded for all scenarios.

North Fork John Day River Population
Population performance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements result from tributary habitat actions, with greatest benefits accruing for the 100-year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions. Viability thresholds are exceeded for all scenarios.

Middle Fork John Day River Population
Population performance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements result from tributary habitat actions, with greatest benefits accruing for the 100-year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions. Viability thresholds are exceeded for all scenarios.

South Fork John Day River Population
Population performance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements result from tributary habitat actions, with greatest benefits accruing for the 100-year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions. The viability threshold for productivity is exceeded for all action scenarios. The abundance threshold is reached in about 30% of the action scenarios.

Upper Mainstem John Day River Population
Population performance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements result from tributary habitat actions, with greatest benefits accruing for the 100-year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions. Viability thresholds are exceeded for all scenarios.

Umatilla River Population
Population performance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements results from tributary habitat actions, with greatest benefits accruing for the 100 year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions. Viability thresholds are exceeded for all scenarios.

Walla Walla River Population
Population performance is increased markedly for all scenario combinations analyzed. Relatively small differences exist between scenario results at 25 and 100 years. The largest contribution to performance improvements is estimated to be due to tributary habitat actions. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions. Viability thresholds are exceeded for all scenarios.

1.11 Time and Cost Estimates

Section 11 summarizes the time and partial costs expected for recovery of Oregon Mid-C steelhead populations. Appendix I discusses the costs of implementing the various actions identified in Section 9 in more detail.

Currently, we estimate the overall total cost for implementation of proposed actions that we were able to estimate for all ten Oregon Mid-C steelhead populations at $512,843,328. This estimate reflects preliminary summary partial costs for recovery of the populations based on implementation of identified management actions, where available information was sufficient to do so. The draft cost estimates (Table I-1) were prepared by a NMFS economist at the Northwest Fisheries Science Center in Seattle using a regional recovery cost database, together with input and review from ODFW, regional experts, and the Mid-Columbia Sounding Board in 2007. The total cost will increase when unit cost estimates, scale of projects, and costs for all actions are determined. Costs for some of the expensive actions like land acquisition, flow enhancement, land leases, and RM&E have yet to be determined.

Estimated costs for different projects range widely from relatively less expensive fish passage projects to more expensive projects, such as restoring stream channel structure and complexity. The Lower John Day ($116,192,806) and Deschutes River Westside ($114,110,501) populations have the most expensive estimated total project costs, while the South Fork John Day ($8,656,103) and Fifteenmile ($28,358,906) populations have the smallest total costs. These total cost differences may be due to many factors such as size of the population, extent to which current conditions need to be improved, scale of projects, number of projects identified, and the availability of recovery action cost information by population at this time.

NMFS estimates that implementation of the recovery actions for the Mid-Columbia steelhead DPS, like recovery for most of the ESA-listed Pacific Northwest salmon and steelhead, could take 50 to 100 years. While this recovery plan contains an extensive list of actions that need to be undertaken to recover Oregon's Mid-Columbia steelhead populations, there are many uncertainties involved in predicting the course of recovery and in estimating total costs. These include uncertainties regarding biological and ecosystem responses to recovery actions, as well

as uncertainties regarding long-term and future funding. Given the uncertainties in developing recovery cost estimates, Oregon is not able to estimate total or 10-year implementation costs to recover Oregon's populations in the Mid-Columbia steelhead DPS. Table I-2 in Appendix I, however, provides current average expenditures on habitat projects expected during the next five-year period. These projected five-year habitat project expenditures total approximately $102 million.

In early 2008, Oregon, NOAA, and other partners will develop a plan for recovery project implementation that will include project cost estimates. The implementation plan will identify what entity or individual will carry out the recovery actions and the timeline for implementation. Recovery costs will be revised in the future as specific project budgets are completed.

1.12 Implementation Plan and Adaptive Management Framework

The successful implementation of the Oregon Mid-Columbia Steelhead Conservation and Recovery Plan recovery actions, research, monitoring and evaluation, and adaptive management process will require significant funds and the coordinated work of ODFW, State agencies, tribes, counties, irrigation districts, agriculture and private forest land managers, NMFS, U.S. Forest Service, BLM, other Federal agencies, local residents, citizen groups, utilities, other agencies, and individuals. ODFW, in coordination with the Oregon Governor's Office and NMFS, has taken the lead in developing this recovery plan; all will continue to be instrumental in its implementation.

Oregon's recovery plan implementation framework is intended to provide a collaborative approach to implementation, science guidance and policy direction, as well as facilitate information exchange and coordination from local-level action entities to upper level decision makers and provide linkage to state, DPS and regional forums. Existing forums, groups, partnerships and involved citizens make this implementation structure possible, but additional resources and funding will be needed to make it work effectively and successfully. The basic components of Oregon's implementation framework include a Recovery Team, an Implementation Coordinator, an Implementation Team, a Technical Team, and Watershed Teams. These teams will interface with and potentially strengthen the various state agency teams associated with the Oregon Plan for Salmon and Watersheds that provide for policy, management, and monitoring of interagency Oregon Plan programs for the conservation and restoration of habitat, water quality, and salmon. In addition, these teams will function to coordinate within the DPS implementation and adaptive management framework. The implementation framework will adapt and change as necessary to adjust to funding, available resources, and implementation needs.

Mid-C steelhead have a complex life cycle that traverses habitats from high elevation tributaries to the open ocean. Life history strategies and life stage specific habitat requirements are complex. There are many limiting factors and threats that influence the viability of Oregon's Mid-C steelhead at all life stages. The suite of proposed management actions to address primary limiting factors and threats across the entire life cycle is extensive and diverse. Although the limiting factors and threats, as well as the management actions, have been developed based on the best available science, there remains considerable uncertainty regarding the outcomes and

effectiveness of the proposed management actions as well as the status of the populations. It is this uncertainty which generates the essential need for an effective adaptive management process.

A successful adaptive management process requires that we understand how and why steelhead and their associated habitats respond to the management actions we take to address key limiting factors and threats. In addition, success requires a decision framework and process which considers new information in the development and implementation of future management actions.

One of the great challenges facing the development and implementation of an effective adaptive management strategy for Oregon's Mid-C steelhead is the extensive number of organizations that implement management actions, as well as the complexity in jurisdictional and management decision authority. There are many different organizations including state agencies, tribes, counties, irrigation districts, agriculture and private forest land managers, NOAA, U.S. Forest Service, BLM, other federal agencies, local residents, citizen groups, utilities and others that implement management actions.

Along with this implementation complexity is a parallel level of jurisdictional, management decision authority, and process complexity. There is no one single decision body that holds decision authority for management actions across all the H's. Decision authority for management actions resides across many entities including state, tribal, federal, county as well as others. Those diverse decision frameworks and processes, many independent of others, create coordination and collaboration challenges. We acknowledge that it is unreasonable to expect centralization and integration of all authorities and decision processes into a single decision framework. Our approach is to develop a collaboration and coordination process that uses the implementation structures and allows for sharing of information and decisions that influence recovery of Mid-C steelhead.

1.13 Research, Monitoring, and Evaluation

Section 13 presents a detailed monitoring and evaluation (M&E) plan that covers the Oregon portion of the Mid-C steelhead DPS. It describes the types of monitoring approaches that are used, current efforts underway, and additional M&E recommended for assessing the status and trends in population viability and for evaluating the success of management actions implemented to recover these steelhead populations. Logistical and monetary limitations are understood to exist; however, a comprehensive M&E plan should help to focus efforts towards the common goal of assessing success in population and DPS recovery.

The M&E plan is based in part on principles and concepts laid out in the NMFS guidance document, *Adaptive Management for ESA-Listed Salmon and Steelhead Recovery: Decision Framework and Monitoring Guidance (May 1, 2007)* http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/upload/Adaptive_Mngmnt.pdf. It also borrows from RM&E plans that were developed for Mid-Columbia subbasins and other Columbia Basin regions.

The plan also follows the principles of adaptive management, the process of adjusting management actions and/or directions based on new information. Adaptive management is considered crucial for salmonid recovery programs because of the length and complexity of the salmonid life cycle, and the uncertainties involved in improving salmonid survival and status. The plan addresses adaptive management by linking monitoring and evaluation to biological and physical responses, and using these results to better design and implement of management actions.

Types of Monitoring Programs

Several types of monitoring are needed to support adaptive management and to allow managers to make sound decisions:

- **Status and Trends Monitoring.** Status monitoring includes measures of the current state or condition of the population at any given time. Trend monitoring tracks these conditions to provide a measure of the increasing, decreasing, or steady state of a status measure through time. Status and trends monitoring includes the collection of standardized basic information used to monitor broad-scale trends over time in the status of fish populations, habitat conditions, and other ecosystem factors affecting fish. This information is the basis for evaluating the cumulative effects of management actions on fish and the aquatic and terrestrial ecosystem.

- **Action Effectiveness Monitoring.** Action effectiveness monitoring involves project-scale monitoring of local conditions to determine if implemented actions were effective in creating the desired proximate change. Action effectiveness monitoring typically is used to determine whether project- or program-specific goals were met. This type of monitoring also includes post-project monitoring to see whether the actions continue to function as they were designed or intended. Note that status and trend monitoring may be appropriate for fulfilling these needs but that project effectiveness monitoring generally requires focused evaluations of more specific parameters directly associated with actions. Specific indicators and metrics need to be developed in plans for each category of action. Specific plans will include measurable variables or parameters to address each objective, study design (spatial and temporal scale, tests and controls, statistical criteria, etc.), data collection methods and reference examples, and analyses and decisions in response to results.

- **Implementation and Compliance Monitoring.** Implementation and compliance monitoring involves monitoring of management actions to determine if they were implemented as planned and meet established benchmarks. This monitoring is typically conducted by the groups implementing the management and restoration actions.

- **Uncertainties Research.** Uncertainties research includes scientific investigations of critical assumptions and unknowns that constrain effective recovery plan implementation. Uncertainties include unavailable pieces of information required for informed decision making as well as studies to establish or verify cause-and-effect and identification and analysis of limiting factors.

Population-Specific Research, Monitoring, and Evaluation Needs

The plan addresses each major population group separately. In some cases, specific objectives are provided at the population scale to characterize unique monitoring needs. Specific approaches are presented that address each objective. A brief sampling design, including the spatial and temporal scale of application, is provided for each objective. Measurement variables protocols and a description of the analysis are presented. Existing and potential funding sources are identified and finally, implementation and coordination details are discussed. The techniques described for each population are not necessarily exhaustive, but are meant to be representative of those actions considered to have potential while recognizing logistical and monetary constraints.

In general, population research, monitoring and evaluation activities are designed to gain information needed to improve knowledge of population viability. They examine status and trends in abundance and productivity of natural spawners; status of spatial structure based on current and historically utilized habitat; status and trend in condition of current and historically utilized habitat; freshwater and full life cycle productivity, and primary factors limiting freshwater production; current status, and change in future status of population life history and phenotypic diversity; effect of disease and predation on population abundance, productivity, diversity, and distribution; effect of harvest on population abundance, productivity, and diversity; effect of hydropower on population abundance, productivity, diversity, and distribution; and effect of habitat degradation and habitat restoration activities on population abundance, productivity, and distribution.

Following are specific research, monitoring and evaluation needs for each population in addition to the general types of activities described above:

Fifteenmile Creek population

- Improved estimates of abundance of stray hatchery fish
- Determine life history characteristics

Deschutes River Eastside and Westside populations

- Effectiveness of passage at Pelton-Round Butte Complex
- Effectiveness of reintroduction into Whychus Creek and the Crooked River population
- Extent of mainstem spawning
- Impact of Snake River strays on viability
- Fall back rate of natural and hatchery fish that pass Sherars Falls
- Spawning distribution of hatchery-origin strays
- Genetic characteristics of natural populations and the degree of introgression of hatchery strays
- Steelhead-resident rainbow relationship in Westside population and impact on steelhead capacity

Crooked River population

- Assess the success of restoring natural production within the Crooked River population boundaries

John Day River populations

- Improved estimates of abundance of hatchery-origin strays
- Spawning distribution of hatchery-origin strays

Umatilla River population

- Hatchery supplementation effectiveness
- Relative reproductive success of hatchery fish
- Spawning distribution of hatchery-origin fish
- Effectiveness of major flow enhancement actions (Phase 3)

Walla Walla River population

- Improved estimates of abundance of hatchery-origin strays
- Spawning distribution of hatchery-origin strays
- Proportion of population spawning below Nursery Bridge
- Effectiveness of major flow enhancement and passage improvement actions

Out of Basin Research, Monitoring and Evaluation Needs

The following types of RM&E actions are needed to support assessment of recovery of the Mid-C steelhead DPS and its Oregon populations:

- Survival improvements from hydrosystem actions
- Survival improvements from predator control actions
- Survival improvements from estuary actions
- Population specific mainstem harvest rates
- Marine survival estimates and variation through time
- Influence of transportation on Snake River hatchery steelhead straying

1.14 Population Summaries

Tables 1-6 through 1-16 summarize vital information related to the recovery of each of Oregon's ten Mid-C steelhead populations. For each population, the summaries identify: key population attributes, minimum viability levels for a low risk recovery scenario, viability assessment results, the viability gap, major limiting factors and threats, and the highest priority tributary habitat strategies and actions.

Table 1-6. Summary of Recovery Information for Fifteenmile Creek Population.

Key Population Attributes
The population occupies the entire Fifteenmile Subbasin and several smaller subbasins—including the Rock, Mosier, Chenoweth, Mill, and Threemile watersheds—which enter the Columbia River directly downstream from Fifteenmile Creek. Current spawning distribution is similar to historical with major production areas in Fifteenmile, Ramsey, Eightmile, and Fivemile creeks.
Recent year natural spawners include only natural-origin fish. Hatchery strays in the Fifteenmile Creek population have rarely been documented.
The population contains three MaSAs, all located in the Fifteenmile Creek watershed: Upper Fifteenmile, Eightmile and Fivemile. It also contains five MiSAs: Mill, Chenoweth, Threemile, Mosier and Lower Fifteenmile.
It is the only Mid-C steelhead population that is classified as an entirely winter run life history type. It is part of the Cascade Eastern Slope Tributaries MPG.
The population is considered a Basic size population with a mean minimum abundance threshold of 500 spawners.
Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk)
Abundance: Minimum abundance threshold of 500 spawners.
Productivity: Minimum productivity level of 1.56 recruits per spawner at the threshold abundance.
Viability Assessment Results
Abundance/Productivity: Population is at low risk based on current abundance and productivity. The Abundance/Productivity point estimate resides above the 1% risk curve, but the population is not considered to be at very low risk because of uncertainty criteria, the 98% confidence interval (CI) extends below the 25% risk curve. These A/P results should be viewed with caution, as abundance and productivity estimates for the Fifteenmile population are based on 15 years of spawner/recruit data.
Spatial Structure/Diversity: The integrated SS/D rating is low risk for the population. There has been little change in distribution relative to the historical distribution. The absence of major reductions in distribution resulted in a rating of very low risk for spatial structure metrics. There have likely been minor reductions in life history diversity and phenotypic variation, but these changes are not severe enough to raise risk levels to moderate. There are few hatchery fish in the population resulting in low risk for spawner composition.
Overall Viability Rating: Population *currently meets viability criteria* because both A/P and SS/D are rated at low risk. A relatively small increase in productivity is required to move this population into "highly viable" status. Monitoring should be continued to allow analysis of a longer data time series.
Viability Gap
Abundance/Productivity: The recent 10-year geomean natural-origin abundance of 703 exceeds the minimum threshold abundance of 500. The current productivity estimate of 1.82 recruits per spawner resides between the 5% and 1% risk curves. There is no observed gap or uncertainty gap for the 5% risk level. The observed and uncertainty gaps for the 1% risk level are 0.03 and 0.09 respectively.
Spatial Structure/Diversity: There are no gaps for SS/D since all the SS/D metrics rated very low or low risk.
Limiting Factors and Threats
Primary Limiting Factors: Tributary Habitat: low flows, high water temperatures, degraded riparian condition, sediment routing, degraded floodplain, degraded channel structure (channel confinement and overall habitat diversity); *Hydro:* mainstem passage.
Primary Threats: Current land use practices (including roads, residential development, and agricultural and forest practices) and the Columbia River mainstem hydrosystem.
Primary Life Stages Affected: Fry, summer parr, winter parr, smolts.
VSP Characteristics Impacted: Abundance, productivity, spatial structure, diversity.
Tributary Management Strategies and Actions (Highest Priority)
Habitat Strategies
Strategy: Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs.
Strategy: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement water

conservation measures, improve irrigation conveyance and efficiency.

Strategy: Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, riparian fencing.

Strategy: Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, and stabilize streambanks.

High Priority Areas for all strategies: Fifteenmile Cr - Mouth to FS boundary; Ramsey Cr - Mouth to new FS boundary; Eightmile Cr - Hwy 197 to FS boundary; Fivemile Cr - Mouth to FS boundary.

Harvest Strategies

Strategy: Manage harvest to maintain current low impact fisheries. *Key actions:* Maintain current low impact fisheries.

Hatchery Strategies

Strategy: Reduce uncertainty in abundance and proportion of stray hatchery fish spawning naturally. *Key actions*: increased monitoring of hatchery fish on spawning grounds.

Table 1-7. Summary of Recovery Information for Deschutes River Eastside Population.

Key Population Attributes
The Deschutes River Eastside population occupies the Deschutes River from its mouth to Trout Creek and all tributaries flowing in from the east side, including Willow Creek above Pelton Dam.
Spawners in the population include natural-origin returns, hatchery returns from Deschutes River-origin fish produced at Round Butte Hatchery and out-of-DPS hatchery strays primarily from the Snake River Basin. Hatchery-origin fish comprise a significant proportion of the natural spawners.
The population contains six MaSAs: Buck Hollow, Bakeoven, Ward/Antelope/Cold, Lower Trout, Upper Trout and Willow. It contains two MiSAs: Jones Canyon and Campbell.
The population exhibits a summer life history strategy and is part of the Cascade Eastern Slope Tributaries MPG.
The ICTRT considers it an Intermediate population with a mean minimum abundance threshold of 1,000 spawners.
Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk)
Abundance: Minimum abundance threshold of 1,000 spawners.
Productivity: Minimum productivity level of 1.35 recruits per spawner at the threshold abundance.
Viability Assessment Results
Abundance/Productivity: The population is at low risk based on current abundance and productivity. The point estimate on the viability curve resides above the 1% curve, but the population is not considered to be at very low risk since the 99% CI extends below the 25% risk curve.
Spatial Structure/Diversity: The integrated SS/D rating is moderate risk for the population. The rating for Goal A "allowing natural rates and levels of spatially mediated processes" was low risk. However, the population's spawning distribution is reduced from the historical distribution, primarily from loss of spawning in the Willow Creek drainage. The population remains broadly distributed with little changes in gaps and good continuity within the current accessible habitat. The rating for Goal B "maintaining natural levels of variation" was moderate risk. Habitat changes in key tributary production areas have likely resulted in limitations to life history diversity and reduction in phenotypic expression. Also, a significant proportion of natural spawners are out-of-DPS strays which resulted in a high risk rating for spawner composition.
Overall Viability Rating: The Deschutes River Eastside population *currently meets the recommendation for viable status.* The SS/D rating is moderate risk primarily because of the influence of habitat changes on life history and phenotypic expression, as well as out-of-DPS hatchery spawners.
Viability Gap
Abundance/Productivity: The recent 10-year geomean natural-origin abundance of 1,599 substantially exceeds the minimum threshold abundance of 1,000. The current productivity estimate of 1.89 resides in the very low risk zone and thus there are no observed abundance/productivity gaps. The lower end of the productivity 99% confidence interval is below the 25% risk curve resulting in a 0.05 gap to meet uncertainty criteria for 1% risk level. The abundance/productivity dataset is a relatively short time series which results in a larger 90% CI than is typical of most other Oregon Mid-C populations.

Spatial Structure/Diversity: Spatial structure/diversity gaps were identified for the following metrics: *Phenotypic variation*: moderate risk due to likely reduction in juvenile and adult migration patterns resulting from flow and temperature changes in tributary production areas; *Spawner composition*: Out-of-DPS spawners rated high risk due to the high proportion of Snake River strays spawning naturally in the population. Out-of-population within MPG spawners rated moderate risk due to the proportion of Round Butte Hatchery fish spawning naturally in the population.
Limiting Factors and Threats *Primary Limiting Factors: Tributary Habitat:* degraded riparian condition, low flows, high water temperatures, degraded channel structure/complexity and floodplain connectivity, impaired fish passage. *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage. *Primary Threats:* Hatchery production which results in high proportions of stray hatchery fish in natural spawning areas; current land use practices (grazing, roads, residences, forestry and agricultural practices that simplify habitats and irrigation withdrawals); the Columbia River mainstem hydrosystem. *Primary Life Stages Affected:* Spawners, fry, summer parr, winter parr, smolts. *VSP Characteristics Impacted:* Abundance, productivity, spatial structure, diversity.
Tributary Management Strategies and Actions (Highest Priority) *Habitat Strategies* *Strategy:* Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs. *Priority areas*: Bakeoven Cr (mouth to Deep Cr), Buck Hollow Cr (mouth to Macken Canyon), Trout Cr (Little Trout Cr. to headwaters) *Strategy*: Restore passage and connectivity. *Key actions*: Remove/replace barriers, adequate screening of irrigation diversions. *Priority areas*: Bakeoven Cr, Mud Springs Cr., Hay Cr *Strategy*: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement water conservation measures, improve irrigation conveyance and efficiency. *Priority areas:* Trout Cr (mouth to Clover Cr), Antelope Cr *Strategy:* Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas*: Trout Cr (Little Trout Cr to Clover Cr, sections from mouth to Antelope Cr), Antelope Cr, Hay Cr *Strategy:* Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, and stabilize streambanks. *Priority areas*: same as for riparian strategy. *Hydrosystem Strategies* *Strategy:* Improve flow patterns through Pelton-Round Butte Complex (PRBC), restore water quality below PRBC. *Priority areas*: Deschutes R. (at and below PRBC). *Harvest Strategies* *Strategy:* Use harvest to reduce stray hatchery spawners. *Key actions*: selective fisheries. *Hatchery Strategies* *Strategy:* Reduce uncertainty regarding hatchery strays and reduce abundance and proportion of stray hatchery fish spawning naturally. *Key actions*: coded-wire-tagging program, development of alternative broodstocks for programs contributing strays, increased monitoring on spawning grounds and trap and removal of strays.

Table 1-8. Summary of Recovery Information for Deschutes River Westside Population.

Key Population Attributes The Deschutes River Westside population occupies the mainstem Deschutes River from Trout Creek to the Pelton-Round Butte Complex (PRBC) at RM 100 and tributaries joining the Deschutes from the Westside, including the Warm Springs River and Shitike Creek below the hydroelectric complex and the Metolius River and Whychus Creek drainages above the complex. The Warm Springs watershed and Shitike Creek currently provide most spawning habitat. Whychus Creek was once a major steelhead producer for the population. Recent year natural spawners include returns originating from naturally spawning parents, strays from the Deschutes Subbasin Round Butte Hatchery program, and a significant number of out-of-DPS hatchery strays from the Snake

River. Natural-origin spawners have comprised an average of 82% of natural spawning fish since 1978.

The population contains six MaSAs: Upper Warm Springs, Whychus, Upper Metolius, Mill, Beaver and Shitike; and nine MiSAs.

The population exhibits a summer life history strategy and is part of the Cascades Eastern Slope Tributaries MPG.

The ICTRT considers it a 'large' population with a mean minimum abundance threshold of 1,500 spawners. Access to a considerable amount of historical habitat is blocked by PRBC, with current spawning only below the barrier. The minimum abundance threshold is 1,000 spawners for currently available habitat.

Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk)

Abundance: Minimum abundance threshold of 1,500 spawners (1,000 for currently accessible habitat).

Productivity: Minimum productivity level of 1.35 recruits per spawner at the threshold level.

Viability Assessment Results

Abundance/Productivity: Population is at high risk based on current abundance and productivity. The point estimate on the viability curve resides below the 25% risk curve.

Spatial Structure/Diversity: The integrated spatial structure/diversity rating is high risk for the population. It rates at moderate risk for two of the spatial distribution metrics because the current distribution is substantially reduced from the historical intrinsic distribution due to blocked passages to areas above the Pelton-Round Butte Complex. Ratings for two metrics related to Goal B "maintaining natural patterns of variation" resulted in a moderate rating for Goal B and the overall moderate rating. Genetic variation rated moderate due to limited data and the lack of differentiation between the Deschutes samples and outside-basin hatchery samples. Samples collected in 2005-2007 will better inform the risk associated with genetic variation. The proportion of out-of-DPS hatchery strays resulted in a high risk rating for spawner composition. Most of these strays originate from the Snake River Basin.

Overall Viability Rating: The Deschutes River Westside *population does not currently meet recommendations for viability and is below maintained status*. However, it is the only extant Large or Very Large population in the MPG and should be recovered to meet the viability criteria. A substantial increase in productivity will be required to raise the A/P values to the low risk level. Genetics information presently being collected will better inform the genetics variation risk level in the future. A reduction in the out-of-ESU hatchery stray proportion will be needed to reduce the risk rating for the spawner composition metric.

Viability Gap

Abundance/Productivity: The recent 10-year geomean natural-origin abundance of 456 is well below the abundance threshold of 1,000, the threshold abundance for currently available habitat. The current productivity estimate of 1.05 recruits per spawner is well below the minimum of 1.35 required at the threshold abundance. The observed gaps, which are greater than uncertainty gaps, for the 5% and 1% risk levels are 0.78 and 0.92 respectively. This gap is by far the largest observed gap of all the Oregon Mid-C populations. The large gap results from the substantial difference in the equilibrium abundance (448) and the threshold abundance, as well as the low productivity.

Spatial Structure/Diversity: Spatial structure/diversity gaps were identified for the following metrics: *Spatial extent and range of population*: moderate risk because spawner distribution is substantially reduced from historical due to blocked access to Whychus Creek and the Metolius River; *Genetic variation:* moderate risk because there are limited genetics data available and the samples that have been analyzed show similarity to out-of-DPS hatchery strays; *Spawner composition: O*ut-of-DPS spawners rated high risk because out-of-DPS strays have comprised a significant proportion of the natural spawners in this population for many generations.

Limiting Factors and Threats

Primary Limiting Factors: Tributary Habitat: degraded channel structure and complexity, altered sediment routing, high water temperature, low flows and lack of fish passage over PRBC; *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage and tributary passage to blocked areas above Pelton-Round Butte Complex.

Primary Threats: Hatchery production that results in high proportions of stray hatchery fish in natural spawning areas; current land use practices (grazing, roads, residences, forestry and agricultural practices that simplify habitats and irrigation withdrawals); the Columbia River mainstem hydrosystem, Pelton-Round Butte Complex.

Primary Life Stages Affected: Spawners, fry, summer parr, winter parr, smolts.

VSP Characteristics Impacted: Abundance, productivity, spatial structure, diversity.

Tributary Management Strategies and Actions (Highest Priority)
Habitat Strategies
Strategy: Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs. *Priority areas:* Spawning areas in mainstem Deschutes R. below PRBC.
Strategy: Restore passage and connectivity. *Key actions*: Restore passage at PRBC, remove/replace barriers, adequate screening of irrigation diversions. *Priority areas*: Deschutes R. (RM 100), Warm Springs R, Shitike Cr, Beaver Cr.
Strategy: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement water conservation measures, improve irrigation conveyance and efficiency. *Priority areas:* Whychus Cr.
Strategy: Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas*: Deschutes R. (Eagle Cr to Shitike Cr), Deschutes R (Trout Cr to PBR), Warm Springs R., Shitike Cr., Beaver Cr., Whychus Cr.
Strategy: Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, and stabilize streambanks. *Priority areas*: Deschutes R. (Eagle Cr to Shitike Cr), Deschutes R. (Trout Cr to PBRC), Warm Springs R. (mouth to Badger Cr), Shitike Cr. (mouth to road crossing), Beaver Cr. (mouth to Robinson Park Bridge)
Hydrosystem Strategies
Strategy: Restore steelhead production in historical habitats. *Key actions*: develop juvenile collection and passage through PRBC, improve flow patterns through PRBC, restore water quality below PRBC. *Priority areas*: Deschutes R. (at and below PRBC).
Harvest Strategies
Strategy: Use harvest to reduce stray hatchery spawners. *Key actions*: selective fisheries.
Hatchery Strategies
Strategy: Reduce uncertainty regarding hatchery strays and reduce abundance and proportion of stray hatchery fish spawning naturally. *Key actions:* coded-wire-tagging program, development of alternative broodstocks, increased monitoring on spawning grounds and trap and removal of strays.
Strategy: Reduce genetic risks associated with Round Butte Hatchery Program. *Key actions*: investigate incorporating naturally produced local steelhead into RBH broodstock.
Strategy: Restore natural production in historically utilized habitats. Key actions: develop plan for steelhead reintroductions above PRBC. *Priority areas*: Metolius R, Whychus Cr, Deschutes R.

Table 1-9. Summary of Recovery Information for Deschutes/Crooked River Population.

Key Population Attributes
The Deschutes/Crooked River population once occupied the Crooked River drainage, a major watershed in the Deschutes basin.
The population is now extinct because of the lack of passage above Pelton Dam.
The population exhibited a summer life history strategy and is part of the Cascade Eastern Slope Tributaries MPG.
The ICTRT considers it a very large population with a mean minimum abundance threshold of 2,250 spawners.
Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk)
Abundance: Minimum abundance threshold of 2,250 spawners.
Productivity: Minimum productivity level of 1.19 recruits per spawner at the threshold abundance.
Viability Assessment Results
The ICTRT did not complete a viability assessment for the population because it is currently extinct.
Overall Viability Rating: The Deschutes/Crooked River population is currently considered extinct.
Viability Gap
A gaps analysis was not completed for the Deschutes/Crooked River population because it is currently extinct.
Limiting Factors and Threats

Primary Limiting Factors: Tributary Habitat: degraded channel structure and complexity and floodplain connectivity, degraded riparian condition, high water temperature, low flows, altered hydrology sediment routing, and lack of fish passage; *Hydro:* Impaired upstream and downstream migration.

Primary Threats: grazing and agricultural practices, urban development, off highway vehicle (OHV) use, irrigation withdrawal, dams, lack of floodplain connectivity; Pelton-Round Butte Complex on the mainstem Deschutes blocks fish passage.

Primary Life Stages Affected: All life stages.

VSP Characteristics Impacted: Abundance, productivity, spatial structure, diversity.

Tributary Management Strategies and Actions (Highest Priority)

Habitat Strategies

Strategy: Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs. *Priority areas*: Crooked River (RM 6-14, RM 55-70), McKay Cr, Ochoco Cr (below Ochoco Dam)

Strategy: Restore passage and connectivity. *Key actions*: Remove/replace barriers including dams, road culverts, irrigation structures, infiltration galleries; provide adequate screening of irrigation diversions. *Priority areas*: Rice Baldwin Dam, Stearns Dam, Seamus Dam, Parga Dam, Peoples irrigation diversion

Strategy: Restore floodplain connectivity and function. *Key actions*: Reconnect floodplain and side channels to channel. *Priority areas:* Crooked River (RM 31-51), McKay Cr

Strategy: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement water conservation measures, improve irrigation conveyance and efficiency, lease/purchase water rights and convert to instream. *Priority areas:* Crooked River (RM 14-55), McKay Cr, Allen Cr, Ochoco Cr (below Ochoco Dam)

Strategy: Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas*: Crooked River (RM 14-55), McKay Cr, Ochoco Cr (below Ochoco Dam), Allen Cr

Strategy: Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, and stabilize streambanks. *Priority areas*: Crooked River (RM 31-51), McKay Cr.

Hydrosystem Strategies

Strategy: Restore steelhead production in historical habitats. *Key actions*: develop juvenile collection and passage through PRBC, improve flow patterns through PRBC, restore water quality below PRBC. *Priority areas*: Deschutes R. (at and below PRBC).

Hatchery Strategies

Strategy: Restore natural production to blocked areas above PRBC. *Key actions*: Develop and implement a comprehensive plan for the reintroduction of steelhead into the Crooked River population area.

Table 1-10. Summary of Recovery Information for Lower Mainstem John Day River Population.

Key Population Attributes

The population occupies the Lower John Day watershed below the mouth of the South Fork John Day River and the town of Dayville. Steelhead in this population spawn in tributary streams connected to the lower John Day River including Bridge, Butte, Thirtymile, Hay and Rock creeks.

Recent year natural spawners include returns originating from naturally spawning parents, and a small fraction of strays from the Snake River and Columbia River hatchery programs.

The population contains 11 MaSAs and 19 MiSAs. Major spawning areas include Bridge, Mountain, Cottonwood, Hay, Middle Rock, Upper Rock, Pine Hollow, Long Rock (Lower John Day) Thirtymile, Butte, and Grass Valley. All 11 MaSAs are currently occupied and 11 of the 19 MiSAs are occupied.

The population exhibits a summer life history strategy and is part of the John Day River MPG.

It is considered a Very Large population with a mean minimum abundance threshold of 2,250 spawners.

Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk)

Abundance: Minimum abundance threshold of 2,250 spawners.

Productivity: Minimum productivity level of 1.19 recruits per spawner at the threshold abundance.

Viability Assessment Results

Abundance/Productivity: The population is at moderate risk based on current A/P. The productivity is very low risk because the point estimate is above very low risk and the lower end of the adjusted standard error is above the 5% risk level. The abundance is moderate risk because it resides between the 5% and 25% risk levels.

Spatial Structure/Diversity: The integrated rating is moderate risk for the population. The rating for Goal A "allowing natural rates and level of spatially mediated processes" was very low. The current spawner distribution is similar to historical with all MaSAs occupied. The MiSAs that are currently unoccupied have little influence on gaps and continuity, and spawners are spread over a very broad geographic area. The rating for Goal B "maintaining natural levels of variation" was moderate risk. This rating was a result of moderate risk for life history and genetic variation and high risk for spawner composition out-of-DPS hatchery strays. The magnitude and trend in out-of-DPS hatchery strays are of significant concern. Analysis of genetics information will yield considerable insight into the genetic variation and characteristics of this population.

Overall Viability Rating: The Lower Mainstem John Day River population *does not currently meet recommendations for viability*, although it does meet criteria for a "maintained" population. To achieve a viable rating, this population must improve in both A/P and SS/D. Out-of-DPS origin spawners are the most influential factor on diversity risk. Additional population specific data are needed to better quantify the spawner composition in this population to reduce the uncertainty associated with this risk metric.

Viability Gap

Abundance/Productivity: The recent 10-year geomean natural-origin abundance of 1,800 is 72% of the threshold abundance of 2,250 natural spawners. The current productivity of 2.99 recruits per spawner is well above the minimum required to meet the 1% risk level. The lower end of the 99% CI also resides above the minimum needed to meet the 1% risk level. The observed abundance/productivity gap to reach the 5% and 1% risk levels is 0.11. This gap is a result of the difference in the equilibrium abundance (2,019) and the threshold abundance.

Spatial Structure/Diversity: Gaps were identified for the following spatial structure/diversity metrics: *Major life history strategies:* moderate risk because habitat changes have resulted in reduced juvenile life history diversity and restricted summer rearing distribution. *Genetic variation*: moderate risk because there are no genetics data and due to potential genetic effects of the high proportion of out-of-DPS spawners. *Spawner composition:* Out-of-DPS spawners rated high risk due to high proportion and increasing trend of out-of-DPS spawners.

Limiting Factors and Threats

Primary Limiting Factors: Tributary Habitat: degraded channel structure and complexity (habitat quantity and diversity), altered sediment routing, water temperature, and altered hydrology. Impaired fish passage is also a high priority limiting factor in Bridge, Butte, Kahler, Muddy, Rock, and Thirtymile creeks. *Hatchery*: effects of naturally spawning stray hatchery fish on viability. *Hydro:* mainstem passage.

Primary Threats: Hatchery production that results in high proportions of stray hatchery fish in natural spawning areas; current land use practices (agricultural and grazing practices, removal of overstory trees and bank vegetation from the riparian corridor, water withdrawals, wetland draining and conversion, and stream channelization and diking; the Columbia River mainstem hydro system.

Primary Life Stages Affected: Juvenile rearing, egg incubation, egg-to-fry, fry-to-smolt, smolts.

VSP Characteristics Impacted: Abundance, productivity, spatial structure, diversity.

Tributary Management Strategies and Actions (Highest Priority)

Habitat Strategies

Strategy: Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs. *Priority areas*: Pine, Bridge, Cottonwood creeks.

Strategy: Restore passage and connectivity. *Key actions*: Remove/replace barriers, adequate screening of irrigation diversions. *Priority areas*: Rock, Upper Rock, Middle Rock, Lone Rock, Thirtymile, Butte, and Bridge creeks.

Strategy Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, stabilize streambanks. *Priority areas*: Rock, Middle Rock, Thirtymile and Butte creeks.

Strategy: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement water

conservation measures, improve irrigation conveyance and efficiency. *Priority areas:* Rock, Bridge, Rock Mountain, lower Parrish and Kahler creeks

Strategy: Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas:* Lone Rock, Mountain Cr (Wheeler Co), Parrish Cr, Cherry Cr, Kahler Cr, Bridge Cr, Thirtymile Cr, Butte Cr, and upper reaches of Pine Hollow Canyon Cr.

Strategy: Restore passage and connectivity: *Key actions:* Remove or minimize use of push up dams; remove or replace barriers blocking passage; provide screening at all irrigation diversions; replace screens that do not meet criteria. *Priority areas*: Rock, Upper Rock, Middle Rock, Lone Rock, Thirtymile, Butte, and Bridge creeks.

Harvest Strategies

Strategy: Use harvest to reduce stray hatchery spawners. *Key actions*: selective fisheries.

Strategy: Reduce catch and release mortality on natural steelhead spawner. *Key actions*: voluntary curtailment of fishing at higher water temperatures.

Strategy: Improve quality of harvest information. *Key actions*: expand creel surveys.

Hatchery Strategies

Strategy: Reduce uncertainty of origin of hatchery strays and increase ability to recognize hatchery fish. *Key actions:* coded-wire-tagging program, development of alternative broodstocks.

Strategy: Reduce uncertainty in abundance and proportion of stray hatchery fish spawning naturally. *Key actions:* increased monitoring on spawning grounds and possibly trapping.

Table 1-11. Summary of Recovery Information for North Fork John Day River Population.

Key Population Attributes
The population occupies the North Fork John Day watershed excluding the Middle Fork drainage. The North Fork John Day is the largest tributary to the John Day River, draining approximately 1,800 mi^2.
Recent year natural spawners include returns originating from naturally spawning parents, and a small fraction of strays from the Snake and Columbia River hatchery programs.
The population contains 8 MaSAs (Lower North Fork John Day, Potamus, Big Wall, Big, Upper North Fork John Day, Desolation, Granite, and Owens) and seven MiSAs (Bridge, Meadow Brook, two Cabins, Fivemile, Meadow and Ditch).
The population exhibits a summer life history strategy and is part of the John Day River MPG.
The population is considered a Large population with a mean minimum abundance threshold of 1,500 spawners.
Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk)
Abundance: Minimum abundance threshold of 1,500 spawners.
Productivity: Minimum productivity level of 1.26 recruits per spawner at the threshold abundance.
Viability Assessment Results
Abundance/Productivity: The North Fork John Day River population is at very low risk based on current abundance and productivity. The point estimate for abundance and productivity resides above the 1% risk curve and the 99% confidence interval for productivity is above the 25% risk curve.
Spatial Structure/Diversity: The combined integrated SS/D rating is low risk for the population. The rating for Goal A "allowing natural rates and level of spatially mediated processes" was very low. Current spawner distribution mimics the intrinsic distribution. The population is distributed broadly across the landscape in numerous MaSAs and MiSAs. Good continuity exists between spawning areas and current gaps between spawning areas are similar to historical gaps. The rating for Goal B "maintaining natural levels of variation" was low risk. However, there remains considerable uncertainty about the ratings for genetic variation and out-of-DPS hatchery strays in the natural spawners. Additional genetic analyses and interpretation is needed to determine if the genetic variation is similar to historical conditions and to examine evidence for degree of stray hatchery fish introgression. The metric for out-of-DPS hatchery strays rated very high. The data used for this rating are a composite from four John Day populations. Additional population specific spawner composition data are needed to improve the certainty of the out-of-DPS stray hatchery risk rating. If there is

significant hatchery introgression that is affecting the genetic variation through time then the risk rating for "genetic variation" will increase and the overall risk rating for Goal B and SS/D will also increase.

Overall Viability Rating: The overall viability rating for the North Fork John Day steelhead population *is considered highly viable* as a result of the A/P rating of very low risk, and the SS/D rating of low risk. There remains considerable uncertainty regarding the genetic effect of out-of-DPS strays, as well as the actual proportion of natural spawners that are hatchery strays. Enhanced monitoring efforts should be undertaken to develop better estimates of the composition of North Fork John Day spawners.

Viability Gap

Abundance/Productivity: The recent 10-year geomean natural-origin abundance of 1,740 exceeds the threshold abundance of 1,500. The current productivity of 2.41 recruits per spawner is well above the value needed to meet the 1% risk level. The lower end of the 90% CI resides above the 1% risk level. No abundance/productivity gaps exist for the 5% or 1% risk levels.

Spatial Structure/Diversity: All metrics rated very low or low risk except for the following: *Spawner composition:* Out-of-DPS spawners rated high risk due to the high estimated proportion of Snake River hatchery strays within this population. There is also considerable uncertainty regarding the hatchery fraction estimates for this population.

Limiting Factors and Threats

Primary Limiting Factors: Tributary Habitat: degraded floodplain connectivity and function, degraded channel structure and complexity (key habitat quantity, habitat diversity, channel stability), altered sediment routing, water temperature, and low flows; *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage.

Primary Threats: Hatchery management that results in high proportions of stray hatchery fish in natural spawning areas; current land use practices (riparian disturbance, stream channelization and relocation, grazing, forest practices, road building, irrigation withdrawals, mining and dredging); the Columbia River mainstem hydro system.

Primary Life Stages Affected: Parr-to-smolt survival, egg-to-fry survival, smolts.

VSP Characteristics Impacted: Abundance, productivity, diversity.

Tributary Management Strategies and Actions (Highest Priority)

Habitat Strategies

Strategy: Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs. *Priority areas*: tributaries within the NF John Day Wilderness, NF John Day River (Big Cr to headwaters), SF Desolation Cr, upper Clear Cr

Strategy: Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas*: Cottonwood Cr below Fox Cr, Camas Cr above Wilkins Cr

Strategy: Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, stabilize streambanks. *Priority areas*: Camas Cr (Wilkins Cr to Cable Cr), Clear Cr below Ruby Cr, Olive Cr below Beaver Cr, Bull Run Cr, Cottonwood Cr below EF Cottonwood

Strategy: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement water conservation measures; improve irrigation conveyance and efficiency. *Priority areas:* Cottonwood/Fox, Rudio, Camas Cr above Wilkins Cr

Harvest Strategies

Strategy: Use harvest to reduce stray hatchery spawners. *Key actions*: selective fisheries.

Strategy: Reduce catch and release mortality on natural steelhead spawner. *Key actions*: voluntary curtailment of fishing at higher water temperatures.

Strategy: Improve quality of harvest information. *Key actions*: expand creel surveys.

Hatchery Strategies

Strategy: Reduce uncertainty of origin of hatchery strays and increase ability to recognize hatchery fish. *Key actions:* coded-wire-tagging program, marking of all hatchery steelhead in Columbia River Basin, development of alternative broodstocks, reduced transport of hatchery smolts from Snake River.

Strategy: Reduce uncertainty in abundance and proportion of stray hatchery fish spawning naturally. *Key actions:* increased monitoring on spawning grounds and possibly trapping.

Table 1-12. Summary of Recovery Information for Middle Fork John Day River Population.

Key Population Attributes
The population occupies the Middle Fork drainage, which contains five watersheds, all used by steelhead.
Recent year natural spawners include returns originating from naturally spawning parents, and a small fraction of strays from the Snake and Columbia River hatchery programs.
Two MaSAs exist in the Middle Fork John Day River population, including Middle Fork John Day and Long Creek, and no MiSAs.
The population exhibits a summer life history strategy and is part of the John Day River MPG.
It is considered an Intermediate population with a mean minimum abundance threshold of 1,000 spawners.
Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk)
Abundance: Minimum abundance threshold of 1,000 spawners.
Productivity: Minimum productivity level of 1.35 recruits per spawner at the threshold abundance.
Viability Assessment Results
Abundance/Productivity: The population is at moderate risk based on current abundance and productivity. The point estimate is between 5% and 25% risk curves.
Spatial Structure/Diversity: The integrated SS/D rating is low risk for the population. The rating for Goal A "allowing natural rates and levels of spatially mediated processes" was between very low and low risk. Current spawner distribution mimics the intrinsic distribution. The population is distributed broadly across the landscape, in multiple MaSAs with adequate gaps and good continuity between spawning areas. The rating for Goal B "maintaining natural levels of variation" was low risk; however, additional genetics analyses are needed to better assess genetic variation and hatchery introgression. The population rated high risk for proportion of out-of-DPS hatchery strays based on a limited time series of composite John Day population data. Better population specific spawner composition data are needed to better understand the out-of-DPS hatchery stray influence. If significant hatchery introgression affects genetic variation through time, then the risk rating will increase, thus raising the overall risk rating for Goal B and the overall SS/D rating.
Overall Viability Rating: The population *does not currently meet the recommended viability criteria*, although it does meet criteria for a "maintained" population. Increased annual abundance would allow this population to achieve a risk rating of low for A/P and raise the overall viability rating to viable.
Viability Gap
Abundance/Productivity: The recent 10-year geomean natural-origin abundance of 756 is 75.6% of the threshold abundance of 1,000. The current productivity of 2.45 recruits per spawner is above the minimum needed at threshold abundance. The lower end of the 90% CI is well above the 25% risk level. The observed abundance/productivity gap to reach the 5% and 1% risk levels is 0.08. This gap is a result of the difference in equilibrium abundance (928) and the threshold abundance.
Spatial Structure/Diversity: All metrics rated very low or low risk except for the following: *Spawner composition:* Out-of-DPS spawners rated high risk due to the high estimated proportion of out-of-DPS strays within this population.
Limiting Factors and Threats
Primary Limiting Factors: Tributary Habitat: degraded channel structure and complexity (habitat quantity and diversity), degraded floodplain function and connectivity, altered sediment routing, altered hydrology, and water temperature; *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage.
Primary Threats: Hatchery management that results in high proportions of stray hatchery fish in natural spawning areas; current land use practices (riparian disturbance, stream channelization and relocation, grazing, forest practices, road building, passage barriers, irrigation withdrawals, mining and dredging); the Columbia River mainstem hydro system.
Primary Life Stages Affected: fry-to-smolt, egg incubation; egg-to-parr, smolts, adult spawning.
VSP Characteristics Impacted: Abundance, productivity, diversity.
Tributary Management Strategies and Actions (Highest Priority)
Habitat Strategies
Strategy: Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs.

Priority areas: Upper reaches of Big, Big Boulder, and Granite Boulder creeks that originate in the Vinegar Hill-Indian Rock Scenic Area.

Strategy: Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas*: Mainstem Middle Fork John Day (Crawford to Bridge Cr, Horse to Camp Cr, Long Cr, Camp Cr).

Strategy: Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, stabilize streambanks. *Priority areas*: Middle Fork from mouth of Granite Boulder Cr to Ragged Cr, between Big Boulder Cr and Camp Cr, and near the mouth of Mosquito Cr

Strategy: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement water conservation measures; improve irrigation conveyance and efficiency. *Priority areas:* Long Cr and tributaries

Harvest Strategies

Strategy: Use harvest to reduce stray hatchery spawners. *Key actions*: selective fisheries.

Strategy: Reduce catch and release mortality on natural steelhead spawner. *Key actions*: voluntary curtailment of fishing at higher water temperatures.

Strategy: Improve quality of harvest. *Key actions*: expand creel surveys.

Hatchery Strategies

Strategy: Reduce uncertainty of origin of hatchery strays and increase ability to recognize hatchery fish. *Key actions:* coded-wire-tagging program, development of alternative broodstocks.

Strategy: Reduce uncertainty in abundance and proportion of stray hatchery fish spawning naturally. *Key actions:* increased monitoring on spawning grounds and possibly trapping.

Table 1-13. Summary of Recovery Information for South Fork John Day River Population.

Key Population Attributes
The population occupies the South Fork drainage in the John Day River Basin. Steelhead spawn and rear through the lower South Fork John Day up to Izee Falls at RM 28.5 and in Murderers Creek and other South Fork tributaries.
Recent year natural spawners include returns originating from naturally spawning parents, and a small fraction of strays from the Snake River and Columbia River hatchery programs.
The population includes three MaSAs: Upper South Fork, Lower South Fork and Murderers Creek.
It exhibits a summer life history strategy and is part of the John Day River MPG.
The population is considered a Basic population with a mean minimum abundance threshold of 500 spawners.
Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk)
Abundance: Minimum abundance threshold of 500 spawners.
Productivity: Minimum productivity level of 1.56 recruits per spawner at the threshold abundance.
Viability Assessment Results
Abundance/Productivity: The population is at moderate risk based on current abundance and productivity. The point estimate resides between the 25% and 5% viability curves. The lower bound of the adjusted standard error for both the productivity and abundance extend below the 25% risk level.
Spatial Structure/Diversity: The integrated SS/D rating is low risk for the population. The rating for Goal A "allowing natural rates and levels of spatially mediated processes" rated midway between very low and low risk. Although the current spawner distribution mimics the intrinsic distribution, only three MaSAs exist within the population. Good continuity exists between spawning areas and gaps between areas have remained relatively unchanged. The rating for Goal B "maintaining natural levels of variation" is low risk. As is the case for all John Day steelhead populations, there is uncertainty in ratings of metrics "genetic variation" and "proportion of spawners that are out-of-DPS strays." Limited genetics data for South Fork steelhead restrict efforts to determine if the current population variation is similar to historical conditions and to examine the degree of hatchery fish introgression. The metric for proportion of out-of-DPS strays rated as high risk. However, the analyses relied on composite data from four John Day populations. Additional population specific spawner composition data are needed to better inform the risk rating and to reduce the associated uncertainty.
Overall Viability Rating: The population *does not currently meet the recommended viability criteria*, although it does meet

criteria for a "maintained" population. Improvement in abundance will allow this population to achieve viable status. However, while the population received a SS/D rating of low risk, there is considerable uncertainty surrounding the spawner composition data. Enhanced monitoring of the hatchery-wild ratios on the South Fork spawning grounds should be conducted to improve the hatchery fraction estimate and reduce the degree of uncertainty.

Viability Gap

Abundance/Productivity: The recent 10-year geomean natural-origin abundance of 259 is 51.8% of the threshold abundance of 500. The current productivity of 2.00 recruits per spawner is greater than the minimum required at the abundance threshold. The lower end of the 90% CI extends well below the 25% risk level. The observed abundance/productivity gap to reach the 5% and 1% risk levels is 0.22. The uncertainty gap for the 1% risk level is 0.23. The gaps are primarily a result of the difference between the equilibrium abundance (409) and the threshold abundance.

Spatial Structure/Diversity: All metrics rated very low or low risk except the following: *Spawner composition*: Out-of-DPS spawners rated high risk due to the high estimated proportion of out-of-DPS strays within this population.

Limiting Factors and Threats

Primary Limiting Factors: Tributary Habitat: altered sediment routing, degraded channel structure and complexity (habitat quantity and diversity), altered hydrology and low flow, water temperature, and impaired fish passage; *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage.

Primary Threats: Hatchery management that results in high proportions of stray hatchery fish in natural spawning areas; current land use practices (riparian disturbance, stream channelization and relocation, grazing, forest practices, road building, fish passage barriers (culverts, and other seasonal barriers), and irrigation withdrawals); the Columbia River mainstem hydro system.

Primary Life Stages Affected: Juvenile rearing, adult spawning, egg incubation, egg-to-parr survival, smolts.

VSP Characteristics Impacted: Abundance, productivity, diversity.

Tributary Management Strategies and Actions (Highest Priority)

Habitat Strategies

Strategy: Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs. *Priority areas*: Lower Murderers Cr tributaries draining the south side of Aldrich Mountain.

Strategy: Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas*: Upper South Fork River above Izee Falls, SF Murderers Cr, Deer Cr

Strategy: Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, stabilize streambanks. *Priority areas*: same as for riparian strategy.

Strategy: Restore degraded floodplain connectivity and function. *Key actions*: Reconnect floodplain to channel, reconnect side channels and off-channel habitats, restore wet meadows. *Priority areas:* SF Murderers Cr, Deer Cr, Upper South Fork River above Izee Falls.

Strategy: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement water conservation measures; improve irrigation conveyance/efficiency. *Priority areas:* SF Murderers Cr, Deer Cr, Upper South Fork River above Izee Falls.

Harvest Strategies

Strategy: Use harvest to reduce stray hatchery spawners. *Key actions*: selective fisheries.

Strategy: Reduce catch and release mortality on natural steelhead spawner. *Key actions*: voluntary curtailment of fishing at higher water temperatures.

Strategy: Improve quality of harvest information. *Key actions*: expand creel surveys.

Hatchery Strategies

Strategy: Reduce uncertainty of origin of hatchery strays and increase ability to recognize hatchery fish. *Key actions:* enhance coded-wire-tagging program, development of alternative broodstock.

Strategy: Reduce uncertainty in abundance and proportion of stray hatchery fish spawning naturally. *Key actions:* increased monitoring on spawning grounds and trapping.

Table 1-14. Summary of Recovery Information for Upper Mainstem John Day River Population.

Key Population Attributes
The population occupies the John Day River drainage above the town of Dayville and the mouth of the South Fork John Day River.
Recent year natural spawners include returns originating from naturally spawning parents and a small fraction of strays from the Snake River and Columbia River hatchery programs.
The population includes five MaSAs, Upper John Day, Upper Middle Mainstem John Day, Laycock, Beech and Canyon, and no MiSAs. The MaSAs are located primarily in the upper portions of the population boundaries.
The population exhibits a summer life history strategy and is part of the John Day River MPG.
It is considered an Intermediate population with a mean minimum abundance threshold of 1,000 spawners.
Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk)
Abundance: Minimum abundance threshold of 1,000 spawners.
Productivity: Minimum productivity level of 1.35 recruits per spawner at the threshold abundance.
Viability Assessment Results
Abundance/Productivity: The population is at moderate risk based on current abundance and productivity. The point estimate for abundance and productivity resides between the 5% and 25% risk curves.
Spatial Structure/Diversity: The integrated SS/D rating is moderate risk for the Upper Mainstem John Day River population. The rating for Goal A "allowing natural rates and levels of spatially mediated processes" was very low because the current distribution is nearly identical to the historical distribution. The rating for Goal B "maintaining natural levels of variation" was moderate risk. This risk rating was a result of a moderate rating for changes in major life history strategies. Additional genetics information needs to be assessed to determine current genetic variation and to examine for the degree of introgression of hatchery fish. The population was rated as high risk for out-of-DPS hatchery strays based on a limited time series of composite John Day population hatchery fish observation data. Better population specific spawner composition data are needed to better determine the out-of-DPS hatchery fraction. If there is significant hatchery introgression that affects the genetic variation of this population through time, then the risk rating for Goal B will increase, and the overall risk rating for SS/D will increase.
Overall Viability Rating: The population *does not currently meet the recommended viability criteria*, although it does meet criteria for a "maintained" population. An increase in abundance is needed for this population to achieve viable A/P criteria. In addition, the SS/D rating was moderate due to loss in life history diversity and high risk for spawner composition.
Viability Gap
Abundance/Productivity: The recent 10-year geomean natural-origin abundance of 524 is only 52.4% of the threshold abundance of 1,000. The current productivity of 2.14 recruits per spawner is well above the minimum required at the threshold abundance. The lower end of the 90% CI resides above the 25% risk level. The observed A/P gap to reach the 5% and 1% risk levels is 0.37. The uncertainty gaps are less than the observed gaps. The gap is primarily a result of the difference in the equilibrium abundance (730) and the threshold abundance.
Spatial Structure/Diversity: Gaps were identified for the following SS/D metrics: *Major life history strategies:* moderate risk due to reduced opportunities for juvenile movement patterns and reduced summer rearing distribution that has resulted from altered mainstem and tributary habitats. *Spawner composition:* Out-of-DPS spawners rated high risk due to the high proportion of out-of-DPS strays and uncertainty in the estimates of hatchery fraction.
Limiting Factors and Threats
Primary Limiting Factors: Tributary Habitat: degraded channel structure and complexity (habitat quantity and diversity), degraded riparian areas and LWD recruitment, altered sediment routing, water temperatures, altered hydrology and degraded floodplain function and connectivity. Impaired fish passage is also a priority limiting factor in Beech and Laycock creeks. *Hatchery:* effects of naturally spawning stray hatchery fish on viability. *Hydro:* mainstem passage.
Primary Threats: Hatchery production that results in high proportions of stray hatchery fish in natural spawning areas; current land use practices (agricultural practices, livestock overgrazing, removal of large trees from the riparian corridor, wetland draining/conversion, stream channelization/diking); the Columbia River mainstem hydro system.
Primary Life Stages Affected: Juvenile rearing, egg incubation, egg-to-parr survival, smolts, adult spawning.

VSP Characteristics Impacted: Abundance, productivity, spatial structure, diversity.
Tributary Management Strategies and Actions (Highest Priority) *Habitat Strategies* *Strategy*: Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs. *Priority areas*: EF and Middle Fork of Canyon Cr, John Day River above Blue Mt. Hot Springs. *Strategy*: Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas*: Upper mainstem John Day River, Beech Cr, Bear Cr, lower reaches of Fields Cr, Belshaw Cr and Riley Cr. *Strategy:* Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, stabilize streambanks. *Priority areas*: Mainstem John Day River (Dayville to Blue Mt. Hot Springs), Indian Cr, Pine Cr, lower Beech Cr, middle Canyon Cr, lower Strawberry Cr *Strategy*: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement water conservation measures; improve irrigation conveyance/efficiency. *Priority areas:* Fields, Indian, Pine, Beech, Strawberry and Laycock creeks, John Day River (Dayville to Mt. Vernon). *Strategy*: Restore passage and connectivity. *Key actions*: Remove or minimize use of push up dams, remove or replace culverts and/or other passage barriers. *Priority areas*: Beech, Canyon, Strawberry, Dixie, and Reynolds creeks. *Harvest Strategies* *Strategy:* Use harvest to reduce stray hatchery spawners. *Key actions*: selective fisheries. *Strategy:* Reduce catch and release mortality on natural steelhead spawner. *Key actions*: voluntary curtailment of fishing at higher water temperatures. *Strategy:* Improve quality of harvest information. *Key actions*: expand creel surveys. *Hatchery Strategies* *Strategy:* Reduce uncertainty of origin of hatchery strays and increase ability to recognize hatchery fish. *Key actions:* enhance coded-wire-tagging program, development of alternative broodstocks. *Strategy:* Reduce uncertainty in abundance and proportion of stray hatchery fish spawning naturally. *Key actions:* increased monitoring on spawning grounds and trapping.

Table 1-15. Summary of Recovery Information for Umatilla River Population.

Key Population Attributes The Umatilla River steelhead population occupies the Umatilla watershed and a few smaller streams in Washington State that flow directly into the Columbia River. Recent year natural spawners include returns originating from naturally spawning parents, Umatilla River hatchery-origin fish and out-of-DPS strays, primarily from the Snake River Basin. The ICTRT has identified 13 MaSAs for this steelhead population. Eleven of the MaSAs are within the Umatilla drainage in Oregon: Butter, East Birch, McKay, Meacham, Middle Umatilla, Upper Umatilla, Lower Middle Umatilla, Lower Birch, Lower Umatilla, Wildhorse and West Birch. The population also has three MiSAs: Alkali, Fourmile Canyon, and Cottonwood. Two of the MaSAs, Alder Creek and Glade Creek, are included in the Umatilla population, but are direct tributaries to the Columbia River on the Washington side. Currently only eight of the 13 MaSAs are occupied. The population exhibits a summer life history strategy and is part of the Umatilla/Walla Walla Rivers MPG. It is considered a Large population with a mean minimum abundance threshold of 1,500 spawners.
Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk) *Abundance:* Minimum abundance threshold of 1,500 spawners. *Productivity:* Minimum productivity level of 1.26 recruits per spawner at the threshold abundance.
Viability Assessment Results *Abundance/Productivity*: The population is at moderate risk. The productivity is at low risk because the point estimate is above 5% risk level and the adjusted standard error is above the 25% risk level. Abundance is moderate because the point estimate is slightly below the 5% risk level.

Spatial Structure/Diversity: The integrated SS/D rating is moderate risk for the population. The rating for Goal A "allowing natural rates and levels of spatially mediated processes" was moderate risk. There has been significant reduction in spawner distribution relative to intrinsic potential distribution. This reduction has caused significant increases in gaps between spawning areas as well as disrupted continuity. The rating for Goal B "maintaining natural levels of variation" was moderate risk. Habitat changes have been significant in the Umatilla Basin resulting in changes to flow profiles and elevated temperatures. These changes have resulted in impacts to life history diversity and phenotypic trait variation. The out-of-DPS strays in combination with local origin hatchery fish spawning naturally put the population at high risk for spawner composition. Within basin habitat changes have likely resulted in selective mortality of specific components of juvenile and adult life stages resulting in a moderate risk rating.

Overall Viability Rating: The population *does not currently meet the recommended viability criteria* because A/P and SS/D risks ratings are both moderate. It does meet criteria for a "maintained" population. Improvement in many of the SS/D metrics and a small increase in the average abundance will raise the population to viable status.

Viability Gap

Abundance/Productivity: The recent 10-year geomean natural-origin abundance of 1,472 is 98.1% of the threshold abundance of 1,500. The current productivity of 1.50 recruits per spawner is above the minimum of 1.26 required at the threshold abundance. The lower end of the 90% CI resides slightly above the 25% risk level. The observed A/P gap for the 5% and 1% risk levels is 0.09. The uncertainty gap for the 1% risk level is less than the observed gap.

Spatial Structure/Diversity: Gaps were identified for the following SS/D metrics: *Spatial Extent or Range of Population*: moderate risk because the current spawner distribution is substantially reduced from the historical distribution. Loss of spawning in the Butter and McKay watersheds has resulted in the reduced distribution. *Increase or decrease in gaps and continuities*: moderate risk because of the increased gaps and changed continuity resulting from losses of occupancy in the Butter and McKay watersheds. *Major life history strategies:* moderate risk as a result of reduced opportunity for life history expression for juvenile and adult life stages. This reduced opportunity has resulted from significant habitat changes in the Umatilla Basin. *Phenotypic variation:* moderate risk due to effects of flow and temperature on adult and juvenile migration characteristics. *Spawner composition*: Overall rating is high risk due to two moderate ratings for the component metrics. Out-of-DPS spawners rated as moderate risk due to the estimated level of strays observed at Three-mile Falls Dam over the last three generations. Within-population spawners rated moderate risk due to the proportion and duration of Umatilla Hatchery fish spawning in the basin. *Selective change in Natural Processes-Habitat:* moderate risk due to the selective effects of temperature and flow changes on juvenile and adult characteristics.

Limiting Factors and Threats

Primary Limiting Factors: Tributary Habitat: high water temperature, sediment routing, impaired fish passage, degraded channel structure and complexity and low flows; *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage.

Primary Threats: Hatchery production that results in high proportions of stray hatchery fish in natural spawning areas; current land use practices that reduce habitat quality, quantity and disrupt ecosystem functions; the Columbia River mainstem hydrosystem.

Primary Life Stages Affected: fry, summer parr, winter parr, smolts.

VSP Characteristics Impacted: Abundance, productivity, spatial structure, diversity.

Tributary Management Strategies and Actions (Highest Priority)

Habitat Strategies

Strategy: Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs. *Priority areas:* North Fork Umatilla R, Umatilla R (Meacham Cr. to forks), Buck Cr, NF Meacham Cr, E. Meacham Cr, Thomas Cr, W. Birch Cr (Bear Cr to headwaters), E. Birch Cr (California Gulch to headwaters), SF Umatilla R (mouth to Thomas Cr).

Strategy: Restore passage and connectivity. *Key actions*: Remove or replace culverts and/or other passage barriers, construct ladders over existing dams, provide adequate screening at all irrigation diversions. *Priority areas*: Birch Cr, W. Birch Cr, Bridge Cr, and diversions within current steelhead distribution.

Strategy: Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas*: Umatilla R (Mission Br to forks), Meacham Cr (mouth to headwaters), Birch Cr, West Birch Cr (mouth to Gorge), East Birch Cr,

Bear Cr, Iskuulpa Cr.

Strategy: Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, stabilize streambanks. *Priority areas*: Umatilla R (Mission Br. to forks), Meacham Cr, NF Meacham Cr, Birch Cr, West Birch Cr (mouth to Gorge), East Birch Cr, Bear Cr.

Strategy: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Implement Umatilla Basin Project Phases I-IIII, implement water conservation measures, improve irrigation conveyance/efficiency. *Priority areas:* Umatilla R (mouth to Thornhollow), Birch C, West Birch Cr (mouth to Gorge), East Birch Cr, Bear Cr.

Hydrosystem Strategies

Strategy: Improve hydrosystem operations and facilities at Boyd Project to enhance steelhead survival and viability. *Key actions:* Modify bypass flows at Project if possible to mimic instream water right, modify fish passage facilities to meet current standards, remove weir panels from diversion dam during non-operation, maintain trash racks. *Priority areas:* At and below Boyd Project.

Harvest Strategies

Strategy: Manage harvest to maintain current low impact fisheries. *Key actions:* Maintain current low impact fisheries.

Hatchery Strategies

Strategy: Reduce uncertainty of origin of hatchery strays and increase ability to recognize hatchery fish. *Key actions:* coded-wire-tagging program, development of alternative broodstocks for the hatchery programs that produce the strays.

Strategy: Reduce abundance and proportion of out-of-basin stray hatchery fish spawning naturally. *Key actions:* no consensus actions.

Strategy: Re-establish natural production in historically utilized areas. *Key actions*: re-establish natural production in Little Butter and Butter creeks and some MiSAs through adult outplanting and juvenile releases.

Strategy: Reduce genetic influence of hatchery fish in broodstock. *Key actions*: Eliminate use of hatchery produced adults in broodstock.

Strategy: Reduce interactions between residual hatchery steelhead and natural steelhead. *Key actions*: no consensus actions.

Strategy: Reduce potential ecological interactions between coho and natural steelhead. *Key actions*: reduce number of hatchery coho released in Umatilla R. and relocate releases downstream of areas important to steelhead production.

Table 1-16. Summary of Recovery Information for Walla Walla River Population.

Key Population Attributes

The Walla Walla River steelhead population occupies the Walla Walla watershed, with the exception of the Touchet River drainage, which is considered a separate independent steelhead population. The main tributaries of the Walla Walla River are the North and South forks and Couse, Pine, Birch, Cottonwood and Mill creeks. The North and South forks and Couse Creek are entirely within Oregon, but the remaining tributaries span the state line. Two small watersheds that empty directly into the Columbia River below the Walla Walla River confluence are included in the Walla Walla population boundaries.

Recent years natural spawners include returns originating from naturally spawning adults and from outside-DPS strays that originate from Lyons Ferry Hatchery releases in the lower Walla Walla River.

The population is comprised of three MaSAs (Mill, Pine, and Walla Walla) and two MiSAs (Dry and Switzler). Currently two of three MaSAs are occupied, including Walla Walla and Mill. Spawning and rearing occur in the lower reaches of the Pine Creek MaSA.

The population exhibits a summer life history strategy and is part of the Umatilla/Walla Walla Rivers MPG.

It is considered an Intermediate size population with a mean minimum abundance threshold of 1,000 spawners.

Minimum Viability Levels For Low Risk Recovery Scenario (5% extinction risk)

Abundance: Minimum abundance threshold of 1,000 spawners.

Productivity: Minimum productivity level of 1.35 recruits per spawner at the threshold abundance.

Viability Assessment Results

Abundance/Productivity: The population is at moderate risk based on current abundance and productivity. The point estimate falls between the 5% and 25% risk curves. The risk rating should be viewed with caution given two considerations. First, the time series is short, with only eight complete brood years. Second, there is considerable uncertainty associated with the amount of spawning and production that occurs within the population outside of the area above Nursery Bridge Dam, particularly in Mill Creek. Better information relating abundance above Nursery Bridge Dam to the remaining area in the population is needed to reduce these data uncertainties.

Spatial Structure/Diversity: The integrated SS/D rating for the population is moderate risk. The rating for Goal A "allowing natural rates and levels of spatially mediated processes" was moderate risk. There has been significant reduction in spawner distribution which has resulted in increased gaps and loss of continuity within the population, as well as between the Walla Walla population and other Mid-Columbia steelhead populations. The rating for Goal B "maintaining natural levels of variation" was moderate risk. Water temperature and hydrograph changes, as well as barriers have likely influenced life history diversity and phenotypic expression. Out-of-DPS strays have put the population in the moderate risk category for the spawner composition metric. Within basin habitat changes have likely resulted in selective mortality at multiple life stages resulting in a moderate risk rating.

Overall Viability Rating: The population *does not currently meet the recommended viability criteria*, although it does meet criteria for a "maintained" population. The A/P values are at moderate risk and the time series is short resulting in considerable uncertainty. Additional brood years are needed to demonstrate sustained recruits per spawner and abundance values above the low risk criteria level. Significant improvements to spatial structure and diversity are needed to improve the risk level.

Viability Gap

Abundance/Productivity: The recent 10-year geomean natural-origin abundance of 650 is well below the threshold abundance of 1,000. The current productivity of 1.34 recruits per spawner is slightly less than the minimum of 1.35 required at the threshold abundance. The lower end of the 95% CI extends well below the 25% risk level. The observed gaps for A/P at the 5% and 1% risk levels were 0.34 and 0.45 respectively. The uncertainty gaps at the 5% and 1% risk levels were less than the observed gaps. These gaps should be viewed cautiously because there is only a short data series available to estimate productivity.

Spatial Structure/Diversity: Gaps were identified for the following SS/D metrics: *Major life history strategies:* moderate risk due to changes in juvenile and adult movement patterns as well as reduced juvenile rearing distribution relative to historical opportunities. The reduced life history strategies have resulted from significant flow and temperature changes within the basin. *Phenotypic variation:* moderate risk due to the effect of flow and temperature changes on phenotypic variation. Adult and juvenile migration patterns have been significantly altered due to these habitat changes. *Spawner composition:* Out-of-DPS spawners rated moderate risk due to the proportion and duration of out-of-DPS spawners in the population. *Selective change in Natural Processes-Habitat:* moderate risk due primarily flow and temperature effects on migration, movement and rearing patterns.

Limiting Factors and Threats

Primary Limiting Factors: Tributary Habitat: high water temperature, sediment routing, impaired fish passage, degraded channel structure and complexity, degraded floodplain connectivity and function, and low flow; *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage.

Primary Threats: Hatchery management that results in high rates of straying hatchery fish in natural spawning areas; current land use practices that reduce habitat quality, quantity and disrupt ecosystem functions; the Columbia River mainstem hydrosystem.

Primary Life Stages Affected: fry, summer parr, winter parr, smolts.

VSP Characteristics Impacted: Abundance, productivity, spatial structure, diversity.

Tributary Management Strategies and Actions (Highest Priority)

Habitat Strategies

Strategy: Protect and conserve natural ecological processes. *Key actions*: Protect highest quality habitats; apply BMPs. *Priority areas*: SF Walla Walla (Elbow to headwaters), SF Walla Walla Tribs, NF Walla Walla (Little Meadows to headwaters).

Strategy: Restore passage and connectivity. *Key actions*: Remove or replace culverts and/or other passage barriers, construct ladders over existing dams, provide adequate screening at all irrigation diversions. *Priority areas*: Mill Cr., Birch Cr, Couse Cr, and unscreened irrigation diversions within current steelhead distribution.

Strategy: Restore riparian condition and LWD recruitment. *Key actions*: restore natural plant communities, maintain fencing, adjust grazing strategies (new fencing may be part of an adjusted strategy). *Priority areas*: Walla Walla R (Mill Cr. to forks), SF Walla Walla (mouth to Elbow Cr), NF Walla Walla R (mouth to Little Meadows Cyn).

Strategy: Restore degraded and maintain properly functioning channel structure and complexity. *Key actions*: restore natural channel form, increase LWD, and stabilize streambanks. *Priority Areas*: Walla Walla R (Mill Cr. to forks), SF Walla Walla (mouth to Elbow Cr), NF Walla Walla R (mouth to Little Meadows Cyn).

Strategy: Restore natural hydrograph to provide sufficient flow during critical periods. *Key actions*: Investigate feasibility of water storage or exchange, implement water conservation measures, and improve irrigation conveyance/efficiency. *Priority Areas:* Walla Walla R (mouth to Little Walla Walla diversion), Walla Walla R. (Mill Cr to forks), NF Walla Walla R (mouth to Little Meadows Cyn).

Hydrosystem Strategies

Strategy: Improve hydro operations and facilities at Twin Reservoirs Project. *Key actions:* Conduct assessment of fishway and modify to meet juvenile fish passage standards.

Harvest Strategies

Strategy: Manage harvest to maintain current low impact fisheries. *Key actions:* Maintain current low impact fisheries.

Hatchery Strategies

Strategy: Reduce uncertainty of origin of hatchery strays and increase ability to recognize hatchery fish. *Key actions:* enhance coded-wire-tagging program, development of alternative broodstocks for the hatchery programs producing strays.

Strategy: Reduce abundance and proportion of hatchery strays spawning naturally. *Key actions:* no consensus actions.

Section 2 Introduction

This plan provides a framework and roadmap for the conservation and recovery of Middle Columbia River (Mid-C) steelhead (*Oncorhynchus mykiss)* in the State of Oregon. Mid-C steelhead currently occupy habitat in five major Oregon subbasins: Fifteenmile Creek and the Deschutes, John Day, Umatilla and Walla Walla rivers, as well as a number of small tributaries that flow directly into the Columbia River. The plan focuses on the recovery of Mid-C steelhead populations in these subbasins.

Oregon Mid-C steelhead were originally listed as threatened under the Endangered Species Act (ESA) as part of the Middle Columbia River steelhead Evolutionarily Significant Unit (ESU) on March 25, 1999 (69 FR 33101). After NOAA Fisheries' National Marine Fisheries Service (NMFS) revised its species determinations for West Coast steelhead, Mid-C steelhead populations were listed as threatened on January 5, 2006 (71 FR 834) as the Middle Columbia River steelhead Distinct Population Segment (DPS). The DPS includes all steelhead populations in Oregon and Washington tributaries of the Columbia River upstream of the Hood and Wind River systems, up to and including the Yakima River. The Snake River is not part of the DPS.

The draft recovery plan describes a process to remove or minimize the threats to the long-term survival and recovery of Mid-C steelhead and improve the viability to the level that protection under the ESA is not required.

The document describes:

- The institutional framework and rationale for recovery plans
- How NOAA's National Marine Fisheries Service expects to use the plan
- The regional domains of the Columbia Basin within which the recovery plans are written
- The relation of this plan to other planning processes and other ESA mandates
- Desired status--delisting (viability) criteria and broad sense recovery goals
- The current status of listed Mid-C steelhead
- Gaps between current status and viable status
- Limiting factors and threats
- Recovery strategies, management strategies and actions
- Management action effectiveness
- Cost analysis
- Research, monitoring and evaluation
- A framework for implementation and adaptive management

2.1 Species Recovery under ESA

Section 4(f) of the ESA requires NMFS to develop and implement recovery plans for species listed as endangered or threatened under the Act. These plans must, at a minimum, contain (1) a description of site-specific management actions necessary to achieve the plan's goal for the conservation and survival of the species; (2) objective, measurable criteria that, when met, would result in a determination that the species be removed from the list; and, (3) estimates of the time

required and cost to carry out the measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal. Recovery plans are guidance and not regulatory documents, thus no agency or entity is required by the ESA to implement the recovery strategies or actions in the plans unless otherwise legally mandated (NMFS 2006a). Although not regulatory, the authors of the ESA clearly saw recovery plans as a central guiding vehicle for the recovery of listed species.

NMFS is the agency responsible for recovery planning for salmon and steelhead, and also for decisions to list and delist marine species as endangered or threatened. Nevertheless, NMFS recognizes that local support of recovery plans is essential to their successful implementation. It is committed to involving local citizens and groups — those whose activities directly affect the listed species, and whose activities are most affected by recovery requirements — in development of the plans. The State of Oregon has taken the lead, in collaboration with NMFS and many other agencies, in developing the recovery plan for Oregon Mid-C steelhead. This plan fulfills the initial ESA recovery planning requirements for Mid-C steelhead, and represents the participation and leadership of tribal and non-tribal citizen groups.

As a template for listed species recovery, a recovery plan describes a process to remove the threats to long-term survival and persistence by reversing the decline of a listed species and its habitat so that they initially become viable and eventually achieve their historical role in the natural-cultural system of the Columbia Basin. A recovery plan provides the necessary information that Federal agencies (NMFS and the U.S. Fish and Wildlife Service (USFWS)) have determined will lead to recovery of listed species and their associated habitats. The plan describes the current species status, the 'gap' that needs addressing to reach recovery, as well as ongoing or proposed actions designed to aid in the recovery of the species. The plan also provides estimated timeframe and costs for the overall effort. The final recovery plan will be considered a "living document." As new information becomes available, such as the outcome of the Federal Columbia River Power System Biological Opinion process, better understanding of climate change, or as monitoring and adaptive management reveal the need for change, revised and additional actions will be added to the plan.

Once a species is deemed recovered, and therefore removed from a 'listed status,' section 4(g) of the ESA requires the monitoring of the species for a period of not less than five years to ensure that it retains its recovered status and does not decline to such a state that requires the need to again list it as either a threatened or endangered species under the ESA.

2.2 State of Oregon Recovery Planning

The State of Oregon considers this plan its conservation plan for the Oregon portion of the Middle Columbia River steelhead DPS. The plan supports the State of Oregon's Plan for Salmon and Watersheds (Oregon Plan) and meets the requirements of Oregon's Native Fish Conservation Policy (NFCP) (OAR 635-007-0502 to 0509). The Oregon Plan is a comprehensive partnership between government, communities, private landowners, industry and citizens funded by the Oregon Legislature. The Oregon Plan mission is:

> *To restore the watersheds of Oregon and to recover the fish and wildlife populations of those watersheds to productive and sustainable levels in a manner that provides substantial environmental, cultural and economic benefits.*

The Native Fish Conservation Policy, adopted in 2002 by the Oregon Fish and Wildlife Commission, provides refined policy to support implementation of the Oregon Plan. The NFCP is Oregon's policy for managing native fish and determining restoration priorities that improve the effectiveness of conservation efforts under the Oregon Plan. The NFCP focuses on the conservation of naturally produced fish because they are the basis for Federal ESA listings and are the foundation for productive fisheries programs.

The NFCP uses conservation plans as a means to identify and implement strategies and actions to restore and maintain native fish in Oregon. The conservation plans describe commitments by the State of Oregon that will conserve the sustainability of ESUs/DPSs and restore biological attributes necessary to achieve desired status goals that will provide significant ecological, economic and cultural benefits for all Oregonians. The plans are developed through a sequential process, nearly identical to the one used for this recovery planning effort:

1. Determine the management unit, ESU or DPS
2. Determine its current status
3. Define a desired status (viability and broad sense goals)
4. Determine any gap between the two and the factors causing the gap (limiting factors)
5. Identify strategies and actions that address the limiting factors
6. Monitor and evaluate the ESU (or DPS) status and actions implemented and use adaptive management to make adjustments.

Status assessments conducted under the NFCP resemble assessments for ESA recovery in that they focus on groups of populations from a common geographic area with similar genetic and life history traits called Species Management Units (SMUs). Oregon, however, believes there are ecological and adaptive differences between summer and winter forms of steelhead and separates them into different SMUs. Populations delineated within Oregon's Mid-C summer steelhead SMU are similar to those defined for the Cascade Eastern Slope Tributaries MPG, except that the Deschutes Eastside and Westside populations are combined into a single population and the Fifteenmile Creek winter steelhead population is included in the Lower Columbia winter steelhead SMU. Oregon currently considers both SMUs as "At Risk" (ODFW 2005d). We chose to use the ICTRT population delineations because they were developed based on more recent information. We do not believe that the delisting criteria or management actions would differ if the Oregon NFCP populations or SMU boundaries were used because of the close similarity to the ICTRT boundaries.

As a conservation plan under the NFCP, this plan for Oregon Mid-C steelhead populations goes beyond achieving ESA recovery requirements. Its desired status includes achievement of 'broad sense goals', including meeting social and cultural benefits. This approach to species recovery includes development of goals for harvestable population levels viewed essential by all the parties involved. Although somewhat broader than the definition of recovery provided by the

ESA, these broad sense recovery goals incorporate many of the traditional uses as well as rural and Native American values deemed important in Oregon and throughout the Pacific Northwest.

Consistent with the Oregon Plan and NFCP — as well as the ESA — this plan provides structure and guidance to efforts to protect and restore Oregon Mid-Columbia steelhead and their habitats, while providing flexibility for actions to be determined by appropriate parties. It is designed to support and build on the existing conservation network across Oregon's portion of the DPS. This partnership of regulatory and non-regulatory entities, private landowners, and others represents an effective means for achieving viability targets and broader recovery goals.

This Recovery Plan was developed to parallel and build from the Oregon Conservation Strategy. The Oregon Conservation Strategy (Conservation Strategy) was developed by ODFW in response to a national effort guided by the U.S. Congress and the U.S. Fish and Wildlife Service to encourage states to develop comprehensive wildlife conservation plans. The Oregon Fish and Wildlife Commission approved the Conservation Strategy in August 2005 and the strategy was approved by the USFWS in March 2006. The Conservation Strategy provides a long-term, big picture "blueprint" for conserving Oregon's natural resources. The strategy is designed to maintain and improve environmental health for today and future generations. The principle goal is to "maintain healthy fish and wildlife populations by maintaining and restoring functioning habitats, prevent declines of at-risk species, and reverse declines in these resources where possible." Like the Recovery Plan, the Conservation Strategy is not a regulatory document and relies on voluntary conservation actions. Mid-Columbia River steelhead are identified as a "Strategy Species" that are distributed throughout three ecoregions specified as critical for achieving the goals of the Conservation Strategy. The Conservation Strategy identifies six key issues for which specific goals and actions are presented. All of the actions identified within this Recovery Plan align with the key issues and goals identified in the Conservation Strategy. The limiting factors and management actions described in this Recovery Plan are more spatially and temporally explicit than the actions in the Conservation Strategy. In addition, this plan addresses a wider array of issues such as hydrosystem, harvest, hatcheries and predation.

2.3 Tribal Treaty/Trust Obligations

Northwest Indian tribes have legally enforceable treaty rights reserving to them a share of the salmon harvest, and they are "co-managers" with state and federal agencies in regulating salmon harvest. These rights and expectations may not necessarily be fully met by achieving the basic purposes of the ESA and delisting of the species, although it will lead to major improvements in the current situation.

Historically, Mid-C steelhead were found throughout central Oregon and south-central Washington. Mid-C steelhead were important to Native Americans of the interior west, including the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes and Bands of the Yakama Nation, and the Confederated Tribes of the Warm Springs Reservation. Native Americans throughout the Pacific Northwest maintain strong cultural values for steelhead and salmon species. These fish have long had important tribal subsistence, ceremonial and commercial value. Steelhead have also been, and continue to be, of importance to the recreational fishing industry of the region.

Several treaty tribes exist within the area considered the range of Mid-C steelhead; the Yakama, Umatilla, Walla Walla, and Warm Springs tribes. The Treaty of June 9, 1855 was between the United States and the Walla Walla, Cayuse, and Umatilla Tribes, now the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). In 1855 the Warm Springs and Wasco tribes signed with the United States in the Treaty with the Middle Oregon Tribes of Oregon. The Confederated Tribes of the Warm Springs (CTWSRO) consists of the Warm Springs, Wasco and Paiute tribes. The Confederated Tribes of the Yakama represent 14 bands and tribes that were a party of the 1855 Treaty with the Yakamas and United States.

Ensuring a sufficient abundance of salmon and steelhead to sustain harvest can be an important element in fulfilling treaty rights. NMFS is committed to meeting Federal treaty and trust obligations to the tribes. These obligations are described in a July 21, 1998 letter from Terry D. Garcia, Assistant Secretary for Oceans and Atmosphere, U.S. Dept of Commerce, to Mr. Ted Strong, Executive Director of the Columbia River Inter-Tribal Fish Commission. This letter states that recovery *"…must achieve two goals; 1) the recovery and delisting of salmonids listed under the provisions of the ESA; and 2) the restoration of salmonid populations over time, to a level to provide a sustainable harvest sufficient to allow for the meaningful exercise of tribal fishing rights."* Thus it is appropriate for recovery plans to take these conditions into account and plan for a recovery strategy that includes harvest.

The ESA and tribal trust responsibilities complement one another. Both depend on a steady upward trend toward ESA recovery and delisting in the near term, while making river, harvest, and land management improvements for the long term. Furthermore, ESA delisting cannot occur until both biological objectives and the listing factors are considered and NMFS determines, based on an evaluation of the listing factors, that the DPS is no longer likely to require the protection of the Act. Therefore, NMFS will make no delisting decision until it is clear that the threats to the DPS have been addressed and that the status and trends of both the fish and their habitats will be healthy and sustainable in the long term.

Section 3 Background and Regional Context

Section 3 describes the context of Oregon's recovery plan for Mid-C steelhead within the framework of NMFS's larger recovery planning efforts. It also describes the State of Oregon's process led by the Oregon Department of Fish and Wildlife to develop a scientifically sound, realistic road map for recovery through broad technical, stakeholder, and public involvement. In addition it identifies the recovery goals for the DPS, discusses the listing of Mid-C steelhead, and provides a short description of the population's life history characteristics and critical habitat.

3.1 Context of Plan Development

This recovery plan is one piece of a larger recovery planning effort for listed species across the Pacific Northwest, as well as in other parts of the Mid-C DPS. It is also part of a broader planning effort by the State of Oregon to conserve and rebuild Oregon's native salmon and steelhead runs. These overlapping processes are discussed in this section.

3.1.1 NMFS's Regional Process

Currently, 17 ESUs and DPSs of Pacific salmon and steelhead in the Pacific Northwest are listed under the ESA. NMFS has designated five geographically-based recovery domains for preparing recovery plans for the listed species. The Mid-C steelhead DPS falls within the Interior Columbia domain (which is divided into three sub-domains: the Snake River, Mid-Columbia, and Upper Columbia). The other domains are the Willamette-Lower Columbia; Puget Sound and Washington Coast; Oregon Coast; and the Southern Oregon/ Northern California Coast domains. Opportunities exist for technical and stakeholder involvement in each domain.

Technical Recovery Team
For each domain, NMFS appointed an independent Technical Recovery Team (TRT) that has geographic and species expertise for the domain and can provide a solid scientific foundation for recovery plans. The charge of each TRT is to define ESU/DPS structures, develop recommendations on biological viability criteria for ESUs/DPSs and populations, to provide scientific support to local and regional recovery planning efforts, and to provide scientific evaluations of recovery plans. The TRTs include biologists from NMFS, state, tribal, and local entities, agencies, academic institutions, and private consulting groups. All the TRTs operate from a common scientific foundation. Each TRT has used the same biological principles for developing its recommended ESU/DPS and population viability criteria — criteria that will be used, along with threats-based criteria, to determine whether a species has recovered sufficiently to be downlisted to threatened (if endangered) or delisted — although they have developed regionally specific approaches to these criteria. Each TRT's recommendations are assessed using the Viable Salmonid Population (VSP) framework, with viability criteria expressed in terms of abundance, productivity (population growth rate), spatial distribution, and diversity (McElhany et al. 2000).

Planning Forums

In each domain, NMFS has worked with state, tribal, local and other Federal stakeholders to develop planning forums appropriate to the domain, which builds to the extent possible on ongoing, locally led efforts. NMFS separated the Mid-Columbia River steelhead DPS into four management units (Figure 3-1) that reflect its diverse human and physical landscape: the Oregon Unit, Yakima Unit, Columbia Gorge Unit (Klickitat/White Salmon/Rock Creek), and Southeastern Washington Unit (Touchet and the Washington portion of the Walla Walla River).

Individual recovery plans developed by local forums for the four management units form the foundation of the DPS-level recovery plan. This recovery plan is for the Oregon management unit. The State of Washington took responsibility for recovery planning for the portion of the Mid-Columbia DPS within its borders. The State of Washington's Salmon Recovery Act established six regional boards that are comprised of government and tribal representatives, landowners, and private citizens. With substantial funding from Washington's Salmon Recovery Board and the Northwest Power and Conservation Council (NPCC), these groups produced the June 2005 Draft Snake River Salmon Recovery Plan for SE Washington, and the October 2005 Draft Yakima Subbasin Salmon Recovery Plan that address the drainages within the State of Washington regarding Mid-C steelhead. NMFS and representatives from the four management units worked together to develop DPS-level direction that identified the viability scenarios for Cascades Eastern Slope Tributaries and Umatilla/Walla Walla MPGs that overlap parts of Oregon and Washington states.

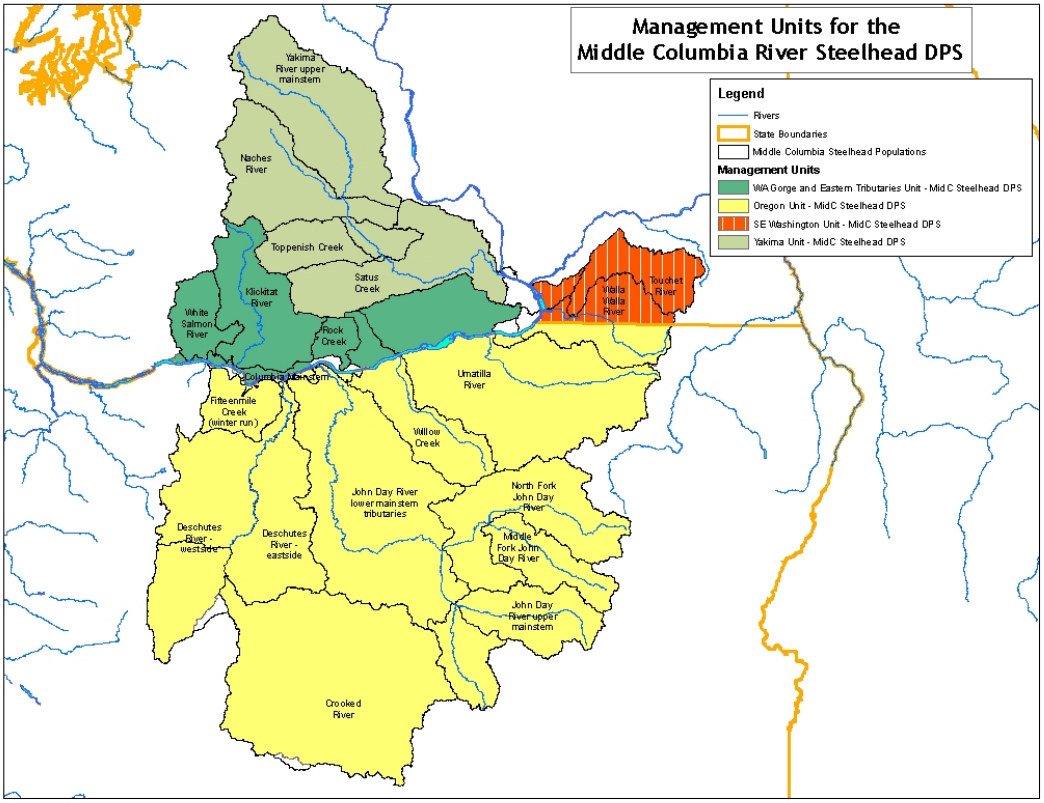


Figure 3-1. NMFS Management Units for the Middle Columbia River Steelhead DPS.

For more information about NMFS, the domains, and the TRTs, see the following Internet site: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/index.cfm.

3.1.2 State of Oregon Recovery Planning Process

The State of Oregon developed this plan in partnership with other state and Federal natural resources agencies, the tribes, and local communities. The plan took shape through a collaborative process with broad technical, stakeholder and public involvement. The planning process drew on direction developed through related planning processes, included the NPCC subbasin plans, the Oregon Plan and Native Fish Conservation Policy planning. ODFW took the lead in drafting the Oregon Mid-C steelhead recovery plan with the assistance of a cadre of other entities. Members of ODFW, NMFS, Tribes, and many other contributors compiled the information for the Oregon portion of the Mid-Columbia River basin from multiple sources, including federal, state, tribal, private, and local watershed organizations that are involved in salmon recovery.

ODFW has involved critical players in the plan's development at each stage in the decision-making process. The plan reflects substantial the review, discussion, critique and recommendations of four primary forums: a State-level Expert Panel, a diverse public sounding board, a recovery planning team, and population-specific management action teams. Appendix A lists the members of each of these groups. The Interior Columbia TRT was also involved in the process. This involvement is vital to the plan's success and will help ensure that it is both scientifically and technically sound and supported by various stakeholders and private landowners.

- *Oregon Mid-Columbia Expert Panel*. The Expert Panel was created by the Oregon Department of Fish and Wildlife for purposes of recovery planning and consisted of biologists with significant knowledge of the limiting factors and threats influencing Oregon's listed salmon and steelhead populations. Panelists identified common key and secondary threat themes and limiting factors for the populations.

- *Mid-Columbia Sounding Board.* The Mid-Columbia Sounding Board (MCSB) consists of representatives of local communities, agricultural and timber interests, water users, land managers, governing bodies, tribes, and industry and environmental interests. The MCSB provides policy guidance in the development of all aspects of the plan and ensures locally appropriate and locally supported recovery actions needed to achieve species recovery goals. The MCSB was particularly instrumental in the development of broad sense recovery goals, recovery scenarios, recovery strategies, and strategic guidance for development and prioritization of management actions.

- *Mid-Columbia Recovery Planning Team.* The recovery planning team includes state, Federal, Tribal, and watershed council technical representatives across the DPS. The team provided technical guidance and assisted in writing different aspects of the plan.

- *Management Action Teams.* The three management action teams include local experts representing state and federal natural resource agencies, the tribes, watershed councils and Portland General Electric. The teams developed management actions for the ten steelhead populations.

Involvement by these different entities helps ensure that recovery goals and actions are consistent and compatible with the goals and direction adopted in related efforts. This integrated approach establishes partnerships that allow actions to be implemented effectively and efficiently.

Plan Review, Revision, Adoption and Implementation
Drafts of the Oregon Mid-C steelhead recovery plan were posted on the NMFS Web site to provide an opportunity for informal public response during the development phase. The initial 2005 draft was a framework and progress report intended to keep the interested reader abreast of the development of the draft plan. The 2007 draft was the first complete draft available for review.

This is the second complete draft of the recovery plan. It will be refined following extensive review, including a formal period of public comment through Federal and State processes, by public agencies, environmental organizations, landowners, interested public and other stakeholders. In spring 2009 the draft recovery plan will be revised and published in final form for public reference and use.

Once this recovery plan is approved, all federal and nonfederal funding entities should develop a coordinated, prioritized, and accountable funding strategy. To facilitate implementation, NMFS intends to provide streamlined regulatory assurances for actions that are undertaken to implement recovery. Adaptive management including a comprehensive monitoring, evaluation and research component will be a high priority during the recovery effort. Adjustments to on the ground actions in response to new information will be incorporated as we learn from our successes and failures. The challenges of salmon recovery are immense, particularly in the face of increasing human populations and heavy demand for precious resources such as sufficient clean water. It will be important to monitor the benefits and costs of completed actions and to work in a collaborative forum to tackle the hard issues to come.

3.2 Overview of Recovery Goals

A simplified way of looking at species recovery includes addressing those factors that lead to the species being listed. Section 4(a) (1) of the ESA and NMFS' implementing regulations (50 CFR part 424) set forth procedures for listing species. The Secretary of Commerce (Secretary) must determine, through the regulatory process, if a species is endangered or threatened because of any one or a combination of the following factors: (1) The present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; or (5) other natural or human-made factors affecting its continued existence. NMFS has previously detailed the impacts of various factors contributing to the decline of Pacific salmon and *O. mykiss* (e.g., citations for ESU listing determinations;

NMFS 1997c, ‘‘Factors Contributing to the Decline of Chinook Salmon—An Addendum to the 1996 West Coast Steelhead Factors for Decline Report;’’ NMFS 1996a, ‘‘Factors for Decline—A Supplement to the Notice of Determination for West Coast Steelhead Under the Endangered Species Act’’). The Federal Register notices and technical reports concluded that all of the factors identified in section 4(a)(1) of the ESA have played a role in the decline of West Coast salmon and *O. mykiss* ESUs/DPSs. The Federal Register notices and technical reports provide a more detailed treatment of the relevant factors for decline for specific ESUs/DPSs. The following discussion briefly summarizes findings regarding the principal factors for decline across the range of West Coast salmon and *O. mykiss*. While these factors are treated in general terms, it is important to underscore that impacts from certain factors are more acute for specific ESUs/DPSs.

1. *The present or threatened destruction, modification, or curtailment of its habitat or range*: West Coast salmon and *O. mykiss* have experienced declines in abundance over the past several decades as a result of loss, damage or change to their natural environment. Water diversions for agriculture, flood control, domestic, and hydropower purposes have greatly reduced or eliminated historically accessible habitat and degraded remaining habitat. Forestry, agriculture, mining, and urbanization have degraded, simplified, and fragmented habitat. Studies indicate that in most western states, about 80 to 90 percent of the historical riparian habitat has been eliminated (Botkin et al. 1995). The destruction or modification of estuarine areas has resulted in the loss of important rearing and migration habitats. Losses of habitat complexity and habitat fragmentation have also contributed to the decline of West Coast salmonids. Sedimentation from extensive and intensive land use activities (e.g., forest practices, roads, livestock grazing, and urbanization) is recognized as a primary cause of habitat degradation throughout the range of West Coast salmon and *O. mykiss*.

   Water quality impairment that affects spawning, migration and rearing is a problem in many areas that were historically suitable rearing and spawning habitat. Summer stream temperature is the primary water quality problem for Mid-C steelhead, and many stream reaches are listed on the Clean Water Act (CWA) 303(d) list for water temperature. Contaminants such as insecticides and herbicides from agricultural run-off and heavy metals from mine waste are common in some areas of designated critical habitat for this DPS.

   Low summer streamflows are also a common characteristic affecting spawning, rearing, and migration. Withdrawal and storage of natural streamflow—and land use practices that reduced water storage on uplands, floodplains and riparian areas—have altered the natural pattern of flows over the seasons and caused inadequate flow, scouring flows, or other flow conditions that inhibit steelhead distribution and survival. Many stream reaches are over-appropriated under state water law at low summer flow, with more allocated water rights than existing streamflow conditions can support.
   Depending upon their natal watershed, adult and out-migrating juvenile steelhead from the Oregon portion of the Mid-Columbia River DPS encounter between one and four mainstem Columbia River dams migrating to and from the ocean. Hydroelectric development has modified natural flow regimes resulting in higher water temperatures,

changes in fish community structure, and increased travel time for migrating adults and juvenile salmonids. Physical features of dams such as turbines also kill migrating fish. The only substantial habitat blockages at present in this DPS are Pelton Dam on the Deschutes River and Condit Dam on the White Salmon River. However, smaller dams, impassable culverts, irrigation dams, and other small passage barriers occur throughout the region.

2. *Overutilization for commercial, recreational, scientific, or educational purposes*: Historically, salmon and *O. mykiss* were abundant in many western coastal and interior waters of the United States. These species have supported, and continue to support, important tribal, commercial and recreational fisheries throughout their range, contributing millions of dollars to numerous local economies, as well as providing important cultural and subsistence needs for Native Americans. Overfishing in the early days of European settlement led to the depletion of many stocks of salmonids, prior to extensive modifications and degradation of natural habitats. However, following the degradation of many west coast aquatic and riparian ecosystems, exploitation rates were higher than many populations could sustain. Therefore, harvest may have contributed to the further decline of some populations.

   Steelhead harvest or fishery impact occurs in Columbia River and tributaries sport fisheries, Columbia River Treaty Indian gillnet fisheries, Columbia River Treaty Indian subsistence fisheries, and tributary Treaty Indian subsistence fisheries. Landing records and coded wire tag analyses indicate that steelhead are not taken in significant numbers in any ocean fishery, apparently because of an offshore, high-seas distribution pattern. Non-Indian commercial fisheries for steelhead in the Columbia River have been prohibited beginning in 1975 and incidental impacts of non-Indian commercial fisheries for other species are minimal because no significant fisheries occur in the group A (see Life History section below) migration time frame.

   Columbia River sport fisheries above and below Bonneville Dam keep only marked (hatchery) fish since the late 1970's. Significant sport fisheries for steelhead between Bonneville Dam and the Deschutes River occur primarily from July through September when fish seek refuge from warm Columbia River temperatures in cool tributary mouths, primarily in Bonneville Reservoir. Steelhead are taken by treaty Indian fisheries in the Columbia River mainstem primarily in fall gillnet fisheries that target Chinook salmon from late August through October. Current steelhead harvest rates in fall treaty Indian fisheries are limited in number and through the use of large mesh gillnets, which target the larger fall Chinook. Small numbers of steelhead are also taken in various ceremonial and subsistence fisheries during the remainder of the year. These fisheries primarily occur by hook-and-line or from platforms with dip nets. Treaty Indian fisheries occur from Bonneville to McNary dams, but most of the effort is between Bonneville Dam and the Deschutes River mouth.

   Steelhead harvest or fishery impact also occurs in the Deschutes Basin sport and tribal dipnet fisheries (which occurs immediately below Sherars Falls in years when fall salmon runs are significant). The required release of wild fish, catch of many non-local fish, and

the reliance on catch record card data for catches above Sherars Falls make estimation of fishery impacts on natural-origin Deschutes River steelhead difficult.

3. *Disease or predation***:** Introductions of non-native species and habitat modifications have resulted in increased predator populations in numerous rivers and lakes. Predation by seabirds can influence the survival of juvenile salmon and *O. mykiss* in some locations. For example, it is estimated that Caspian terns (*Sterna caspia*) in the lower Columbia River and estuary consume approximately 13 percent of the outmigrating smolts reaching the estuary in some years (Collis et al. 2001). Other mainstem predation occurs from walleye (*Stizostedion Vitreum*) and California sea lions (*Zalophus californianus*) of juveniles and adults, respectively.

   Infectious disease is one of many factors that can influence adult and juvenile salmon and *O. mykiss* survival. In general, very little current or historical information exists to quantify changes in infection levels and mortality rates attributable to these diseases. Native *O. mykiss* populations have co-evolved with specific communities of these organisms, but the widespread use of artificial propagation has introduced exotic organisms not historically present in a particular watershed. Habitat conditions such as low water flows and high temperatures can exacerbate susceptibility to infectious diseases.

4. *The inadequacy of existing regulatory mechanisms*: The ESA listings of salmon ESUs and *O. mykiss* DPSs have provided the incentive for numerous protective efforts. While many causes of decline in salmon ESUs and *O. mykiss* DPSs are being addressed (e.g., providing fish passage above artificial barriers), habitat degradation and destruction have been slowed but not prevented. The protective efforts are directed toward addressing the numerous factors that adversely impact Mid-C steelhead and its habitat — water quality and quantity, safe migration, riparian vegetation, food, predation dynamics and complex stream channels, and floodplain connectivity. These actions all will aid in improving these factors within the area of each project. The recovery planning process addresses the cumulative effects of these and other protective efforts, and any additional measures necessary to address the species' factors for decline and extinction risk.

5. *Other natural or manmade factors affecting its continued existence*: Variability in ocean and freshwater conditions can have profound impacts on the productivity of salmon and *O. mykiss* populations. Natural climatic conditions have at different times exacerbated or mitigated the problems associated with degraded and altered riverine and estuarine habitats.

   Widespread presence of hatchery fish throughout the DPS was also identified as contributing to declines in population abundance. Extensive hatchery programs have been implemented throughout the range of West Coast salmon and *O. mykiss*. The Umatilla and Deschutes river systems have ongoing hatchery production programs based on locally derived broodstock. The straying of hatchery steelhead from out-of-DPS production programs poses a significant threat to several steelhead populations in the DPS. Straying of out-of-basin hatchery fish into the Deschutes River has been identified as a chronic occurrence.

3.3 Description and Taxonomy

The March 25, 1999 (64 FR 14517) listing of Mid-Columbia River steelhead was developed in response to a biological review that concluded that summer steelhead in the Mid-Columbia River ESU were "likely to become endangered in the foreseeable future" (NMFS 1999). Protective regulations for Mid-C steelhead were issued under section 4(d) of the ESA on July 10, 2000 (65 FR 42422).

The most prominent factors leading to NMFS' conclusion that Mid-C steelhead were threatened included: (1) declines in abundance of wild steelhead populations, (2) levels of abundance well below historical levels, (3) large numbers of hatchery-origin steelhead entering the Deschutes River basin, and a lack of information regarding this phenomenon, (4) large numbers of hatchery steelhead relative to wild steelhead, and a general lack of information regarding the impacts of hatchery steelhead on wild steelhead populations throughout the region, (5) a lack of information regarding the interactions between resident rainbow trout and anadromous steelhead, and (6) habitat alterations in the region resulting in a loss of spawning and rearing habitat for steelhead, including habitat changes that have exterminated some steelhead runs (Busby et al. 1996; NMFS 1999).

The Mid-Columbia River steelhead ESU included all natural populations of steelhead in streams within the Columbia River basin from above the Wind River in Washington and the Hood River in Oregon upstream to, and including, the Yakima River in Washington, excluding steelhead from the Snake River Basin. It also included resident trout populations of *O. mykiss* below impassible barriers (natural and manmade) that co-occurred with anadromous population in the Mid-Columbia River steelhead ESU (69 FR 33101 June 14, 2004). However, in January 2006, NMFS revised its species determinations for West Coast steelhead under the ESA, delineating steelhead-only Distinct Population Segments (DPSs). NMFS listed the Mid-Columbia River steelhead DPS as threatened on January 5, 2006 (71 FR 834). The Federal Register Notice contains a more complete explanation of this listing decision.

This recovery plan focuses on the anadromous from of *O. mykiss*. However, the strategic focus to restore natural ecological processes throughout the subbasins through habitat restoration and protection will provide productivity and capacity benefits for all *O. mykiss* life history forms. Protection and restoration of natural ecological processes will contribute significantly to restoring a natural balance among *O. mykiss* resident and anadromous life history forms.

Mid-C steelhead historically occupied nine major river systems within the states of Oregon and Washington on the east side of the Cascades Mountains (Figure 3-2) and numerous minor systems. These major tributaries to the Columbia River include the White Salmon, Fifteenmile Creek, Deschutes, John Day, Klickitat, Rock Creek, Umatilla, Walla Walla, and Yakima River systems. The John Day River of central Oregon probably represents the largest naturally spawning, native group of steelhead in the region.

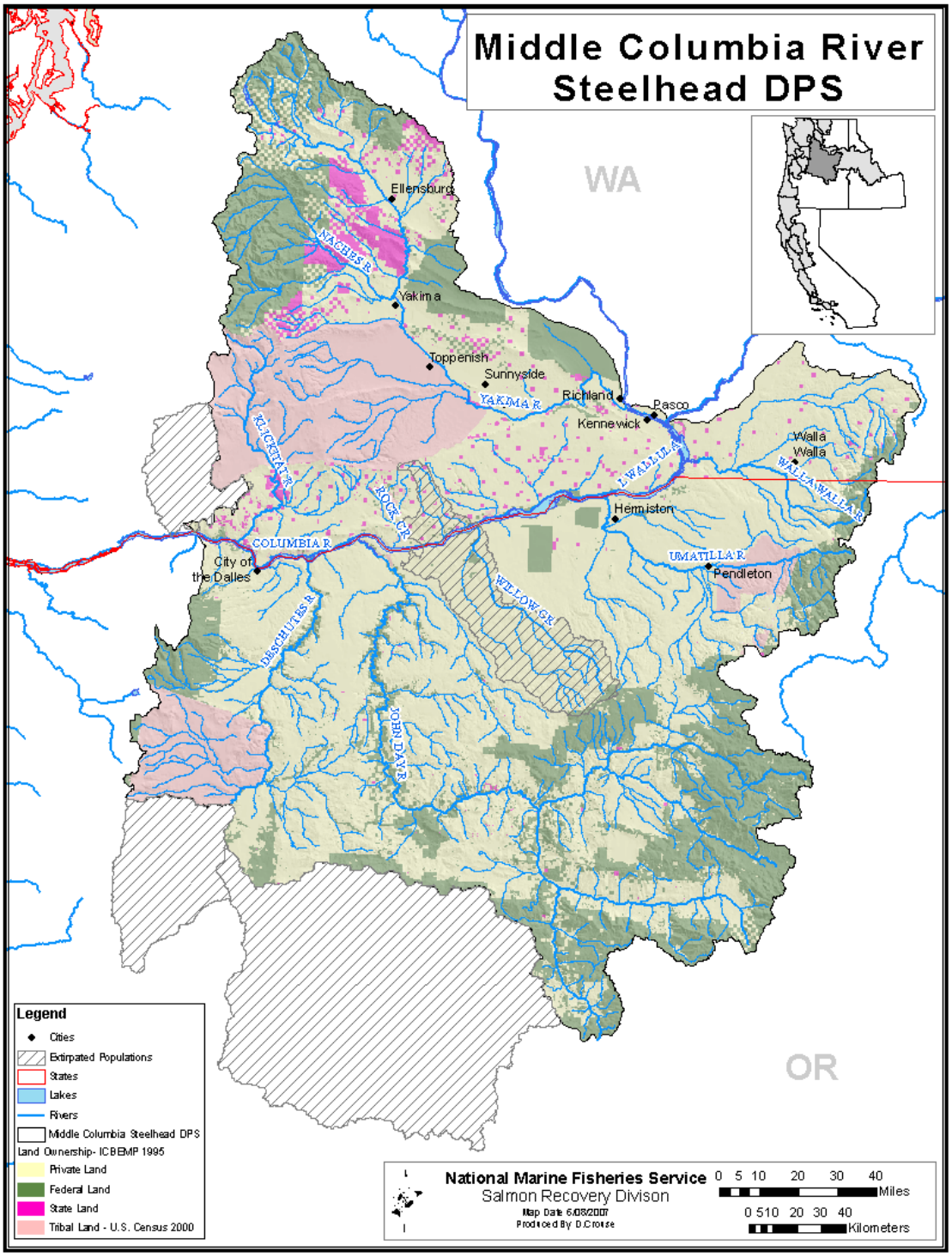


Figure 3-2. Geographic boundaries of the Middle Columbia River Steelhead DPS.

The Interior Columbia Basin Technical Recovery Team (ICTRT 2003) identified historical populations throughout the Interior Columbia River Basin (Figure 3-3). There are 17 extant populations. There are two extinct populations in the Cascades Eastern Slope Major Population

Group (MPG): the White Salmon River and Deschutes Crooked River above Pelton Dam, and one extinct population in the Umatilla/Walla Walla MPG: Willow Creek.

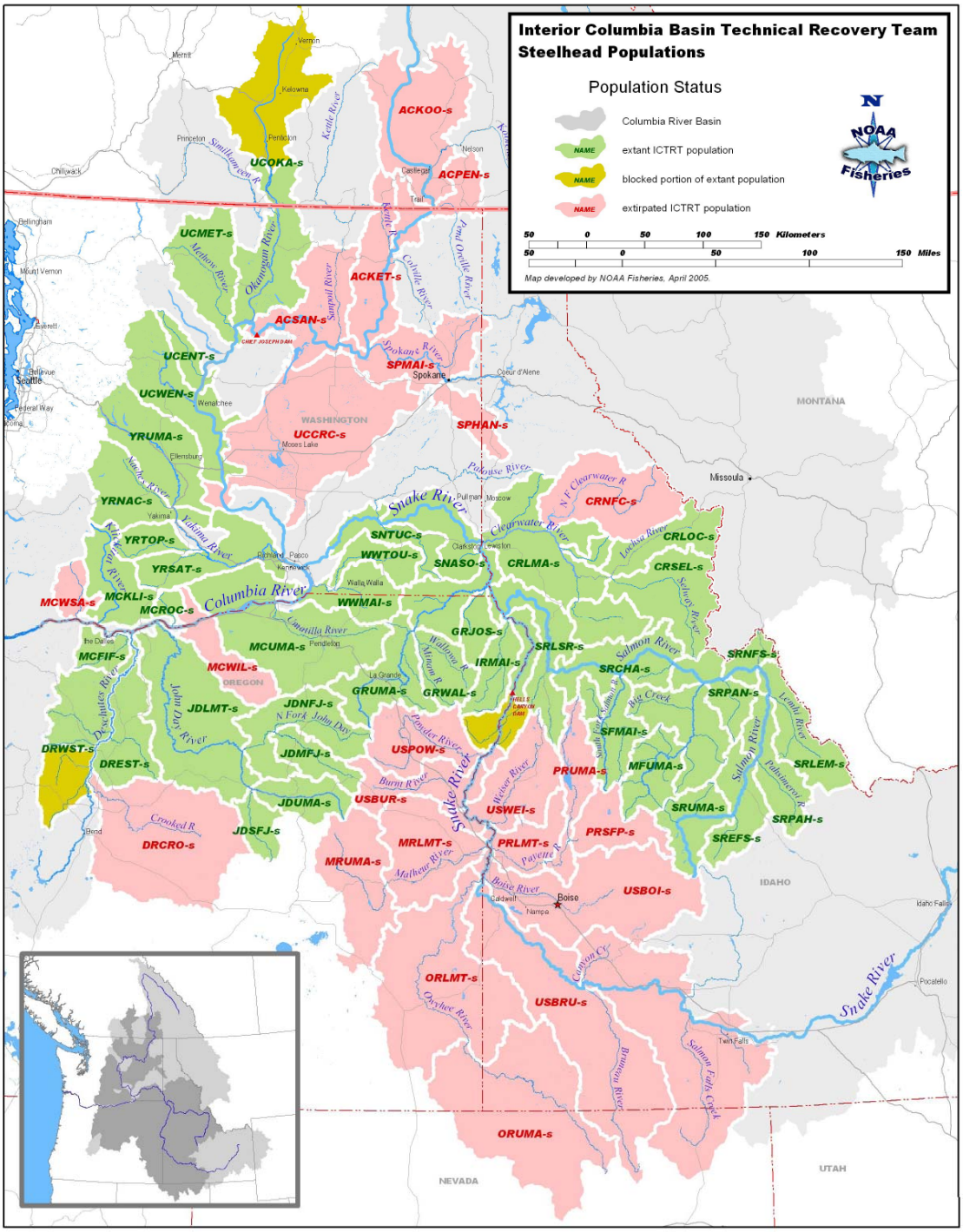


Figure 3-3. Interior Columbia River Basin steelhead populations including populations in the Middle Columbia River Steelhead DPS (ICTRT 2003).

Hatchery programs propagate steelhead in three populations and improve kelt (post spawned adult) survival in one population. No artificial programs produce the winter-run life history in the Klickitat River and Fifteenmile Creek populations. All of the DPS hatchery programs are designed to produce fish for harvest, although two are also implemented to augment the naturally spawning populations in the basins where the fish are released.

3.4 Life History

'Steelhead' is the name commonly applied to the anadromous form of the biological species *O. mykiss*. The present distribution of steelhead extends from Kamchatka in Asia, east to Alaska, and down to southern California (NMFS 1999c), although the historical range of *O. mykiss* extended at least to the Mexico border (Busby et al. 1996). *O. mykiss* exhibit perhaps the most complex suite of life history traits of any species of Pacific salmonid. They can be anadromous or freshwater residents (and under some circumstances, yield offspring of the opposite form). Those that are anadromous can spend up to seven years in fresh water before smoltification, and then spend up to three years in salt water before first spawning. This species can also spawn more than once (iteroparous), whereas all other species of Oncorhynchus except cutthroat trout (*O. clarki*) spawn once and then die (semelparous). The anadromous form of *O. mykiss* is presently under NMFS jurisdiction, while the resident freshwater forms, usually called "rainbow" or "redband" trout, are under the jurisdiction of the U.S. Fish and Wildlife Service.

Within the range of West Coast steelhead, spawning migrations occur throughout the year, with seasonal peaks of activity. In a given river basin there may be one or more peaks in migration activity; since these "runs" are usually named for the season in which the peak occurs, some rivers may have runs known as winter, spring, summer, or fall steelhead. For example, large rivers, such as the Columbia, Rogue, and Klamath rivers, have migrating adult steelhead at all times of the year. There are local variations in the names used to identify the seasonal runs of steelhead; in Northern California, some biologists have retained the use of the terms spring and fall steelhead to describe what others would call summer steelhead.

Steelhead can be divided into two basic reproductive ecotypes, based on the state of sexual maturity at the time of river entry, and duration of spawning migration (Burgner et al. 1992). The "stream-maturing" type (summer steelhead in the Pacific Northwest and Northern California) enters fresh water in a sexually immature condition between May and October and requires several months to mature and spawn. The "ocean-maturing" type (winter steelhead in the Pacific Northwest and Northern California) enters fresh water between November and April with well-developed gonads and spawns shortly thereafter. In basins with both summer and winter steelhead runs, it appears that the summer run occurs where habitat is not fully utilized by the winter run or a seasonal hydrologic barrier, such as a waterfall, separates them. Summer steelhead usually spawn farther upstream than winter steelhead (Withler 1966, Roelofs 1983, Behnke 1992). Coastal streams are dominated by winter steelhead, whereas inland steelhead of the Columbia River Basin are almost exclusively summer steelhead. Winter steelhead may have been excluded from inland areas of the Columbia River Basin by Celilo Falls or by the considerable migration distance from the ocean. The Sacramento-San Joaquin River Basin may have historically had multiple runs of steelhead that probably included both ocean-maturing and stream-maturing stocks (CDFG 1995, McEwan and Jackson 1996). These steelhead are referred

to as winter steelhead by the California Department of Fish and Game (CDFG); however, some biologists call them fall steelhead (Cramer et. al 1995). Fifteenmile Creek and the Klickitat River support the populations of winter steelhead that are furthest inland in the Columbia Basin.

Inland summer steelhead of the Columbia River Basin, especially the Snake River Subbasin, are commonly referred to as either "A-run" or "B-run." These designations are based on a bimodal migration of adult steelhead at Bonneville Dam (235 km from the mouth of the Columbia River), and differences in age (1 versus 2 years in the ocean) and adult size observed among Snake River steelhead. It is unclear, however, to what degree the life history and body size differences observed upstream are correlated back to the groups forming the bimodal migration observed at Bonneville Dam. A-run steelhead are believed to occur throughout the steelhead-bearing streams of the Snake River Basin and the inland Columbia River. B-run steelhead are thought to be produced only in the Clearwater, Middle Fork Salmon, and South Fork Salmon rivers (IDFG 1994).

Life history characteristics for Mid-C steelhead are similar to those of other inland steelhead DPSs. Most fish smolt at two years and spend one to two years in salt water before reentering freshwater, where they may remain up to a year before spawning. All steelhead upstream of The Dalles Dam are summer-run fish that enter the Columbia River from June to August. Adult steelhead ascend mainstem rivers and their tributaries throughout the winter, spawning in the late winter and early spring. Fry emergence typically occurs between May and the end of June. A nonanadromous form of *O. mykiss* co-occurs with the anadromous form in this DPS; information suggests that the two forms may not be isolated reproductively.

3.5 Critical Habitat

Critical habitat was designated on February 16, 2000 [65 FR 7764], but vacated (undesignated) by court order on April 30, 2002. On September 2, 2005, NMFS published a final rule (70 FR 52630) to designate critical habitat for Mid-C steelhead and 12 other ESUs/DPSs of salmon and steelhead. The final rule took effect on January 2, 2006. The Critical Habitat Assessment Review Team (CHART) (NMFS 2004c) rated the conservation value of all 5th-field HUCs supporting populations of Mid-C steelhead.

Essential features of designated critical habitat include substrate, water quality, water quantity, water temperature, food, riparian vegetation, access, water, velocity, space, and safe passage. These features also describe the habitat factors associated with viability for all ESUs and DPSs. The specific habitat requirements for each ESU or DPS differ by life history type and life stage.

Primary constituent elements (PCEs) consist of the physical and biological elements identified as essential to the conservation of the species in the documents identifying critical habitat (Table 3-1). Figure 3-4 depicts those streams designated critical habitat for Mid-C steelhead.

Table 3-1. Types of sites and essential physical and biological features designated as PCEs, and the life stage each PCE supports.

Site	Essential Physical and Biological Features	ESU Life Stage
Freshwater spawning	Water quality, water quantity, and substrate	Spawning, incubation, and larval development
Freshwater rearing	Water quantity and floodplain connectivity	Juvenile growth and mobility
	Water quality and forage	Juvenile development
	Natural cover[a]	Juvenile mobility and survival
Freshwater migration	Free of artificial obstructions, water quality and quantity, and natural cover[b]	Juvenile and adult mobility and survival
Estuarine areas	Free of obstruction, water quality and quantity, and salinity	Juvenile and adult physiological transitions between salt and freshwater
	Natural cover,[a] forage,[b] and water quantity	Growth and maturation
Nearshore marine areas	Free of obstruction, water quality and quantity, natural cover,[a] and forage[b]	Growth and maturation, survival
Offshore marine areas	Water quality and forage[b]	Growth and maturation

[a] Natural cover includes shade, large wood, log jams, beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

[b] Forage includes aquatic invertebrate and fish species that support growth and maturation.

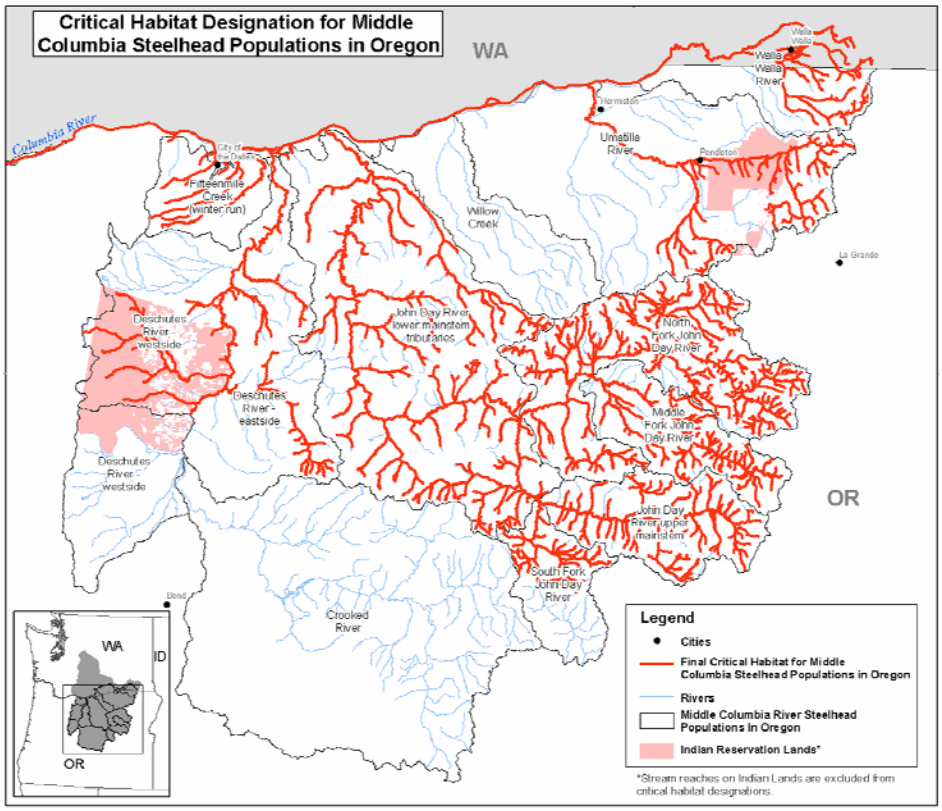


Figure 3-4. Critical habitat designated for salmon and steelhead in Oregon.

Section 4 DPS Structure

This section describes the biological hierarchical organization for the Mid-Columbia River Steelhead DPS, including major population groups and independent populations. It also discusses the characteristics that define the Mid-C steelhead populations in Oregon subbasins.

4.1 Steelhead Population Structure: A Biologically-Based Hierarchy

Steelhead organizational structure is hierarchical from the species level to a level below the population. The homing propensity, distribution across the landscape, and the diverse genetic, life history and morphological characteristics that evolve contribute significantly to the hierarchical structure and long-term persistence.

Recovery planning efforts focus on this biologically based hierarchy that spans DPSs, major groups, populations and substructure within populations, and reflects the apparent degree of connectivity between the fish in each of these hierarchical levels (Figure 4-1). Two levels in this hierarchy, the ESU or DPS and population, were formally defined for listing, delisting, and recovery planning purposes. The ICTRT identified an additional level in the hierarchy between the population and ESU levels. These three levels in the hierarchy are described below.

- **Evolutionarily Significant Unit or Distinct Population Segment:** Two criteria define a salmon ESU or steelhead DPS listed under the ESA: 1) it must be substantially reproductively isolated from other nonspecific units, and 2) it must represent an important component of the evolutionary legacy of the species (Waples 1991). ESUs and DPSs may contain multiple populations that are connected by some degree of migration, and hence may have broad geographic areas, transcending political borders.

- **Major Population Groups:** Within ESUs and DPSs, independent populations can be grouped into larger aggregates that share similar genetic, geographic (hydrographic and ecoregion), and/or habitat characteristics (ICTRT 2003). These "major groupings" are groups of populations that are isolated from one another over a longer time scale than that defining the individual populations, but which retain some degree of connectivity greater than that between ESUs or DPSs. The ICTRT defines this level in the hierarchy as Major Population Groups. These MPGs are analogous to “strata” as defined by the Lower Columbia-Upper Willamette TRT and “geographic regions” described by the Puget Sound TRT.

- **Independent Populations:** McElhany et al. (2000) defined an independent population as: *“…a group of fish of the same species that spawns in a particular lake or stream (or portion thereof) at a particular season and which, to a substantial degree, does not interbreed with fish from any other group spawning in a different place or in the same place at a different season. For our purposes, not interbreeding to a ‘substantial degree’ means that two groups are considered to be independent populations if they are isolated to such an extent that exchanges of individuals among the populations do not*

substantially affect the population dynamics or extinction risk of the independent populations over a 100-year time frame."

Independent populations are the units that will be combined to form alternative recovery scenarios for MPG and DPS viability. Ultimately, the populations are the primary units of recovery actions.

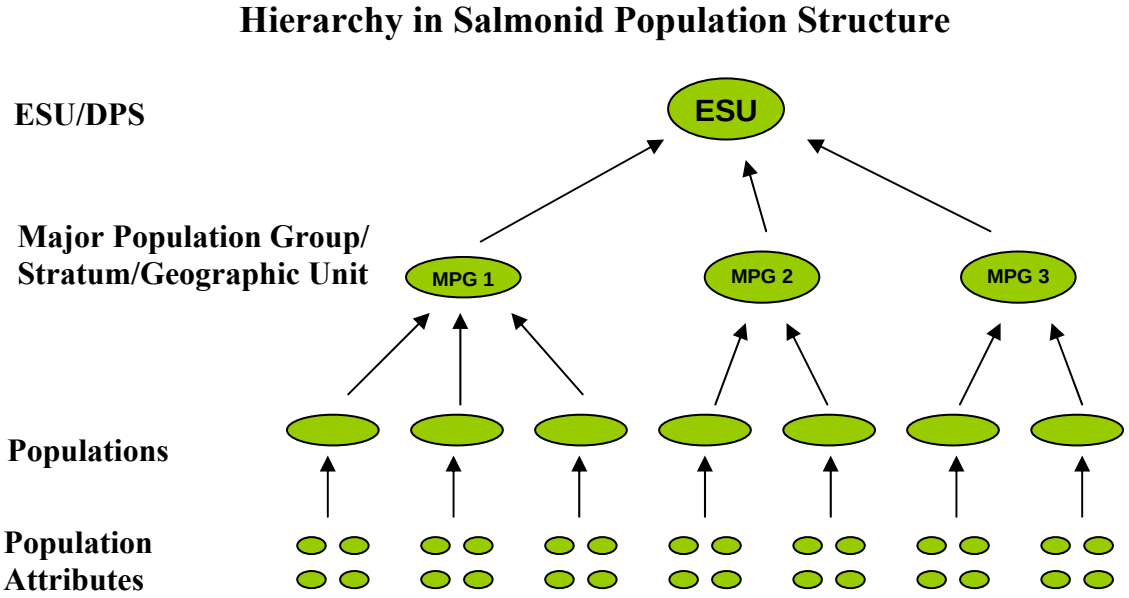


Figure 4-1. Hierarchical population structure within ESA-listed ESUs/DPSs, as identified by the TRTs.

4.1.1 Population Structure Adopted for Recovery Planning

The Oregon Department of Fish and Wildlife has adopted the DPS, Major Population Groups and population structure defined by the ICTRT for purposes of Mid-C steelhead recovery planning. These groups were defined based on genetic, geographic (hydrographic) and habitat considerations (ICTRT 2003) with guidance provided by the Viable Salmonid Populations document (McElhany et al. 2000).

Population Identification
As one of its first tasks in recovery planning, the ICTRT delineated independent populations within the listed ESUs in the Interior Columbia Basin, including those in the Mid-Columbia River steelhead DPS. This delineation of population boundaries is critical for effective conservation planning, since incorrect lumping or splitting of populations (or portions of populations) can provide an inaccurate picture of population status. Over- or underestimating the true status (Abundance/Productivity, Spatial Structure/Diversity) may lead to failed recovery efforts. Similarly, if two "true" populations are treated as a single unit, the status of one may mask the other, potentially leading to the loss of one of the populations (ICTRT 2003).

The ICTRT assessed a variety of information sources to delineate independent populations (ICTRT 2003). It initially classified major groups of populations within ESUs, and then identified independent populations within major groups. It used a variety of data types to define MPGs and independent populations; however, in no case was the entire array of desired information available to inform its decision process. It relied heavily on genetic information, distances between spawning areas related to dispersal (straying distance) as evidence of reproductive isolation, and habitat characteristics. Phenotypic (life history and morphological) characteristics were also considered for distinction at the population level. In addition, it considered two demographic factors. First, because the goal was to identify demographically independent populations, it examined the correlation in abundance time series between areas. Second, it considered historical population size in determining potential population capacity (ICTRT 2003).

Mid-Columbia River Steelhead DPS Populations

The Mid-Columbia River steelhead (*Onchorhynchus mykiss*) DPS includes all natural steelhead populations in streams within the Columbia River basin from above the Wind River in Washington and the Hood River in Oregon (exclusive), upstream to, and including, the Yakima River in Washington, excluding steelhead from the Snake River basin (71 FR 834 January 5, 2006; 64 FR 14517 March 25, 1999). Stream systems in the DPS include Rock Creek and the White Salmon, Klickitat, and Yakima rivers on the northern side of the Columbia and Fifteenmile Creek, and the Deschutes, John Day, Umatilla and Walla Walla rivers and Willow Creek on the southern side (Figure 4-2).

The ICTRT identified four Major Population Groups in the Mid-Columbia River steelhead DPS ─ Cascades Eastern Slope Tributaries, Yakima River, John Day River and Umatilla/Walla Walla Rivers (ICTRT 2003). Figure 4-3 shows these major population groups. Three of these major population groups contain Mid-C steelhead from Oregon tributaries and are addressed in this recovery plan.

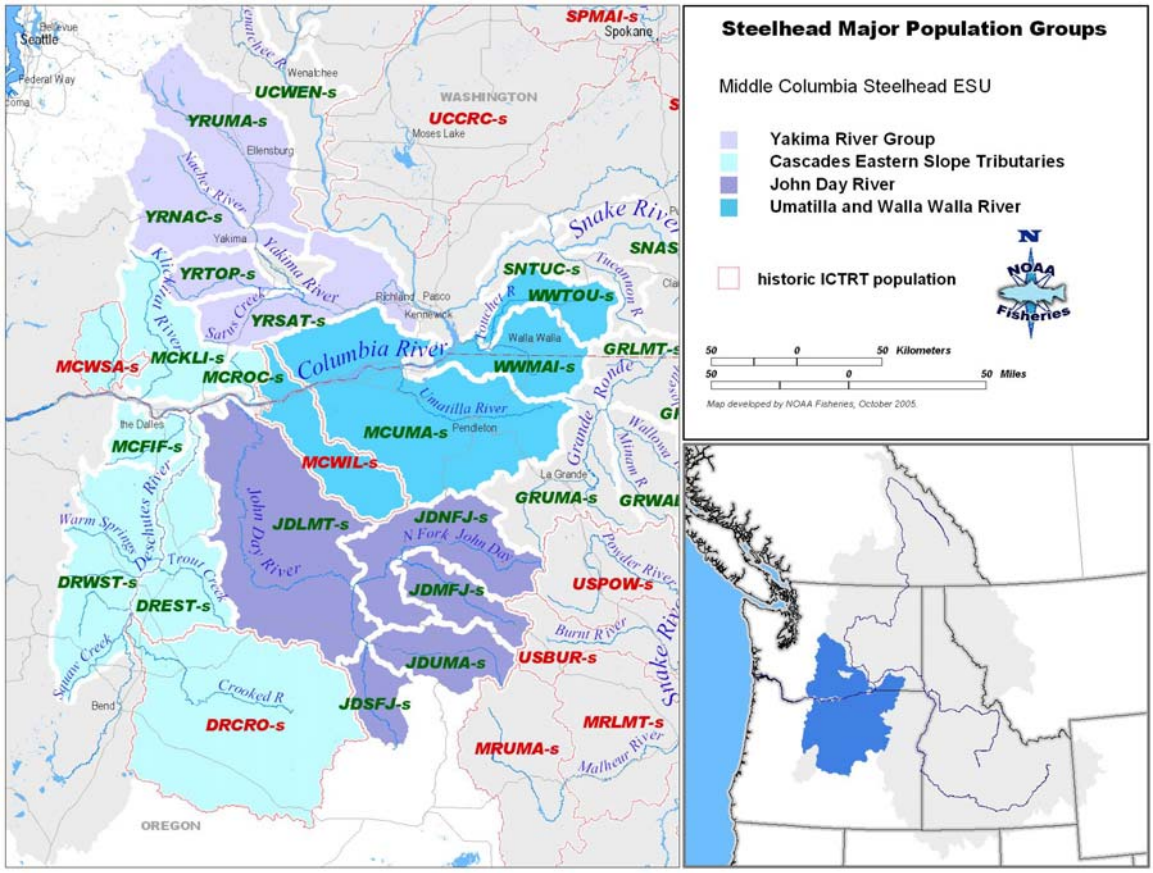


Figure 4-2. Middle Columbia River Steelhead DPS major population groups and populations.

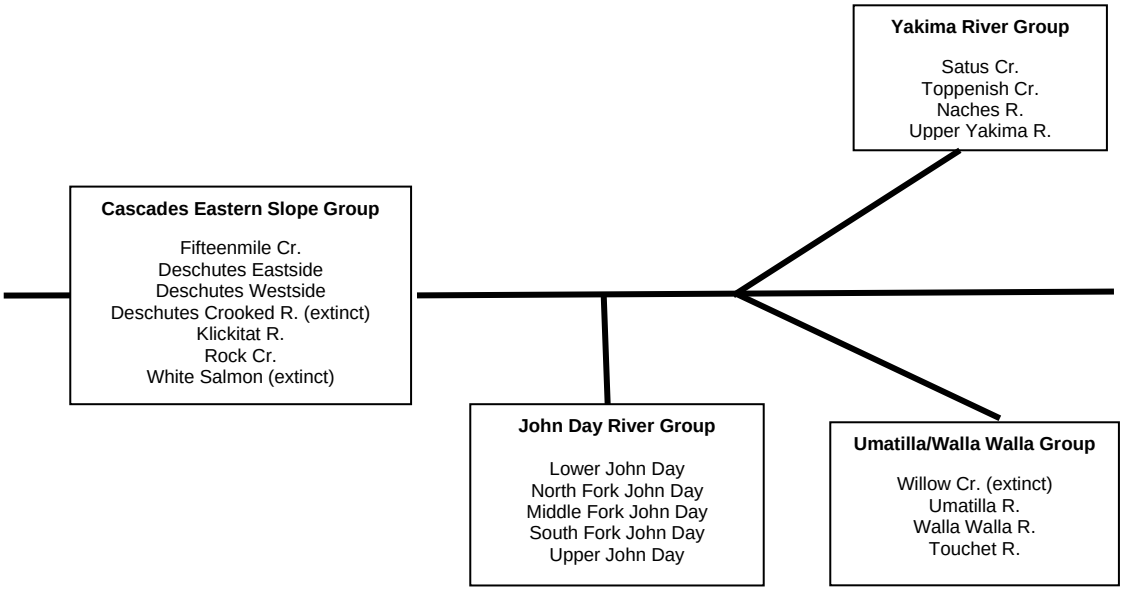


Figure 4-3. Major Population Groups and populations of the Middle Columbia River Steelhead DPS.

Together, the four major population groups in the DPS contain 17 extant and 3 extinct independent populations (ICTRT 2003). Subbasins on the Oregon side of the Columbia River historically supported 12 of the 20 populations in the Mid-Columbia River steelhead DPS. These 12 populations, the subject of this plan, include 10 extant populations: Fifteenmile Creek, Deschutes River Westside, Deschutes River Eastside, Lower Mainstem John Day, North Fork John Day, Upper Mainstem John Day, Middle Fork John Day, South Fork John Day, Umatilla River, and Walla Walla River; and 2 extinct populations: Deschutes/Crooked River and Willow Creek. Five extant populations and one extinct population of Mid-C steelhead reside on the Washington side of the Columbia River and are addressed in other recovery plans. Figure 4-4 shows the independent steelhead populations in the DPS.

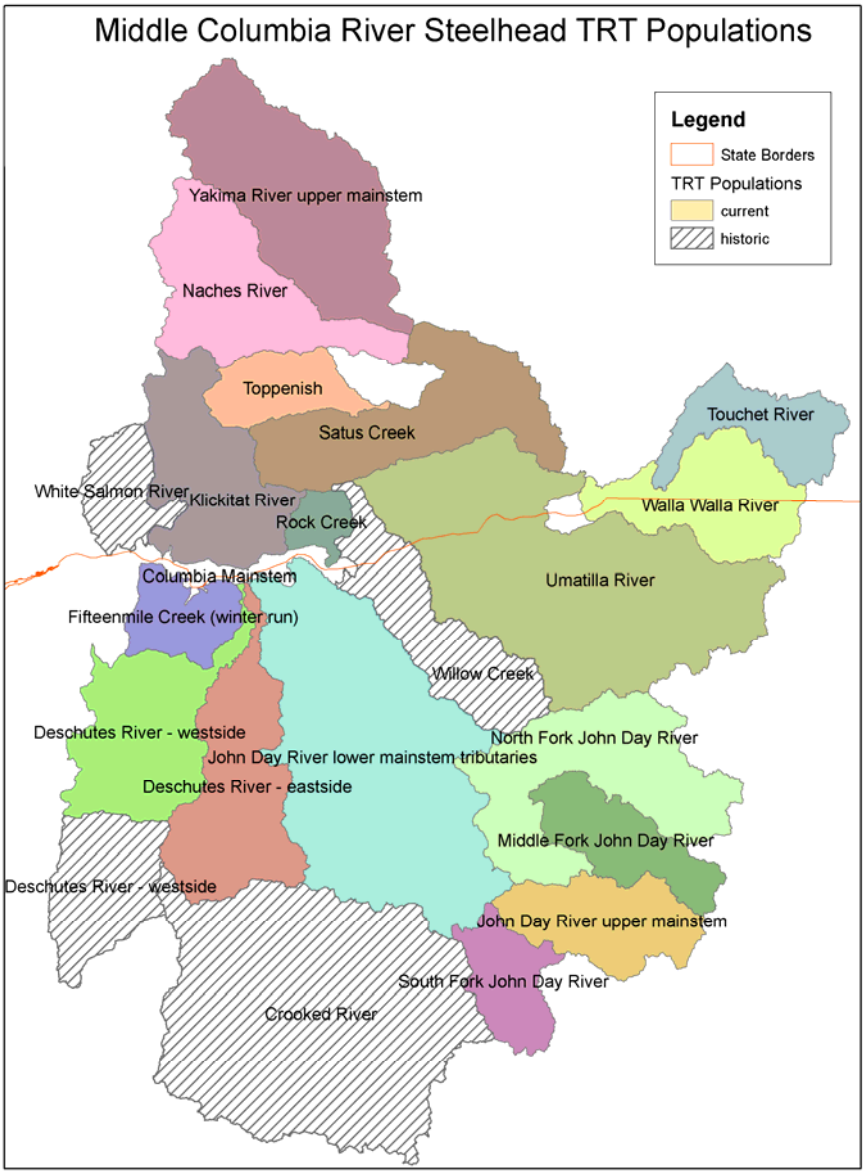


Figure 4-4. Independent populations within the Middle Columbia River Steelhead DPS.

The three major population groups that contain independent Mid-Columbia steelhead populations in Oregon subbasins are described below. These MPGs include the Cascades Eastern Slope Tributaries MPG, John Day River MPG and Walla Walla and Umatilla rivers MPG. Descriptions of the MPGs and independent populations summarize information provided in the ICTRT report *Independent Populations of Chinook, Steelhead, and Sockeye for Listed Evolutionarily Significant Units within the Interior Columbia River Domain* (ICTRT 2003) and the updated population delineation in the interior Columbia Basin memorandum (ICTRT May 11, 2005). Mid-C steelhead populations from Washington tributaries are not discussed in this document.

Cascades Eastern Slope Tributaries MPG

The Cascades Eastern Slope Tributaries MPG contains five extant populations and two extinct populations. Oregon subbasins support three of the extant populations ─ Deschutes River Westside, Deschutes River Eastside, and Fifteenmile Creek ― and historically supported the extinct Deschutes/Crooked River. Populations in the Cascades Eastern Slope Tributaries MPG are united primarily by geographic proximity. The habitats they occupy are diverse, but the constituent rivers generally drain the eastern slope of the Cascades and the dry Columbia Plateau. The MPG supports summer and winter run life history forms of steelhead.

1. *Fifteenmile Creek*: This population occupies Fifteenmile Creek and its tributaries, Fivemile, Eightmile and Ramsey creeks. It also includes five drainages outside of the Fifteenmile Creek watershed ― Threemile, Mill, Chenoweth, Mosier, and Rock creeks ― that flow directly into the Columbia River. The population is moderately segregated from other populations (22 km from the Klickitat and 37 km from the nearest spawning in the Deschutes River), and occupies somewhat different habitat. Fifteenmile Creek steelhead are exclusively winter run fish and are considered the easternmost distribution of winter steelhead in the Columbia basin. These characteristics, coupled with genetic differentiation and capacity, lead to designation as an independent population.

2. *Deschutes River Eastside*: The Deschutes River Eastside summer steelhead population occupies the mainstem Deschutes River from its mouth to the confluence of Trout Creek, and the tributaries entering the Deschutes from the east: Buck Hollow, Bakeoven, and Trout Creeks. Because of uncertainty concerning the relationship of mainstem spawners in the Deschutes River and tributaries, mainstem reaches were grouped with their respective tributary population. The population is separated from the Fifteenmile Creek population by geographic distance (37 km) and run timing (Fifteenmile steelhead are exclusively winter run fish), and from the Deschutes River Westside population because of significant habitat and life history differences. Eastside tributaries drain drier, lower elevation areas than the Westside tributaries, resulting in quite different flow and temperature patterns.

3. *Deschutes River Westside*: The Deschutes River Westside summer steelhead population boundaries encompass the mainstem Deschutes River from the mouth of Trout Creek upstream to Big Falls (current upstream barrier to anadromous fish), and tributaries entering the Deschutes from the west, including the Warm Springs River, Shitike Creek, Whychus Creek and the Metolius River. The current occupied area only includes the

mainstem from the mouth of Trout Creek upstream to Pelton Dam, the Warm Springs River, and Shitike Creek. The remaining area is blocked by the Pelton-Round Butte Complex. The population is separated from the eastside population based on habitat and life history characteristics. Nearly 50% of the habitat resides in the Ponderosa Pine-Bitterbrush Woodland ecoregion. None of the habitat in the Eastside population resides in this ecoregion.

4. *Deschutes Crooked River*: This historical population once occupied the Crooked River drainage, a major watershed in the Deschutes basin. The populations is now extinct as Pelton Dam, a hydroelectric dam at RM 100 on the Deschutes River, blocks all anadromous fish passage. The population boundaries include Crooked River and its tributaries. The population was designated based on historical capacity and distance from other populations. Ochoco Dam built on Ochoco Creek (RM 10) in 1922 and Bowman Dam built on the Crooked River mainstem in 1961 (RM 70) without passage facilities blocked migration to the upper portion of the Basin (Nehlsen 1995). Passage was abandoned at the Pelton-Round Butte Complex in 1968, and anadromous fish passage is now blocked at the Pelton Reregulating Dam (RM 100). There is a current management agreement and plan to re-establish steelhead production within the Crooked River population boundaries up to Ochoco and Bowman dams.

   There is currently (March 2007) a barrier at Opal Springs Dam on the Crooked River immediately upstream from Lake Billy Chinook (LBC) that will need to have safe upstream passage before any production of steelhead is possible within the Crooked River Basin. Opal Springs Dam is not scheduled for federal relicensing for many years. However, state and federal biologists are currently working with the licensee, Deschutes Valley Water District, to work out a plan to provide upstream passage.

John Day River MPG

The ICTRT defined the John Day River MPG as a major grouping based primarily on basin topography and distance from other MPGs. The MPG covers Oregon's John Day River drainage. It is one of the few remaining summer steelhead groups in the Interior Columbia Basin that has had no intentional influence from introduced hatchery steelhead and that has recently been classified as strong or healthy (Huntington et al.1994, Lee et al.1997). The ICTRT identified five populations in this MPG based on genetic information, demographic correlations, and habitat/ecoregion data. Spawning areas are widely distributed across tributary and mainstem habitats.

1. *Lower Mainstem John Day River*: This summer steelhead population includes tributaries to the John Day River downstream of the South Fork John Day River. This widespread population is the most differentiated ecologically from other populations, occupying the lower, drier Columbia Plateau ecoregion. Habitat divergence and distance to other populations are the primary factors in delineating this population.

2. *North Fork John Day River*: The North Fork summer steelhead population occupies the highest elevation, wettest area in the John Day basin. Population boundaries include the main stem and tributaries of the North Fork John Day River. The ICTRT defined the

population based on habitat characteristics, basin topography, and demographic patterns. The population also encompasses sufficient habitat to support an independent population. Chilcote (2001) found that the upper North Fork index count was the most divergent of the John Day stocks, indicating demographic independence.

3. *Middle Fork John Day River*: This summer steelhead population occupies the Middle Fork John Day River and all its tributaries. Spawning areas in the Middle Fork John Day River are separated substantially from all other spawning areas, except for those in the North Fork John Day. The distance between spawning habitat in this population and others combined with habitat differences between this population and the North Fork population, as well as general basin topography, led to independent population designation.

4. *South Fork John Day River*: This summer steelhead population occupies the South Fork John Day River drainage. Genetic data from South Fork John Day River *O. mykiss* samples, which likely includes the anadromous form, indicate that the population is differentiated from those in other parts of the John Day (Currens et al. 1985). This independent population was defined based on genetic information and basin topography.

5. *Upper Mainstem John Day River*: The Upper Mainstem John Day River summer steelhead population includes the mainstem John Day River and tributaries upstream from the South Fork. It is separated from the lower mainstem based on habitat differences, and from the South Fork because of topography.

Walla Walla and Umatilla Rivers MPG

The Walla Walla and Umatilla rivers form a major grouping based on shared ecological characteristics and geographic proximity. They both drain the northwestern slopes of the Blue Mountains, with lower reaches in the warmer, drier habitats of the Columbia Plateau. Within this major group, genetic information, distance between spawning aggregates and ecoregional classifications contributed to ICTRT population delineations.

1. *Umatilla River*: The Umatilla River and its tributaries are considered an independent population. Both genetic analysis (Narum and Powell 2002) and distance from other populations supports separation of this subbasin from the Walla Walla River. There is little genetic differentiation between areas within the Umatilla River subbasin and substantial connectivity between spawning areas in the subbasin.

2. *Walla Walla River*: The Walla Walla River and its tributaries (except the Touchet River) are designated as an independent population. One major tributary to the Walla Walla River, the Touchet River, was identified as a separate population. Several genetic analyses indicate that *O. mykiss* in the Touchet River are genetically distinct from other *O. mykiss* in the Walla Walla basin (Currens 1985, Currens 1997, Narum et al. 2004, Kassler et al. in review). In addition, spawners in the mainstem Walla Walla River and its tributaries are geographically distant (101 km) from those in the Touchet and those in the Umatilla River.

3. *Touchet River*: The ICTRT identified the Touchet River, which flows into the Walla Walla River, as an independent population based on genetic and geographic separation.

4. *Willow Creek*: Willow Creek is an extinct population. It was designated as an independent population based on geographic distance from other populations and capacity sufficient to support an independent population.

Section 5 Desired Status
Delisting and Broad Sense Recovery

Under the ESA, a species no longer requires protection when it is no longer in danger of extinction or likely to become endangered within the foreseeable future based on evaluation of the listing factors specified in ESA Section 4(a)(1). To remove the Mid-Columbia River Steelhead DPS from the Federal ESA list, NMFS must determine that the DPS, as evaluated under the ESA listing factors, is no longer likely to become endangered. Any new factors identified since listing must also be addressed to ensure that the species no longer requires protection as a threatened species.

The desired status for Oregon's steelhead populations in the Mid-Columbia River steelhead DPS is two-fold. First, the populations must reach desired levels of biological viability to support removal of the DPS from the threatened and endangered species list. Second, the State of Oregon and the Mid-C Sounding Board seek to rebuild the populations to provide for sustainable fisheries and other ecological, cultural and social benefits. Broader than the definition of delisting provided by the ESA, these broad sense goals incorporate many of the traditional uses, as well as rural and Native American values, deemed important in the Pacific Northwest.

This section identifies the biological viability levels and criteria Oregon Mid-C steelhead populations need to achieve to support delisting of the DPS. It discusses the approach used by the ICTRT (2007) to define these levels and the viability criteria that we applied to assess viability characteristics for each population, MPG, and the DPS. It also describes our broad sense recovery goal and objectives for the Oregon portion of the Mid-Columbia River steelhead DPS.

5.1 Delisting Goal and Criteria

Our primary goal is to support removal of the Mid-C steelhead DPS from the threatened and endangered species list. This requires that the populations must reach the levels of biological viability defined by the ICTRT and adopted by the State of Oregon in this plan as delisting criteria. In the context of recovery, delisting criteria and viability criteria are considered synonymous. Achieving ICTRT biological viability status at the population and MPG levels is needed before the DPS can be considered at low risk of extinction and a candidate for delisting.

5.1.1 Overall Approach

The ESA requires that recovery plans, to the maximum extent practicable, incorporate objective, measurable criteria that, when met, would result in a determination in accordance with the provisions of the ESA that the species be removed from the Federal List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12). The recovery criteria comprise the core standards that NMFS believes will lead to conditions upon which the decision to de-list a species will be based. The ESA's listing factors, and not the recovery plan, are the legal basis for making de-listing decisions.

One of the main tasks assigned to the NMFS's technical recovery teams for recovery planning was to recommend biologically based viability criteria for application to salmon and steelhead ESUs/DPSs listed under the ESA. Viability criteria identify characteristics and conditions that, when met, would describe viable populations and a viable ESU or DPS that no longer warrants listing. Viability criteria identify the metrics and thresholds that will be used to determine the status of a population and the viability risk.

The ICTRT's approach to recovery is based on guidance from the NMFS Technical Memorandum *Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units (*McElhany et al. 2000). This memorandum provides general direction for setting viability objectives at the ESU and component population levels. Viable salmonid population (VSP) guidelines provided by McElhany et al. (2000) address four major considerations: abundance, productivity, spatial structure and diversity. ESU or DPS level viability criteria consider the appropriate distribution and characteristics of component populations to maintain a viable ESU or DPS in the face of longer-term ecological and evolutionary processes. The Independent Scientific Advisory Board (ISAB 2007b) recently reviewed the ICTRT criteria and concluded "The proposed criteria are based on a well-reasoned and well-supported set of scientific principles and are laid out in a relatively transparent fashion with clear guidelines and examples of their application. The general approach employed by the ICTRT and the underlying understanding of conservation biology and salmon biology are scientifically defensible with no apparent conceptual gaps that might negate the defensibility of the approach."

The ICTRT's approach is consistent with related applications by the Puget Sound and Lower Columbia/Willamette TRTs and the Upper Columbia QAR, and the review of specific information for listed Interior Columbia ESU and DPS populations. The general approach identified for viability criteria has five essential elements:

Stratified Approach: Life history and ecological complexity that historically existed should have a high probability of persistence. The ICTRT stratified the Mid-Columbia River steelhead DPS into groups based on ecoregion characteristics (Eastern Cascades, Columbia plateau, John Day and Yakima), life history types (summer, winter, and summer/winter) and other geographic and genetic considerations.

Viable Populations: Some individual populations within a MPG should have persistence probabilities consistent with a high probability of MPG persistence. The ICTRT defined high persistence probability based on the presence of at least two or one-half of historical populations, whichever is greater, with a negligible risk of extinction.

Representative Populations: Representative populations need to achieve viability criteria or be maintained, but not every historical population needs to meet viability criteria. Viable combinations of populations should include "core" populations that are highly productive, "legacy" populations that represent historical genetic diversity, and dispersed populations that minimize susceptibility to catastrophic events.

Non-deterioration: No population should be allowed to deteriorate until DPS recovery is assured, and all extant populations must be maintained. The ICTRT provided specific

criteria for maintained population status. Current populations and subpopulation structure must be preserved. Recovery measures will be needed in most areas to stop further decline and offset the effects of future impacts.

Safety Factors: Higher levels of recovery should be attempted in more populations than the minimum needed to achieve DPS viability because not all attempts will be successful. Recovery efforts should target all populations, and more than the minimum population viability levels thought to ensure viability. Some populations should be highly viable.

During recovery planning, the ICTRT defined biological viability objectives at the DPS, MPG, and component population levels (McClure et al. 2003). Assessments of viability at these different levels follow guidelines and approaches recommended by the ICTRT. The ICTRT's ESU/DPS-level viability criteria are designed to assess risk for Abundance/Productivity and Spatial Structure/Diversity at the population level. Assessments are then rolled-up to the MPG and ESU levels.

5.1.2 Independent Population-level Viability Criteria

Guidelines for population-level viability (McElhany et al. 2000) state that a viable population should be large enough to:

1. have high probability of surviving environmental variation observed in the past and expected in the future;
2. be resilient to environmental and anthropogenic disturbances;
3. maintain genetic diversity; and,
4. support/provide ecosystem functions.

To address these guidelines, the ICTRT grouped specific population level criteria into two categories: measures addressing abundance and productivity, and measures addressing spatial structure/diversity considerations. It also developed a framework for compiling an aggregate risk score for a population based on the results of applying the individual criteria.

Population Abundance and Productivity

These two population performance characteristics are linked to drive extinction risk. Abundance refers to the average number of spawners in a population over a generation or more. Productivity, or population growth rate, refers to the performance of the population over time in terms of recruits produced per spawner.

Viable populations should demonstrate sufficient productivity to support a net replacement rate of 1:1 or higher at abundance levels established as long-term targets. Productivity rates at relatively low numbers of spawners should, on average, be sufficiently greater that 1.0 to allow the population to rapidly return to abundance target levels. Following guidelines from McElhany et al. (2000), the ICTRT identified the following objective for population abundance and productivity:

Abundance should be high enough that 1) in combination with intrinsic productivity, declines to critically low levels would be unlikely assuming recent historical patterns of

environmental variability; 2) compensatory processes provide resilience to the effects of short-term perturbations; and, 3) subpopulation structure is maintained (e.g., multiple spawning tributaries, spawning patches, life history patterns).

The ICTRT used the Viability Curve concept (McElhaney et al. 2003) as a framework for defining population specific abundance and productivity criteria. A viability curve describes those combinations of abundance and productivity that yield a particular extinction risk threshold. The two parameters are linked relative to extinction risks associated with environmental variability. This approach recognizes that relatively large populations are more resilient in the face of year-to-year variability in overall survival rates than smaller populations. Populations with relatively high intrinsic productivity ─ the expected ratio of spawners to their parent spawners at low levels of spawner abundance ─ are also more robust at a given level of abundance than populations with lower intrinsic productivity. Combinations of abundance and productivity are characterized by viability curves that represent specific extinction risks. Table 5-1 shows combinations of abundance and productivity that represent the 5% extinction risk viability curves for Mid-C steelhead (ICTRT 2007).

Table 5-1. Mid-Columbia River steelhead population viability curves in tabular format (return per spawner and population growth rate versions)[a] (ICTRT 2007).

Middle Columbia Steelhead Growth Rate (S/S)	Spawner to Spawner Measure Minimum Abundance by Population Size Categories				Population Growth Rate (Lambda) Measure Minimum Abundance by Population Size Categories				
	Basic	*Intermediate*	*Large*	*Very Large*	*Population Growth Rate*	*Basic*	*Intermediate*	*Large*	*Very Large*
1.1	5650	5650	5650	5650	**1.02**	48000	48000	48000	48000
1.125	4200	4200	4200	4200	**1.04**	15400	15400	15400	15400
1.13	3900	3900	3900	3900	**1.06**	6600	6600	6600	6600
1.15	3300	3300	3300	3300	**1.08**	3950	3950	3950	3950
1.175	2500	2500	2500	2500	**1.1**	2300	2300	2300	2300
1.2	2050	2050	2050	2250	**1.104**	2000	2000	2000	2250
1.25	1550	1550	1550	2250	**1.12**	1400	1400	1500	2250
1.3	1200	1200	1500	2250	**1.14**	1050	1050	1500	2250
1.35	1000	1000	1500	2250	**1.145**	1000	1000	1500	2250
1.4	800	1000	1500	2250	**1.16**	830	1000	1500	2250
1.45	660	1000	1500	2250	**1.18**	580	1000	1500	2250
1.5	570	1000	1500	2250	**1.2**	510	1000	1500	2250
1.55	520	1000	1500	2250	**1.21**	500	1000	1500	2250
1.6	500	1000	1500	2250	**1.22**	500	1000	1500	2250
1.65	500	1000	1500	2250	**1.24**	500	1000	1500	2250
1.7	500	1000	1500	2250	**1.26**	500	1000	1500	2250
1.75	500	1000	1500	2250	**1.28**	500	1000	1500	2250
1.8	500	1000	1500	2250	**1.3**	500	1000	1500	2250
1.9	500	1000	1500	2250					
2	500	1000	1500	2250					
2.1	500	1000	1500	2250					

[a] Combinations of abundance and productivity exceeding these combinations would have a projected extinction risk of less than 5% in 100 years, assuming continuation of recent (1978-present) variation in return rates. Spawner to spawner estimates generated using Hockey-Stick recruitment function and average variance (0.18), autocorrelation (0.74) and age structure (0.03 age 3; 0.46 age 4; 0.43 age 5; 0.04 age 6) for populations in the ESU. Population growth rate based estimates generated using average running sums based variance (0.17) for ESU populations.

Methodology and Analysis

The ICTRT developed viability curves representing 1%, 5%, and 25% extinction risk. Populations were grouped into four size categories ― Basic, Intermediate, Large or Very Large ― based on historical capacity, represented by the weighted intrinsic potential area within the population boundaries. The team developed a model to calculate the intrinsic spawning habitat

potential within defined populations. This approach quantified potential habitat based on the relationship of spawning use, landscape characteristics, and stream structure. A Geographic Information System (GIS) was used to compile ecological data, and for model development and output. Datasets describing spawning distribution, geomorphological features and instream habitat characteristics were crucial in developing the relationships. After spatial data acquisition, model parameters were formulated by comparing mapped salmon and steelhead spawning distribution to stream physiography and adjacent landforms.

In general, the ICTRT used spawning and habitat surveys to describe a species spatial structure by locality and density. Additionally, where site specific spawning locations were not available, we used general salmonid distributional GIS data produced by state agencies. The team then evaluated the mapped distributions against stream attributes and spatially coincident landscape features calculated from common spatial data themes. These included United States Geological Service (USGS) digital elevation models, the National Hydrography Dataset (NHD), soil data from the Natural Resources Conservation Service (NRCS), and climatic data from the National Climatic Data Center (NCDC). The 1:100,000 scale NHD layer was subdivided into a continuous series of 200-meter reaches, and this became the basic analysis unit. Using information modeled from the digital elevation models, NCDC precipitation grids, and NHD data, the ICTRT computed stream gradient, wetted and bankful width, and channel confinement, and then assigned this information to each 200-meter segment within the stream network. These attributes were concentrated into groups representing all observed combinations, which included 4 width classes, 6 gradient classes, and 3 confinement classes. Each discrete category was assessed by using statistical methods to compare the relative density of spawners observed within each group. Each habitat class was then assigned a rating of "high", "moderate", "low", or "none" in regards to spawning habitat potential (Table 5-2).

Two additional modifiers were applied to the habitat classes described in Table 5-2. First, there were some instances where stream width did not adequately address flow conditions. We found that certain streams that met general size requirements did not have appropriate flow parameters. Therefore, we assigned NHD stream velocities to our reach level data (200-meter segments) and compared these values to salmon and steelhead distributions. Where velocities fell below or above values observed within spawning locations we dropped intrinsic habitat ratings to "low." Our second qualifier incorporated sedimentation. Again, we observed streams where "moderate" or "high" intrinsic reaches (those with preferred widths, gradients, and confinement) were limited by natural environmental features. Soil erodibility was found to exhibit a negative relationship with spawning preferences. Generally, low gradient reaches within highly erodible soil complexes contain a greater potential for fine particle deposition, and hence poor spawning substrates. We identified low gradient reaches from our reach coverage and highly erodible soils from NRCS soils data. Calculations were also developed to assign mean soil erodibility to each 200-meter segment for the contributing watershed. From these assessments, we dropped low gradient reaches within highly erodible soils to a "low" intrinsic spawning potential. From the analyses described above , the ICTRT generated similar categories for all stream segments within the Interior Columbia ESUs/DPSs and assigned their corresponding habitat ratings. Reach length and width values were used to compute habitat area for all streams and we weighted the values by intrinsic spawning potential, so that "good" = (area * 1.0), "moderate" = (area * 0.5), "low" = (area * 0.25), and "none" = (area * 0.0). The ICTRT identified areas above

natural barriers and assigned these reaches a rating of "none." Natural barriers were identified through surveys from field biologists and gradient breaks computed from the DEM. Once calculated, the ICTRT summarized the weighted stream area for each population and generated size categories based on these values.

The ICTRT analyzed how weighted habitat was aggregated within populations, and labeled reaches with continuous high and moderate ratings as spawning branches. A spawning branch was defined as a stream reach with enough habitat to support 50 spawners. The accumulation of branches within populations then became the basis for defining major spawning areas (MaSAs). It also developed a process for aggregating MaSAs by evaluating the continuity of branch habitat and the spatial composition of stream junctions. A MaSA was required to have enough weighted habitat to support 500 spawners. MaSAs are an important habitat unit for assessing ecological complexity within populations, and for the spatial structure/diversity viability assessment.

Table 5-2. Habitat classes showing spawning potential by steelhead and Chinook. BF=Bankfull Width.

Habitat Factors			**Rating**	**Rating**
Stream Width	**Gradient**	**Valley Width**	**Steelhead**	**Chinook**
<3.7 m (chin) WETTED	***0 to .5***	*confined (<= 4x BF)*	**None**	**None**
<3.8 m (sthd) BANKFULL		*20x > BF > 4x*	**None**	**None**
		> 20x BF	**None**	**None**
	.5 to 1.5	*confined (<= 4x BF)*	**None**	**None**
		20x > BF > 4x	**None**	**None**
		> 20x BF	**None**	**None**
	1.5 to 4.0	*confined (<= 4x BF)*	**None**	**None**
		20x > BF > 4x	**None**	**None**
		> 20x BF	**None**	**None**
	4.0 to 7.0	*confined (<= 4x BF)*	**None**	**None**
		20x > BF > 4x	**None**	**None**
		> 20x BF	**None**	**None**
	7.0 to 15.0	*confined (<= 4x BF)*	**None**	**None**
		20x > BF > 4x	**None**	**None**
		> 20x BF	**None**	**None**
	>15.0	*confined (<= 4x BF)*	**None**	**None**
		20x > BF > 4x	**None**	**None**
		> 20x BF	**None**	**None**
3.8 to 25 m	***0 to .5***	*confined (<= 4x BF)*	**None**	**Medium**
		20x > BF > 4x	**Medium**	**High**
		> 20x BF	**Medium**	**High**
	.5 to 1.5	*confined (<= 4x BF)*	**Low**	**Low**
		20x > BF > 4x	**High**	**Medium**

Habitat Factors Stream Width	Gradient	Valley Width	Rating Steelhead	Rating Chinook
		> 20x BF	**High**	**High**
	1.5 to 4.0	*confined (<= 4x BF)*	**Low**	**Low**
		20x > BF > 4x	**High**	**Low**
		> 20x BF	**High**	**Medium**
	4.0 to 7.0	*confined (<= 4x BF)*	**None**	**None**
		20x > BF > 4x	**Low**	**Low**
		> 20x BF	**Low**	**Low**
	7.0 to 15.0	*confined (<= 4x BF)*	**None**	**None**
		20x > BF > 4x	**None**	**None**
		> 20x BF	**None**	**None**
	>15.0	*confined (<= 4x BF)*	**None**	**None**
		20x > BF > 4x	**None**	**None**
		> 20x BF	**None**	**None**
25 to 50m	***0 to .5***	*confined (<= 4x BF)*	**Low**	**None**
		> 4x BF	**Medium**	**Medium**
	.5 to 1.5	*confined (<= 4x BF)*	**Low**	**None**
		> 4x BF	**Medium**	**None**
	1.5 to 4.0	*confined (<= 4x BF)*	**Low**	**None**
		20x > BF > 4x	**Medium**	**None**
	4.0 to 7.0	*confined (<= 4x BF)*	**None**	**None**
		> 4x BF	**None**	**None**
	7.0 to 15.0	*confined (<= 4x BF)*	**None**	**None**
		> 4x BF	**None**	**None**
	>15.0	*confined (<= 4x BF)*	**None**	**None**
		> 4x BF	**None**	**None**
greater than 50m wetted	***0 to .5***	*confined (<= 4x BF)*	**Low**	**None**
		20x > BF > 4x	**None**	**None**
	.5 to 1.5	*confined (<= 4x BF)*	**Low**	**None**
		20x > BF > 4x	**None**	**None**
	1.5 to 4.0	*confined (<= 4x BF)*	**Low**	**None**
		20x > BF > 4x	**None**	**None**
	4.0 to 7.0	*confined (<= 4x BF)*	**Low**	**None**
		20x > BF > 4x	**None**	**None**
	7.0 to 15.0	*confined (<= 4x BF)*	**None**	**None**

Habitat Factors Stream Width	Gradient	Valley Width	Rating Steelhead	Rating Chinook
		20x > BF > 4x	**None**	**None**
	>15.0	*confined (<= 4x BF)*	**None**	**None**
		20x > BF > 4x	**None**	**None**

The ICTRT determined that abundance levels below 500 individuals for any population would pose unacceptable risk for inbreeding depression and other genetic concerns (ICTRT 2007), and established a minimum abundance threshold of 500 individuals for the basic size populations. Higher spawning threshold sizes were established incrementally for the three larger population sizes. Viability curves for all four size categories were truncated at the minimum abundance threshold level. Table 5-1 shows the combination of abundance and productivity values for all four size categories that yield a 5% risk of extinction. Populations were also categorized by their historical spatial distribution pattern and complexity. Table 5-3 shows population characteristics, spatial complexity designation, minimum abundance thresholds, and minimum productivity at threshold escapement needed to achieve a 95% probability of persistence over 100 years.

Table 5-3. Population characteristics and minimum abundance and productivity (at the threshold abundance level) values that represent levels needed to achieve a 95% probability of persistence over 100 years for Mid-Columbia steelhead populations in Oregon.

Population	Extant/ Extinct	Life History	Size	Spatial Category	Threshold[a] Abundance	Minimum Productivity
Cascades Eastern Slope Tributaries MPG						
Fifteenmile Creek	Extant	Winter	Basic	C-Trellis	500	1.56
Deschutes River Eastside	Extant	Summer	Intermediate	B-Dendritic	1,000	1.35
Deschutes River Westside	Extant	Summer	Large (Inter.)[b]	B-Dendritic	1,500 (1,000)	1.26 (1.35)
Deschutes Crooked River	Extinct	Summer	Very Large	B-Dendritic	2,250	1.19
John Day River MPG						
Lower Mainstem John Day River	Extant	Summer	Very Large	B-Dendritic	2,250	1.19
North Fork John Day River	Extant	Summer	Large	B-Dendritic	1,500	1.26
Middle Fork John Day River	Extant	Summer	Intermediate	B-Dendritic	1,000	1.35
South Fork John Day River	Extant	Summer	Basic	B-Dendritic	500	1.56
Upper Mainstem John Day River	Extant	Summer	Intermediate	B-Dendritic	1,000	1.35
Umatilla/Walla Walla Rivers MPG						
Willow Creek	Extinct	Summer	Intermediate	B-Dendritic	1,000	1.35
Umatilla River	Extant	Summer	Large	B-Dendritic	1,500	1.26
Walla Walla River	Extant	Summer	Intermediate	B-Dendritic	1,000	1.35

[a]Threshold abundance is the minimum abundance criteria to achieve a 5% or less risk of extinction at the minimum productivity.

[b] Large size category is for historically accessible area; intermediate size category is for currently accessible area.

The ICTRT also developed specific guidance for assessing current status relative to the Abundance/Productivity viability risk curves (ICTRT 2006). Using this guidance, mean abundance and standard error were calculated as the most recent 10-year geometric mean of natural-origin spawners. Productivity was calculated as recruits per spawner (spawner to spawner) from the 20 most recent completed brood years (less if only that was available). Only natural-origin fish were counted as recruits, and both natural-origin and hatchery-origin fish spawning naturally were counted as parents. No relative reproductive success factors were applied to hatchery parents. The team determined low abundance/productivity by limiting the data series to only include the low abundance parent population sizes. This delimiting was conducted to address the influence of density on recruits-per-spawner. It determined the median parent abundance level, and used the values equal to or less than the median in most cases. In those cases where the median was not used, it censused at 75% of the threshold. In most cases, this resulted in ten recruits-per-spawner data points. To further increase the accuracy and precision of the productivity estimate, the recruits-per-spawner values were adjusted to represent average smolt-to-adult return rates (SAR), thus reducing the variation resulting from variable smolt out-migration and marine survival. The ICTRT calculated a geometric mean and standard error from the censused, SAR adjusted recruits per spawner dataset. It used an aggregate SAR developed from Deschutes, Umatilla, Snake, and Columbia rivers SAR data sets.

The Oregon technical team used the following approach to consider uncertainty in the risk rating. The approach we selected was one of three options presented by the ICTRT (2007). Under this approach, a lower 90% confidence interval bounds was determined to compare against the viability curves. When the lower end of the 90% CI for productivity resides above the 25% risk curve, there is a 95% probability that the true value is above the 25% risk level. To be considered low risk, the point estimate must reside above the 5% risk level for abundance and productivity and the lower 90% CI bound for productivity must reside above the 25% risk level. To be considered very low risk, the point estimate for abundance and productivity must reside above the 1% risk level and there must be less than 1 in 100 chance (the lower end of the 98% CI resides above the 25% risk curve) that the true productivity value is below the 25% risk level. If the point estimate for abundance and productivity falls between the 5% and 25% risk level, then the population is considered at moderate risk regardless of where the 90% CI resides, which equates to a minimum of 50% probability that the true value is above the 25% risk level. Figure 5-1 provides an example of an Abundance/Productivity viability curve.

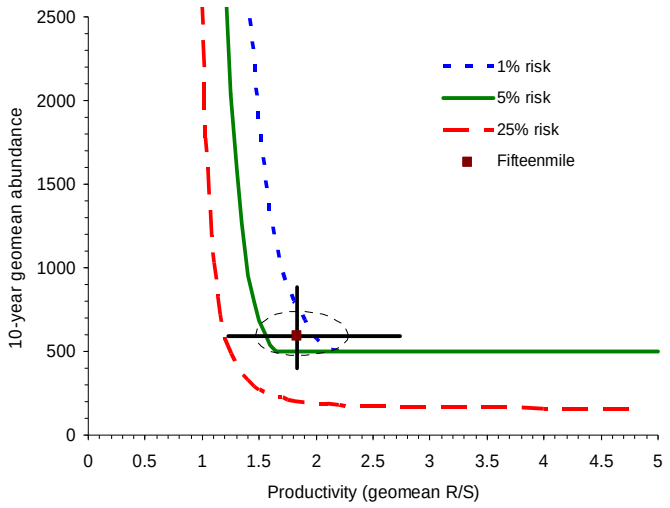


Figure 5-1. Example of Abundance/Productivity viability curves including Fifteenmile Creek current abundance productivity point estimate with standard error elipse and adjusted standard error bounds.

Population Spatial Structure and Diversity

Spatial structure and diversity considerations are combined in the evaluation because they are closely integrated. Spatial structure concerns a population's geographic distribution and the processes that affect that distribution. Diversity refers to the distribution of genetic, life history and phenotypic variation within and among populations.

Distribution influences a population's viability because populations with restricted distribution and few spawning areas are at a higher risk of extinction due to catastrophic environmental events than are populations with more widespread and complex spatial structures. A population with a complex spatial structure, including multiple spawning areas, may experience more opportunity for gene flow, developmental substructure, and life history diversity.

Population-level diversity is similarly important for long-term persistence. Populations exhibiting greater diversity are generally more resilient to short-term and long-term environmental changes. Phenotypic and life history diversity allow populations to use a wider array of environments and protect populations against short-term temporal and spatial environmental changes. Underlying diversity provides the ability to survive long-term environmental changes.

McElhany et al. (2000) provide a number of guidelines for the spatial structure and diversity of viable salmonid populations that consider these principles (Figure 5-2).

Spatial Structure

1. Habitat patches should not be destroyed faster than they are naturally created.
2. Natural rates of straying among subpopulations should not be substantially increased or decreased by human actions.
3. Some habitat patches should be maintained that appear to be suitable or marginally suitable, but currently contain no fish.
4. Source subpopulations should be maintained.
5. Analyses of population spatial processes should take uncertainty into account.

Diversity

1. Human-caused factors such as habitat changes, harvest pressures, artificial propagation, and exotic species introduction should not substantially alter variation in traits such as run timing, age structure, size, fecundity, morphology, behavior, and molecular genetic characteristics.
2. Natural processes of dispersal should be maintained. Human-caused factors should not substantially alter the rate of gene flow among populations.
3. Natural processes that cause ecological variation should be maintained.
4. Population status evaluations should take uncertainty about requisite levels of diversity into account.

Figure 5-2. Viable salmonid population spatial structure and diversity guidelines (McElhany et al. 2000).

The ICTRT identified two primary goals that spatial structure and diversity criteria should address:

1. maintain natural rates and levels of spatially mediated processes, and
2. maintain natural patterns of variation.

The ICTRT also provided a format outlining guidelines for achieving these goals. The format identifies mechanisms, factors and metrics appropriate for assessing population status. Mechanisms are biological or ecological processes that contribute to achieving the goals (e.g., gene flow patterns affect the distribution of genotypic and phenotypic variation in a population.) Factors are characteristics of a population or its environment that influence mechanisms (e.g., gaps in spawning distribution affect patterns in gene flow.) Metrics are measured and assessed at regular intervals to determine whether a population has achieved goals or to evaluate its current risk level. Some viability metrics include variable criteria that are dependent on the spatial complexity designation of the population. Table 5-4 summarizes the associations between these goals, mechanisms, factors and metrics. Spatial complexity designations are also presented in Table 5-4.

Table 5-4. Organization of goals, mechanisms, factors and metrics for spatial structure and diversity risk rating (ICTRT 2007).

Goal	Mechanism	Factor	Metrics
A. Allowing natural rates and levels of spatially-mediated processes.	1. Maintain natural distribution of spawning areas.	a. Number and spatial arrangement of spawning areas.	Number of MaSAs, distribution of MaSAs, and quantity of habitat outside MaSAs.
		b. Spatial extent or range of population.	Proportion of historical range occupied and presence/absence of spawners in MaSAs.
		c. Increase or decrease gaps or continuities between spawning areas.	Change in occupancy of MaSAs that affects connectivity within the population.
B. Maintaining natural levels of variation.	1. Maintain natural patterns of phenotypic and genotypic expression.	a. Major life history strategies.	Distribution of major life history expression within a population.
		b. Phenotypic variation.	Reduction in variability of traits, shift in mean value of trait, loss of traits.
		c. Genetic variation.	Analysis addressing within and between population genetic variation.
	2. Maintain natural patterns of gene flow.	a. Spawner composition.	(1) Proportion of natural spawners that are unnatural out-of ESU spawners.
			(2) Proportion of natural spawners that are unnatural out-of MPG spawners.
			(3) Proportion of hatchery origin natural spawners derived from a within MPG brood stock program, or within population (not best practices) program.
			(4) Proportion of hatchery origin natural spawners derived from a local (within population) broodstock program using best management practices.
	3. Maintain occupancy in a natural variety of available habitat types.	a. Distribution of population across habitat types.	Change in occupancy across ecoregion types.
	4. Maintain integrity of natural systems.	a. Selective change in natural processes or impacts.	Ongoing anthropogenic activities inducing selective mortality or habitat change within- or out-of-population boundary.

Integrating the Four VSP Parameters

These abundance/productivity and spatial structure/diversity considerations form the centerpiece of the ICTRT's framework for assessing ESU viability (ICTRT 2007). The approach is based on guidelines in McElhany et al. (2000), the results of previous applications (i.e., Puget Sound and Lower Columbia/Willamette TRTs and Upper Columbia Qualitative Analysis Review), and a review of specific information available relative to listed Interior Columbia ESU populations.

The ICTRT integrates all four VSP parameters using a simple matrix approach (Figure 5-3). The abundance/productivity (A/P) risk level combines the abundance and productivity VSP criteria

using a viability curve. The spatial structure/diversity (SS/D) risk level integrates across 12 measures of spatial structure and diversity. The overall diversity viability rating for any population is determined using two guiding principles. First, the VSP concept (McElhany et al. 2000) provides a 5% risk criterion to define a viable population. Therefore, any population scored moderate or high risk in the abundance/productivity criteria would not meet the recommended viable standards. In addition, any population that is high risk in SS/D would not be considered viable. Second, populations with a very low rating for A/P and at least a low rating for SS/D are considered to be "Highly Viable." Populations with a low rating for A/P and a very low, low, or moderate rating for SS/D are considered "Viable." In addition, populations with a very low risk rating for A/P and a moderate rating for SS/D are also considered "Viable." This integration approach places greater emphasis on the abundance/productivity criteria. These individual ratings are then integrated to determine the viability of major population groups. The assessments of individual MPGs are aggregated to assess the DPS as a whole (ICTRT 2007).

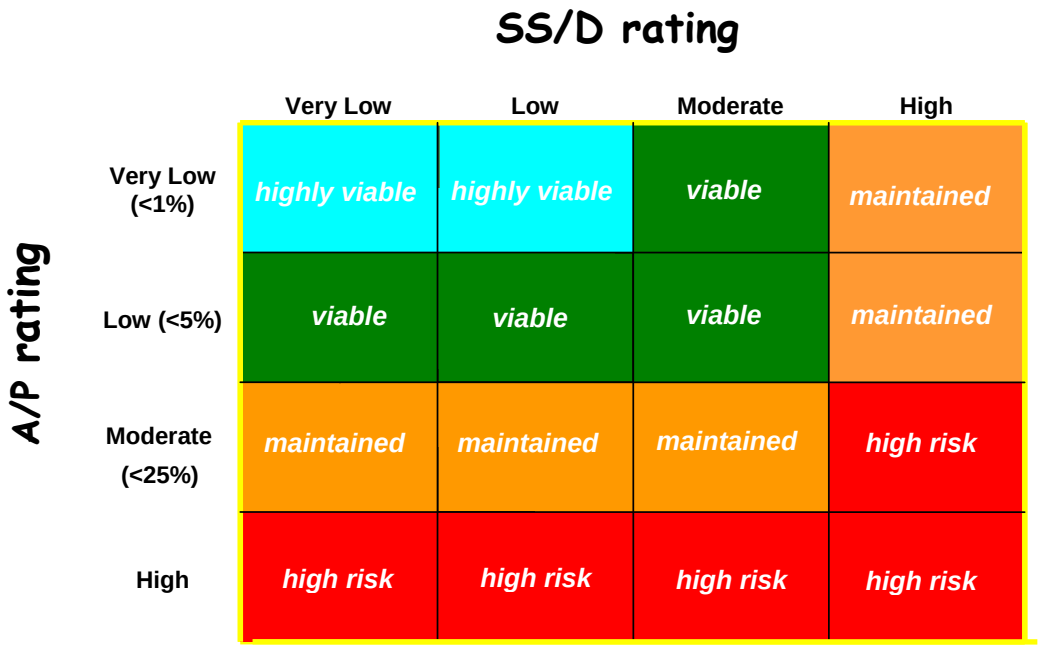


Figure 5-3. Assessing population viability across VSP criteria (ICTRT 2007).

Percentages for abundance and productivity scores represent the probability of extinction in a 100-year time period. The ICTRT used the analysis approach discussed in this section to examine the viability of independent populations in the Mid-Columbia River steelhead DPS.

5.1.3 Major Population Group Viability Criteria

The ICTRT recommended MPG-level risk criteria that assess the level of risk associated with its component populations. While individual populations meeting viability criteria are expected to have low risk of extinction, these additional MPG-level criteria ensure robust functioning of the population group and provide resilience to catastrophic loss of one or more populations. In developing these criteria, the ICTRT assumed that catastrophes do not increase dramatically in frequency, that populations are not lost permanently (due to catastrophe or anthropogenic

impacts) and that permanent reductions in productivity, including long-term, gradual reductions in productivity do not occur (ICTRT 2007). Figure 5-4 shows MPG-level viability criteria identified by the ICTRT.

MPG Viability Criteria (ICTRT 2007)

The following six criteria must be met for an MPG to be regarded as low risk (viable):

1. One-half of the populations historically within the MPG (with a minimum of two populations) must meet at least minimum viability standards.
2. At least one population must be categorized as being "Highly Viable".
3. Viable populations within an MPG must include some populations classified (based on historical intrinsic potential) as "Very Large," or "Large," and "Intermediate" in the same proportion as were present within the MPG historically.
4. Populations not meeting viability standards should be maintained with sufficient productivity that the overall MPG productivity does not fall below replacement (i.e., these areas should not serve as significant population sinks).
5. Where possible, given other MPG viability requirements, some populations meeting viability standards should be contiguous AND some populations meeting viability standards should be disjunct from each other.
6. All major life history strategies (e.g. spring and summer run timing) that were present historically within the MPG must be represented in populations meeting at least the minimum viability requirements.

Figure 5-4. MPG-level viability criteria identified by the ICTRT (ICTRT 2007).

MPG Recovery Scenarios Options

We identified the following options for the three MPGs containing Oregon Mid-C steelhead populations. The Cascades Eastern Slope Tributaries and the Umatilla/Walla Walla MPGs contain populations that reside in Oregon and Washington. Although this recovery plan deals specifically with Oregon populations, we present MPG recovery scenarios considering all populations within each MPG.

Cascades Eastern Slope Tributaries Major Population Group

This MPG contains seven populations, including four Oregon populations, shown in Table 5-5.

Table 5-5. Characteristics of steelhead populations in Cascades Eastern Slope Tributaries MPG.

Population	Extant/Extinct	Life History	Size Category
Fifteenmile Creek	Extant	Winter Run	Basic
Deschutes River Eastside	Extant	Summer Run	Intermediate
Deschutes River Westside	Extant	Summer Run	Large
Deschutes Crooked River	Extinct	Summer Run	Very Large
Klickitat River	Extant	Winter/Summer Run	Intermediate
White Salmon	Extinct	Summer Run	Intermediate
Rock Creek	Extant	Summer Run	Basic

The following ICTRT criteria are recommended for this MPG to be regarded as viable:

1. Four of the seven historical populations in the MPG meet viable criteria standards.
2. One very large/large and two intermediate size populations must be included for the MPG to have proportional representation of the Very Large/Large and Intermediate sizes. The fourth population can be any size from basic to very large.
3. At least one summer run, one winter run, and one population with winter/summer combination must be included for all of the historical major life history strategies to be represented.
4. One of the four viable populations must be highly viable.
5. All populations that do not meet viable status have to meet maintained status.

Given the above criteria, the only viability scenario for this MPG must include the following populations:

- Fifteenmile Creek—represents a winter run requirement and small size.
- Deschutes River Eastside—represents a summer run and intermediate size requirement.
- Deschutes River Westside—represents a summer run and large size requirement.
- Klickitat River—represents a winter/summer run and an intermediate size requirement.
- Rock Creek—must be maintained.

John Day River Major Population Group

This MPG contains five populations. Their characteristics are described in Table 5-6.

Table 5-6. Characteristics of steelhead populations in the John Day River MPG.

Population	Extant/Extinct	Life History	Size Category
Lower Mainstem John Day	Extant	Summer Run	Very Large
North Fork John Day	Extant	Summer Run	Large
Middle Fork John Day	Extant	Summer Run	Intermediate
South Fork John Day	Extant	Summer Run	Basic
Upper Mainstem John Day	Extant	Summer Run	Intermediate

The following ICTRT criteria are recommended for this MPG to be regarded as viable:

1. Three of the five historical populations in the MPG must meet viable criteria standards.
2. Viable populations within the MPG must include two very large/large and one intermediate size population to have proportional representation of the population sizes.
3. All major life history strategies present historically must be represented. There are only summer-run life histories.
4. One of the three viable populations must be highly viable.

5. All populations that do not meet viable status must be maintained.

Given the above criteria, a viability scenario for this MPG must include the following populations:

- Lower Mainstem John Day—represents the only population that meets the very large size requirement.
- North Fork John Day—represents a highly viable population and a large size requirement.
- Middle Fork John Day or Upper Mainstem John Day—either population could meet the second intermediate size requirement.
- South Fork John Day—must be maintained.

Umatilla/Walla Walla Rivers Major Population Group

This MPG contains four populations, including three Oregon populations, shown in Table 5-7.

Table 5-7. Characteristics of steelhead populations in Umatilla/Walla Walla Rivers MPG.

Population	Extant/Extinct	Life History	Size Category
Willow Creek	Extinct	Summer Run	Intermediate
Umatilla River	Extant	Summer Run	Large
Walla Walla River	Extant	Summer Run	Intermediate
Touchet River	Extant	Summer Run	Intermediate

The following ICTRT criteria are recommended for this MPG to be regarded as viable:

1. Two of the four historical populations in the MPG must meet viable criteria standards.
2. Viable populations within the MPG must include one large and one intermediate size populations.
3. All major life history strategies present historically must be represented. There are only summer-run life histories.
4. One of the two viable populations must be highly viable.
5. All populations that do not meet viable status must be maintained.

Given the above criteria, the following two viability scenarios are options:

- Umatilla River—this population is required to meet the large size requirement because it is the only large size population.
- Walla Walla River or Touchet River—either population could meet the second population requirement at intermediate size.

5.1.4 DPS Viability Criteria

The ICTRT determined that, because MPGs are geographically and genetically cohesive groups of populations, they are critical components of ESU/DPS-level spatial structure and diversity. Having all MPGs within the DPS at low risk provides the greatest probability of persistence for the DPS. Figure 5-5 shows DPS-level viability criteria defined by the ICTRT.

DPS-Level Viability Criteria (from Cooney et al. 2005)

1. All extant MPGs and any extirpated MPGs critical for proper functioning of the DPS must be at low risk.

2. DPSs that contained only one MPG historically or that include only one MPG critical for proper function must meet the following criteria:
    a. The single MPG must meet all the requirements to be at low risk (see above). In addition:
    b. Two-thirds or more of the populations within the MPG historically must meet minimum viability standards; AND
    c. At least two populations must meet the criteria to be "Highly Viable."

These extirpated areas will be evaluated to determine whether extirpated MPGs are critical for proper functioning of the DPS using the following considerations:

- Likely demographic (abundance and productivity) contribution of the MPG and its component populations to the DPS.
- Spatial role of the MPG in the DPS (e.g. does the extirpated MPG create a gap in the distribution of the DPS?)
- Likely contribution to overall DPS diversity (e.g. does the extirpated MPG occupy habitats that are substantially different from other habitats currently occupied in the DPS?)

Figure 5-5. DPS-level viability criteria identified by the ICTRT (ICTRT 2007).

5.2 Broad Sense Recovery Goal and Objectives

After achieving steelhead recovery under the ESA, the State of Oregon aims to rebuild Oregon's Mid-C steelhead populations to levels that will provide for sustainable fisheries and other ecological, cultural and social benefits. Although broader than the definition of delisting provided by the ESA, these broad sense goals incorporate many of the traditional uses, as well as rural and Native American values, deemed important in the Pacific Northwest.

During the recovery planning effort, the Oregon Middle Columbia Steelhead Sounding Board led the development of broad sense recovery goals for the region. The Sounding Board included citizens from all Oregon subbasins within the Mid-Columbia steelhead DPS. During the process, the board members worked with recovery planners to identify goals and objectives that would provide abundance, productivity, and diversity well above delisting levels to allow for sustainable fisheries and other cultural uses. The Sounding Board (2006) identified the following broad sense recovery goal and objectives.

Broad Sense Recovery Goal

Oregon's broad sense recovery goal for the Mid-C Steelhead is founded on a belief that citizens throughout the region value and enjoy the substantial ecological, cultural, social, and economic benefits that are derived from having healthy, diverse populations of steelhead.

> *Oregon's Mid-Columbia River natural steelhead populations are sufficiently abundant, productive, and diverse (in terms of life histories and geographic distribution) so that they provide significant ecological, social, cultural, and economic benefits.*

To achieve these benefits for current and future generations, this recovery plan aims to restore Mid-C steelhead in Oregon subbasins to the point where their protection under the ESA is no longer needed and a range of societal benefits are met. Recovery of Mid-Columbia steelhead populations will require actions that preserve, enhance and restore healthy watershed conditions where ecosystem functions, processes and dynamics are intact ─ including instream conditions, riparian habitat diversity and complexity, and upland watershed health in concert with complementary management of harvest, hatcheries and hydropower. Recovery is a process that leads to steelhead populations that are not only viable, but that also provide a harvestable surplus for the treaty tribes and for all other citizens of the region.

This vision for broad-sense recovery incorporates ESA delisting goals in the sense that delisting would be achieved *first* during an extended and stepwise process of achieving broad sense recovery goals. ESA delisting criteria are entirely science-based and establish the biologically-based standards required to sustain the DPS. In contrast, broad-sense recovery represents a level of population performance that will considerably exceed the delisting level.

Recovery Objectives
By the year 2050, proponents of the Middle Columbia River Steelhead Recovery Plan intend to achieve the following objectives:

1. Middle Columbia steelhead are viable throughout the historical range and no longer need protection under the ESA;

2. All currently extant Middle Columbia steelhead populations are highly viable;

3. Extirpated populations (e.g. Willow Creek, Crooked River) are restored in a manner that engages landowner cooperation and does not subject landowners to ESA regulation based on the presence of previously extirpated populations until the introduced populations are self-sustaining and become part of the listed DPS;

4. All extant populations of Middle Columbia steelhead are capable of contributing ecological, social, cultural, and economic benefits on a regular and sustainable basis;

5. Working in concert with existing agreements and collaboratively with landowners and resource managers NOAA will define a suite of additional land and water resource management principles and practices that when followed will alleviate liability for possible ESA regulatory consequences to landowners and resource managers;

6. Out-of-basin limiting factors are addressed equitably and in concert with in-basin limiting factors;

7. Landowners, land managers and agencies are provided with guidance on the protection and management of habitats to promote the recovery of Mid-C steelhead; and,

8. Land and resource managers work with communities and other interests in a coordinated manner to achieve broad sense recovery through a shared vision of conservation where options and choices are preserved for future generations.

A number of actions are needed to accomplish the goal and objectives:

1. Collaborative management processes and approaches, including both volunteer and incentive-based programs, encourage restoration of habitat.

2. Management actions are based on a strategic priority framework that recognizes the importance of protection, enhancement, and restoration throughout the life cycle of the species.

3. Agencies and residents employ a diversity of management approaches across the DPS that meet both social and biological objectives.

4. Landowners and resource managers are provided with information and assistance on how to accomplish recovery goals and objectives.

5. A coordinated research, monitoring, and evaluation program is in place that will facilitate periodic assessments of implementation effectiveness, population status, habitat status, and advise the need, if any, to modify future recovery management actions within an adaptive management framework.

Section 6 Current Status — Viability Assessments

This section summarizes the current status of Oregon's ten independent populations of Mid-C steelhead based on viability assessment results. It also describes the role of each population in achieving viable status at the MPG level. Detailed individual population viability assessments are presented in Appendix B. Section 5 describes the ICTRT's approach and criteria for assessing population viability. All error bars shown represent 90% confidence intervals (CI) unless otherwise indicated. In those cases where 98% CIs are shown is for the purpose of determining if uncertainty criteria for highly viable status has been met.

6.1 Fifteenmile Creek Winter Steelhead Population

The Fifteenmile Creek population occupies the Fifteenmile watershed and several smaller drainages — Rock, Mosier, Chenoweth, Mill, and Threemile — outside the Fifteenmile watershed. The population contains three MaSAs, located in the Fifteenmile Creek watershed: Upper Fifteenmile, Eightmile, and Fivemile. It also occupies five MiSAs: lower Fifteenmile, Threemile, Mill, Chenoweth, and Mosier.

The Fifteenmile Creek Winter Steelhead population is at low risk based on current abundance and productivity. Spawner abundance in recent years has been moderately variable; the most recent 10-year geomean number of natural-origin spawners was 703. During the period 1985-1999, returns per spawner in the Fifteenmile Creek population ranged from 0.37 (1987) to 5.58 (1998). The most recent 15-year (1985-1999) SAR adjusted and delimited geomean of returns per spawner was 1.82 (Appendix B).

Figure 6-1 shows the viability curve for the Fifteenmile Creek population. The Abundance/Productivity (A/P) point estimate resides above the 1% risk curve, but the population is not considered to be at very low risk because of uncertainty criteria, the 98% confidence interval (CI) extends below the 25% risk curve. However, since the 90% CI is above the 25% risk curve, the population is rated at low risk. These A/P results should be viewed with caution, as abundance and productivity estimates for the population are based on 15 years of spawner/recruit data.

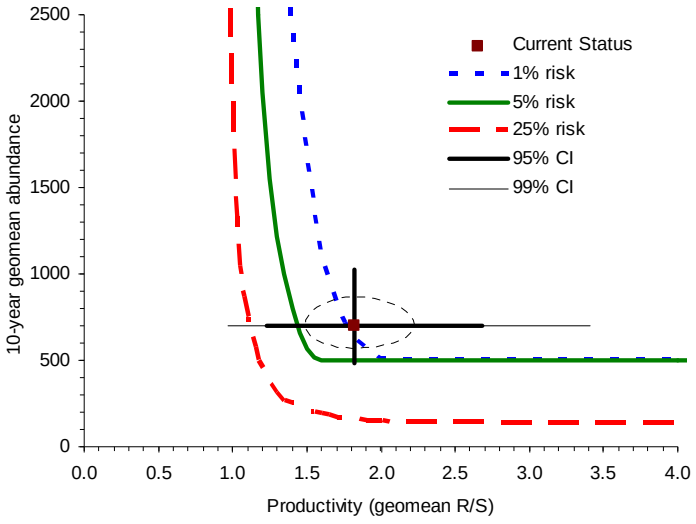


Figure 6-1. Fifteenmile Creek Winter Steelhead population abundance and productivity compared to the DPS viability curve.

The integrated Spatial Structure/Diversity (SS/D) rating is low risk for the Fifteenmile population. There has been little change in distribution relative to the historical distribution. The absence of major reductions in distribution resulted in a rating of very low risk for the spatial structure metrics. We hypothesize that there have been minor reductions in life history diversity and phenotypic variation, but these changes are not severe enough to raise risk levels to moderate. There are few hatchery fish in the population resulting in low risk for spawner composition.

Overall Risk Rating

The Fifteenmile Creek population currently meets criteria for viable status because both Abundance/Productivity and Spatial Structure/Diversity are rated at low risk. The productivity value of 1.82 is above the minimum 1.65 required at the threshold abundance, and the 10-year geomean of natural-origin spawners is well above the viable threshold of 500 for a "basic" size population. A relatively small increase in productivity and reduction in the CI are required to move this population into "highly viable" status. Additional data points will likely decrease the standard error and move the 98% confidence interval out of the high risk region. Monitoring should be continued to allow analysis of a longer data time series.

6.2 Deschutes River Eastside Summer Steelhead Population

The Deschutes River Eastside population includes the mainstem Deschutes River from the mouth to above the Pelton-Round Butte Complex at RM 100, and tributaries joining the Deschutes from the Eastside. Areas above the complex, including Willow Creek, are currently inaccessible. The population contains six MaSAs: Buck Hollow, Bakeoven, Ward/Antelope/Cold/Carp, Lower Trout, Upper Trout and Willow. It contains two MiSAs: Jones Canyon and Campbell. The Willow Creek MaSA and Campbell MiSA are in the inaccessible area above the complex.

The Deschutes River Eastside Summer Steelhead population is at low risk based on current abundance and productivity. Spawner abundance in recent years has been moderately variable; the most recent 10-year geomean number of natural-origin spawners was 1,599. During the period 1990-1999, returns per spawner for steelhead in the Deschutes River Eastside ranged from 0.24 (1991) to 3.97 (1996). The most recent 10-year (1990-1999) geomean of returns per spawner SAR adjusted and median delimited was 1.89 (Appendix B).

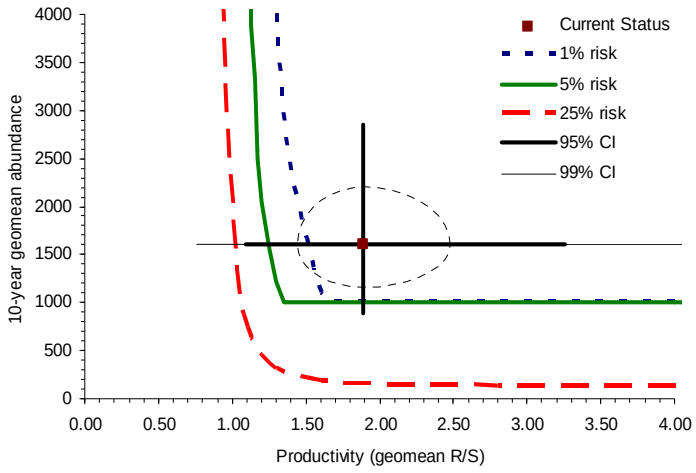


Figure 6-2. Deschutes River Eastside Summer Steelhead population abundance and productivity compared to the viability curve for the DPS.

The current point estimate for productivity on the viability curve for the Deschutes River Eastside Summer Steelhead population resides above the 1% curve, but the population is not considered to be at very low risk since the 98% CI extends below the 25% risk curve (Figure 6-2). Since the 90% CI is above the 25% risk curve, the population is rated at low risk.

The integrated Spatial Structure/Diversity rating is moderate risk for the Deschutes Eastside population. The rating for Goal A "allowing natural rates and levels of spatially mediated processes" was low risk. Although the overall rating for this goal was low, spawning distribution is reduced significantly from the historical distribution with loss of spawning in the Willow Creek drainage being the primary factor. The population remains broadly distributed with little change in gaps and good continuity within the currently accessible habitat.

The rating for Goal B "maintaining natural levels of variation" was moderate risk. Habitat changes in key tributary production areas have likely resulted in limitations to life history diversity and reduction in phenotypic expression. In addition, a significant proportion of natural spawners are out-of-DPS strays that resulted in a high risk rating for the spawner composition metric. Additional genetics information is needed to assess within and between population differentiations, and to improve our understanding of the degree of introgression of out-of-DPS strays. The ongoing genetics work of the USFWS and co-managers will provide the information needed to better assess the genetic health of this population.

Overall Risk Rating
The Deschutes River Eastside population currently meets the ICTRT recommendation for viable status. The 10-year geomean of natural fish abundance of 1,599 is well above the threshold of 1,000. The point estimate of productivity (1.89) puts the population into the very low risk region; however the 90% CI extends well below the 25% risk level. This wide standard error results in a low risk level for abundance/productivity. The spatial structure/diversity rating is moderate risk, primarily because of the influence of habitat changes on life history and phenotypic expression as well as out-of-DPS hatchery spawners.

6.3 Deschutes River Westside Summer Steelhead Population

The Deschutes River Westside population includes the mainstem Deschutes River from Trout Creek to the Pelton-Round Butte Complex at RM 100, and tributaries joining the Deschutes from the Westside. Current distribution is reduced significantly from the historical distribution because of loss of accessibility to the Metolius River and Whychus Creek drainages. Spawning is currently concentrated in the Warm Springs River and Shitike Creek, and in the mainstem Deschutes River between Trout Creek and Pelton Dam. The population contains six MaSAs (Upper Warm Springs, Mill, Beaver, Shitike, Upper Metolius and Whychus) and nine MiSAs (Lower Warm Springs, Oak Canyon, Seekseekqua, Wapinitia, Lower Warm Springs Tribs, Trahan, Eagle, Skookum, and Dry) in the historically accessible habitat.

The Deschutes River Westside Summer Steelhead population is at high risk based on current abundance and productivity. Spawner abundance in recent years has been moderately variable; the most recent 10-year geomean number of natural-origin spawners was 456, which is below the minimum abundance threshold of 1,000 spawners for an "intermediate" size population. During

the period 1980-1999, returns per spawner for steelhead in the Deschutes River Westside population ranged from 0.24 (1987) to 3.72 (1996). The most recent 20-year (1979-1998) geomean of returns per spawner SAR adjusted and delimited at 75% of threshold was 1.05 (Appendix B).

The current point estimate for Abundance/Productivity on the viability curve for the Deschutes River Westside Summer Steelhead population resides below the 25% risk curve (Figure 6-3).

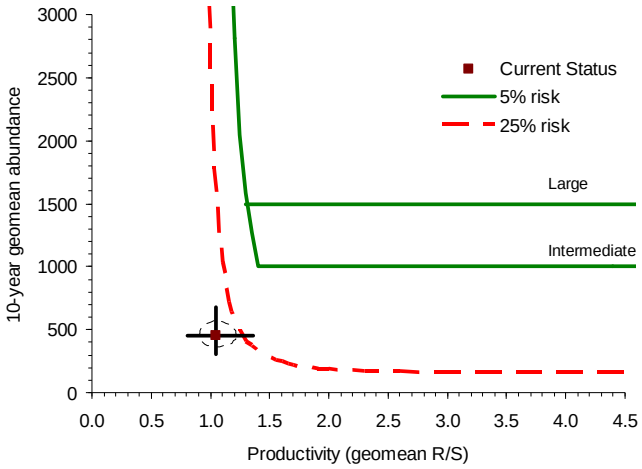


Figure 6-3. Deschutes River Westside Summer Steelhead population abundance and productivity compared to the viability curve for the DPS.

The integrated Spatial Structure/Diversity rating is high risk for the Deschutes River Westside population. The population rates at moderate risk for two of the spatial distribution metrics because the current distribution is substantially reduced from the historical intrinsic distribution due to blocked passages to areas above the Pelton-Round Butte Complex. Ratings for two metrics related to Goal B "maintaining natural patterns of variation" resulted in a moderate rating for Goal B and the overall moderate rating. Genetic variation rated moderate due to limited data and the lack of differentiation between the Deschutes samples and outside-basin hatchery samples. Samples collected in 2005-2006 will better inform the risk associated with genetic variation. The proportion of out-of-DPS hatchery strays resulted in a high risk rating for spawner composition. Most of these strays originate from the Snake River Basin.

Overall Risk Rating

The Deschutes River Westside steelhead population does not currently meet the ICTRT recommended viability criteria and is currently high risk status because the Abundance/Productivity is rated at high risk, and the Spatial Structure/Diversity rating is moderate risk. The 10-year geometric mean abundance of 456 is well below the minimum threshold of 1,000 required for an intermediate size population. The abundance of 456 is slightly below the minimum 500 recommended by the ICTRT for maintained status. A substantial increase in productivity will be required to raise the abundance/productivity values to the low risk level. The genetics information that is presently being collected will better inform the genetics variation risk level in the future. A reduction in the out-of-ESU hatchery stray proportion will be needed to reduce the risk rating for the spawner composition metric.

6.4 Lower Mainstem John Day River Summer Steelhead Population

The Lower Mainstem John Day River population occupies the Lower John Day watershed below the town of Dayville at the mouth of the South Fork John Day River. Steelhead in the Lower Mainstem John Day River population spawn in tributary streams connected by the lower John Day River, including Bridge, Butte, Thirtymile, Service, Mountain and Rock creeks. Multiple smaller drainages also support production. The population contains 11 MaSAs and 19 MiSAs. MaSAs include: Bridge, Mountain, Cottonwood, Middle Rock, Upper Rock, Pine Hollow, Lone Rock, Thirtymile, Butte, Hay, and Grass Valley. MiSAs include: Esau Canyon, Kahler, Jackknife, Pine (John Day), Service, Ferry, Rhodes Canyon, Rowe, Currant, Johnson (John Day), Shoofly, Girds, Cherry, Bologna, Buckhorn, Cottonwood Canyon, Lower Rock 1, Lower Rock 2, and Haystack.

The Lower Mainstem John Day River Summer Steelhead population is at moderate risk based on current abundance and productivity. Spawner abundance in recent years has been highly variable; the most recent 10-year geomean number of natural-origin spawners was 1,800. During the period 1975-1997, returns per spawner for steelhead in the population ranged from 0.14 (1987) to 17.5 (1979). The most recent 19-year (1980-1998) SAR adjusted and delimited geomean of returns per spawner was 2.99 (Appendix B).

The population's productivity is at very low risk. The current point estimate for productivity on the viability curve is above very low risk and the lower end of the adjusted standard error is above the 5% risk level. The abundance is moderate risk because it resides between the 5% and 25% risk levels (Figure 6-4).

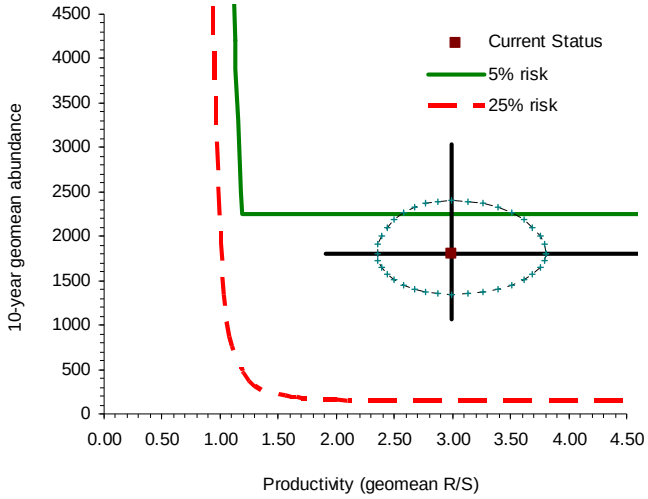


Figure 6-4. Lower Mainstem John Day River Summer Steelhead population abundance and productivity compared to the viability curve for the DPS.

The integrated Spatial Structure/Diversity rating is moderate risk for the Lower Mainstem John Day River population. The rating for Goal A "allowing natural rates and level of spatially mediated processes" was very low. The current spawner distribution is similar to historical with all MaSAs occupied. The MiSAs that are currently unoccupied have little influence on gaps and continuity, and spawners are spread over a very broad geographic area. The rating for Goal B "maintaining natural levels of variation" was moderate risk. This rating was a result of moderate risk for life history and genetic variation, and high risk for spawner composition out-of-DPS hatchery strays. The magnitude and trend in out-of-DPS hatchery strays are of significant

concern. Analysis of genetics information will yield considerable insight into the population's genetic variation and characteristics. Examining genetics data for evidence of hatchery introgression will be useful for future spatial structure/diversity risk assessments.

Overall Risk Rating

With a moderate rating for Abundance/Productivity and a moderate rating for Spatial Structure/Diversity, the Lower Mainstem John Day River Summer Steelhead population does not currently achieve an overall rating of viable according to ICTRT criteria, although it does meet the criteria for a "maintained" population with abundance well above the 500 minimum recommended by the ICTRT for maintained status. To achieve a viable rating, this population must improve in both Abundance/Productivity and Spatial Structure/Diversity. Out-of-DPS origin spawners are the most influential factor on Diversity Risk. Additional population specific data are needed to better quantify the spawner composition in this population to reduce the uncertainty associated with this risk metric.

6.5 North Fork John Day River Summer Steelhead Population

The North Fork John Day is the largest tributary to the John Day River. The North Fork John Day River population contains eight MaSAs: Lower North Fork John Day, Potamus, Big Wall, Big, Upper North Fork John Day, Desolation, Granite and Owens. It contains seven MiSAs: Meadow Brook, Fivemile (North Fork), Ditch, Cabin, Meadow (North Fork), Cabin (North Fork) and Bridge (North Fork). Spawning is distributed broadly throughout the population boundaries including mainstem areas of Cottonwood, Camas, Desolation, and Granite creeks, and the Upper North Fork John Day River, as well as in many tributaries.

The North Fork John Day River Summer Steelhead population is at very low risk based on current abundance and productivity. Spawner abundance in recent years has been moderately variable; the most recent 10-year geomean number of natural-origin spawners was 1,740 (1,898 total spawners). During the period 1973-1997, returns per spawner for steelhead in the North Fork John Day River ranged from 0.10 (1985) to 3.07 (1991). The most recent 20-year (1978-1997) SAR adjusted and delimited geomean of returns per spawner was 2.41 (Appendix B).

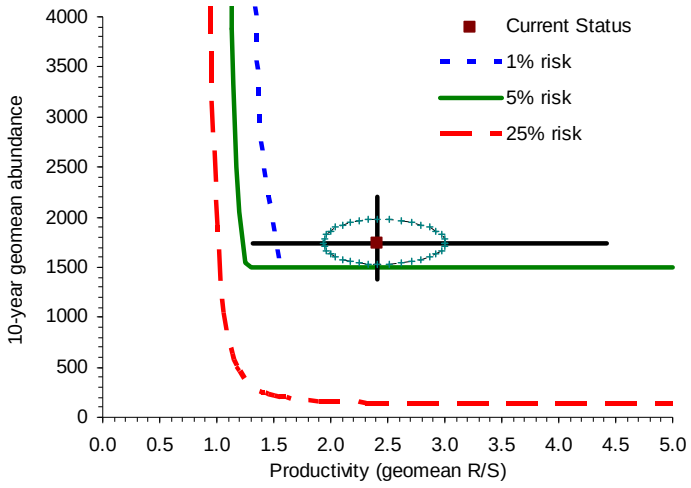


Figure 6-5. North Fork John Day River Summer Steelhead population abundance and productivity compared to the viability curve for the DPS.

The current point estimate for Abundance/Productivity on the viability curve for the population resides above the 1% risk curve and the 98% confidence interval for productivity is above the 25% risk curve (Figure 6-5). The productivity value of 2.41 is well above the minimum needed at threshold abundance, and the abundance of 1,740 is above the 1,500 threshold for a "large" size population.

The combined integrated Spatial Structure/Diversity rating is low risk for the North Fork John Day population. The rating for Goal A "allowing natural rates and level of spatially mediated processes" was very low. The current spawner distribution mimics the intrinsic distribution. The population is distributed broadly across the landscape in numerous MaSAs and MiSAs. Good continuity exists between spawning areas and current gaps between spawning areas are similar to historical gaps. The rating for Goal B "maintaining natural levels of variation" was low risk. However, there remains considerable uncertainty about the ratings for genetic variation and out-of-DPS hatchery strays in the natural spawners. Additional genetic analyses and interpretation is needed to determine if the genetic variation is similar to historical conditions and to examine evidence for degree of stray hatchery fish introgression. We rated the metric for out-of-DPS hatchery strays as very high. The data used for this rating are a composite from four John Day populations. Additional population specific spawner composition data are needed to improve the certainty of the out-of-DPS stray hatchery risk rating. If there is significant hatchery introgression that is affecting the genetic variation through time, the risk rating for "genetic variation" will increase and the overall risk rating for Goal B and Spatial Structure/Diversity will also increase.

Overall Risk Rating
The overall viability rating for the North Fork John Day River Summer Steelhead population is highly viable as a result of the Abundance/Productivity rating of very low risk, and the Spatial Structure/Diversity rating of low risk. The productivity value of 2.41 is well above the minimum needed at threshold abundance, and the abundance of 1,740 is above the minimum of 1,500 natural-origin spawners for a large size population. The Spatial Structure/Diversity metric ratings for genetic variation and out-of-DPS hatchery-origin spawner composition were the most influential on the overall Spatial Structure/Diversity assessment. There is considerable uncertainty regarding the genetic effect of out-of-DPS strays as well as the actual proportion of natural spawners that are hatchery strays. Enhanced monitoring efforts should be undertaken to develop better estimates of the composition of North Fork John Day spawners.

6.6 Middle Fork John Day River Summer Steelhead Population

The Middle Fork John Day population contains two MaSAs, Middle Fork John Day and Long Creek; it does not contain any MiSAs. Spawning is distributed broadly throughout the population boundaries, including mainstem areas in the lower and upper Middle Fork John Day and Long Creek. There are numerous tributary spawning streams distributed from the lower end of the population boundary to the uppermost reaches.

The Middle Fork John Day River Summer Steelhead population is at moderate risk based on current abundance and productivity. Spawner abundance in recent years has been moderately variable; the most recent 10-year geomean number of natural-origin spawners was 756. During

the period 1969-1998, returns per spawner for steelhead in the Middle Fork John Day River ranged from 0.17 (1992) to 3.84 (1997). The most recent 20-year (1979-1998) geomean of returns per spawner SAR adjusted and delimited was 2.45 (Appendix B).

The current point estimate for Abundance/Productivity on the viability curve for the Middle Fork John Day River summer steelhead population is between 5% and 25% risk curves. This productivity is well above the minimum required at threshold abundance; however, abundance is below the threshold (Figure 6-6).

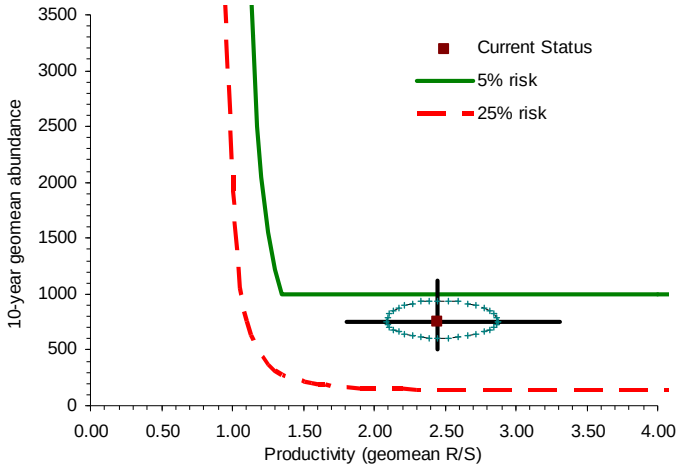


Figure 6-6. Middle Fork John Day River Summer Steelhead population abundance and productivity compared to the viability curve for the DPS.

The integrated Spatial Structure/Diversity rating is low risk for the Middle Fork population. The rating for Goal A "allowing natural rates and levels of spatially mediated processes" was between very low and low risk. The current spawner distribution of the Middle Fork population mimics the intrinsic distribution. The population is distributed broadly across the landscape, in both MaSAs with adequate gaps and good continuity between spawning areas. The rating for Goal B "maintaining natural levels of variation" was low risk. However, additional genetics analyses are needed to better assess genetic variation and hatchery introgression. This population was rated high risk for proportion of out-of-DPS hatchery strays based on a limited time series of composite John Day population data. Better population specific spawner composition data are needed to better understand the out-of-DPS hatchery stray influence. If there is significant hatchery introgression that affects genetic variation through time, then the risk rating will increase, thus raising the overall risk rating for Goal B and the overall rating for Spatial Structure/Diversity.

Overall Risk Rating

The Middle Fork John Day River Summer Steelhead population does not currently meet the ICTRT criteria for viable status, although it does meet the criteria for a "maintained" population because the abundance is well above the minimum of 500 natural-origin spawners for maintained status. The productivity point estimate of 2.45, as well as the lower end of the adjusted standard error, met the low risk criteria. The abundance of 756 is only 75.6% of the minimum threshold criteria of 1,000 natural-origin spawners for an intermediate size population. Increased annual abundance would allow this population to achieve a risk rating of low for abundance/productivity and raise the overall viability rating to viable.

6.7 South Fork John Day River Summer Steelhead Population

Steelhead spawn, rear, and migrate through the lower South Fork John Day River up to Izee Falls, a natural barrier at RM 28.5, and into Murderers Creek, Canyon Creek and other tributaries. The population contains three MaSAs (Upper South Fork John Day, Lower South Fork John Day and Murderers Creek) and no MiSAs.

The South Fork John Day River Steelhead population is at moderate risk based on current abundance and productivity. Spawner abundance in recent years has been moderately variable; the most recent 10-year geomean number of natural-origin spawners was 259. During the period 1961-1998, returns per spawner for steelhead in the South Fork John Day River ranged from 0.20 (1987) to 13.54 (1968). The most recent 20-year (1979-1998) geomean of returns per spawner, adjusted for marine survival and delimited, was 2.06 (Appendix B).

The current point estimate for Abundance/Productivity on the viability curve for the South Fork John Day River summer steelhead population resides between the 25% and 5% viability curves. The lower bound of the adjusted standard error for both the productivity and abundance extend below the 25% risk level (Figure 6-7).

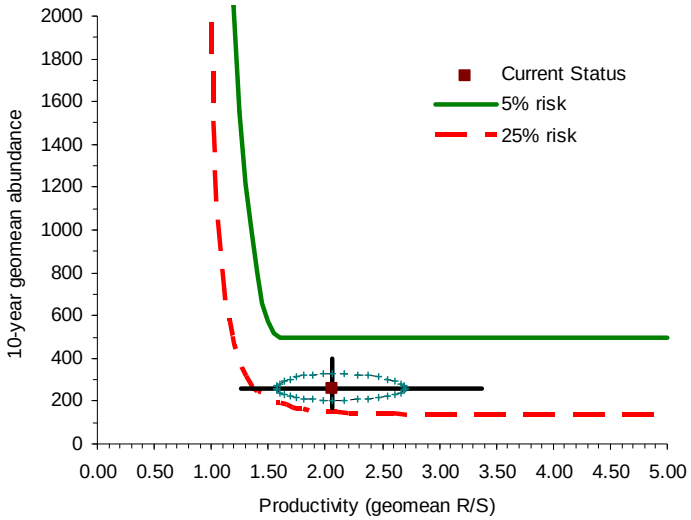


Figure 6-7. South Fork John Day River Summer Steelhead population abundance and productivity compared to the viability curve for the DPS.

The integrated Spatial Structure/Diversity rating is low risk for the South Fork John Day River population. The rating for Goal A "allowing natural rates and levels of spatially mediated processes" rated midway between very low and low risk. Although the current spawner distribution mimics the intrinsic distribution, only three MaSAs exist within the population. Good continuity exists between spawning areas and gaps between areas have remained relatively unchanged. The rating for Goal B "maintaining natural levels of variation" is low risk. As is the case for all John Day steelhead populations there is uncertainty in ratings of metrics "genetic variation" and "proportion of spawners that are out-of-DPS strays." We have limited genetics data for South Fork steelhead to determine if the current population variation is similar to historical conditions and to examine the degree of hatchery fish introgression. The metric for proportion of out-of-DPS strays rated as high risk. However, the analyses relied on composite data from four John Day populations. Additional population specific spawner composition data are needed to better inform the risk rating and to reduce the associated uncertainty.

Overall Risk Rating

The South Fork John Day River steelhead population does not currently meet the ICTRT criteria for viable status. The population does meet criteria for a "maintained" population because the abundance exceeds the minimum of 250 natural-origin spawners for maintained status. The recent 10-year geomean abundance of 259 is only 52% of the minimum goal of 500 for viable status of a "basic" size population. The 20-year delimited recruit per spawner point estimate resides above the minimum value required at a 500 abundance level; however, the lower end of the adjusted standard error is below the 25% risk level. Increased productivity in combination with abundance will allow this population to achieve viable status as the Spatial Structure/Diversity criteria achieved a low risk rating. While the population received a Spatial Structure/Diversity rating of low risk, there is considerable uncertainty surrounding the spawner composition data. Enhanced monitoring of the hatchery-wild ratios on the South Fork spawning grounds will improve the hatchery fraction estimate and reduce the degree of uncertainty.

6.8 Upper Mainstem John Day River Summer Steelhead Population

The Upper Mainstem John Day River steelhead population occupies the John Day Basin above the mouth of the South Fork John Day River at Dayville. The population has five MaSAs: Upper John Day, Upper Middle Mainstem John Day, Beech, Laycock, and Canyon. It does not have any MiSAs. Spawning is distributed broadly across the population including mainstem reaches in the Upper John Day River, Canyon Creek, and Beech Creek, as well as in numerous tributaries from Dayville upstream to the headwaters.

The Upper Mainstem John Day River Summer Steelhead population is at moderate risk based on current abundance and productivity. Spawner abundance in recent years has been moderately variable, the most recent 10-year geomean number of natural-origin spawners was 524 (572 total spawners). During the period 1969-1998, returns per spawner for steelhead in the Upper Mainstem John Day River ranged from 0.19 (1992) to 5.43 (1979). The most recent 20-year (1979-1998) SAR adjusted and delimited geomean of returns per spawner was 2.14 (Appendix B).

The current point estimate for Abundance/Productivity on the viability curve for the Upper Mainstem John Day River summer steelhead population resides between the 5% and 25% risk curves (Figure 6-8).

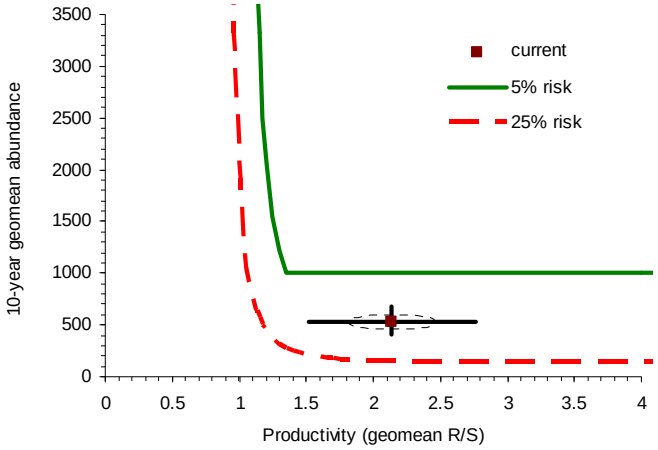


Figure 6-8. Upper Mainstem John Day River Summer Steelhead population abundance and productivity compared to the viability curve for the DPS.

The integrated Spatial Structure/Diversity rating is moderate risk for the Upper Mainstem John Day River population. The rating for Goal A "allowing natural rates and levels of spatially mediated processes" was very low risk. A rating of "very low" was achieved because the current distribution is nearly identical to the historical distribution. The rating for Goal B "maintaining natural levels of variation" was moderate risk. This risk rating was a result of a moderate rating for changes in major life history strategies. Additional genetics information needs to be assessed to determine current genetic variation and to examine for the degree of introgression of hatchery fish. The population was rated as high risk for out-of-DPS hatchery strays based on a limited time series of composite John Day population hatchery fish observation data. Better population specific spawner composition data are needed to better determine the out-of-DPS hatchery fraction. If there is significant hatchery introgression that affects the genetic variation of this population through time, then the risk rating for Goal B will increase, and the overall risk rating for Spatial Structure/Diversity will increase.

Overall Risk Rating
The Upper Mainstem John Day River Summer Steelhead population does not currently meet the ICTRT criteria for viable status, although it does meet criteria for a "maintained" population. The 10-year geomean abundance of 524 is well below the viable goal of 1,000 natural-origin spawners for an "intermediated" size population; however, the abundance is above the 500 minimum recommended for maintained status of an intermediate size population. The productivity point estimate of 2.14 is above the minimum needed at an abundance of 1,000, and the lower end of the adjusted standard error is above the 25% risk level. An increase in abundance is needed for this population to achieve viable Abundance/Productivity criteria. In addition, the Spatial Structure/Diversity rating was moderate risk due to loss in life history diversity and high risk for spawner composition.

6.9 Umatilla River Summer Steelhead Population

The Umatilla River steelhead population includes thirteen historical MaSAs: Butter, East Birch, West Birch, McKay, Meacham, Middle Umatilla, Lower Middle Umatilla, Upper Umatilla, Lower Umatilla, Lower Birch, Alder, Glade and Wildhorse. It contains three historical MiSAs: Alkali, Fourmile Canyon, and Cottonwood (Umatilla). Two of the MaSAs (Alder Creek and Glade Creek) and one MiSA (Fourmile Canyon) that are included in the Umatilla River population are direct tributaries to the Columbia River on the Washington side of the Columbia. These areas are considered in our assessment of spatial structure/diversity for the Umatilla steelhead population, but are not considered for abundance/productivity because no abundance data are available. Current spawning distribution is somewhat limited relative to historical and is concentrated in Birch Creek, Iskuulpa Creek, Meacham Creek, Upper Umatilla River, and the North and South Forks of the Umatilla River.

The Umatilla River Summer Steelhead population is at moderate risk based on current spawner abundance and productivity. Spawner abundance in recent years has been moderately variable, the most recent 10-year geomean number of natural-origin spawners was 1,472 (2,347 total spawners). During the period 1967-2000, returns per spawner for steelhead in the Umatilla River

ranged from 0.3 (1978) to 4.98 (1998). The most recent 20-year (1981-2000) geomean of returns per spawner SAR adjusted and delimited at 75% of the threshold was 1.50 (Appendix B).

The productivity rating for the Umatilla River summer steelhead population is in the low risk zone because the current point estimate on the viability curve for the population is above 5% risk level and the adjusted standard error is above the 25% risk level. Abundance is moderate because the point estimate is slightly below the 5% risk level (Figure 6-9).

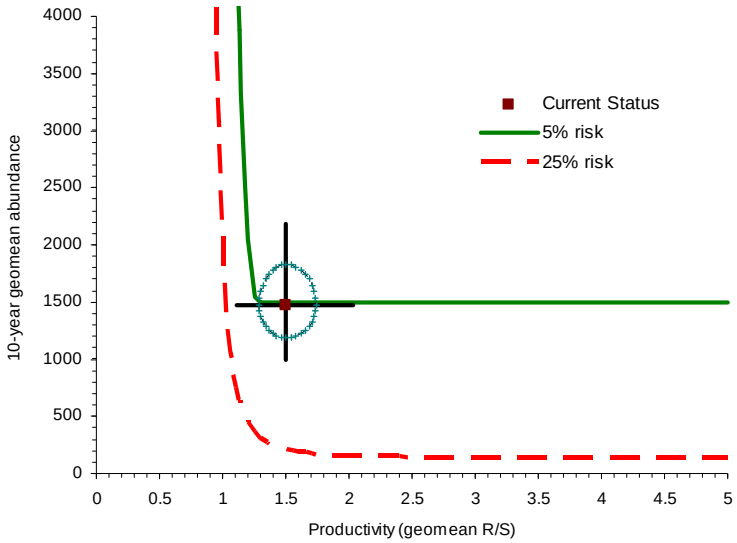


Figure 6-9. Umatilla River Summer Steelhead population abundance and productivity compared to the viability curve for the DPS.

The combined integrated Spatial Structure/Diversity rating is moderate risk for the Umatilla River population. The rating for Goal A "allowing natural rates and levels of spatially mediated processes" was moderate risk. There has been significant reduction in spawner distribution relative to intrinsic potential distribution. This reduction has caused significant increases in gaps between spawning areas as well as disrupted continuity. The rating for Goal B "maintaining natural levels of variation" was moderate risk. Habitat changes have been significant in the Umatilla Basin resulting in changes to flow profiles and elevated temperatures. These changes have resulted in impacts to life history diversity and phenotypic trait variation. The out-of-DPS spawners in combination with local-origin hatchery fish spawning naturally put the population at high risk for spawner composition. Hydrosystem effects and within basin habitat changes have likely resulted in selective mortality of specific components of juvenile and adult life stages resulting in a moderate risk rating.

Overall Risk Rating

The Umatilla River Summer Steelhead population does not currently meet the ICTRT criteria for viable status because Abundance/Productivity and Spatial Structure/Diversity risks ratings are both moderate risk. However, the population does meet criteria for a "maintained" population because the abundance level is well above the minimum 500 required for maintained status. The 20-year delimited recruit per spawner point estimate is 1.50 with the lower end of the adjusted standard error above the 25% risk level, thus placing the productivity at low risk. The 10-year mean abundance of 1,472 is 98.1% of the minimum threshold of 1,500. Improvement in many of the Spatial Structure/Diversity metrics and a small increase in the average abundance will raise the population to viable status.

6.10 Walla Walla River Summer Steelhead Population

The Walla Walla Basin spans the Oregon-Washington border east of the Columbia River. The main tributaries of the Walla Walla River are the North and South forks and Couse, Pine, Birch, Cottonwood and Mill creeks. The North and South forks and Couse Creek are entirely within Oregon, but the remaining tributaries span the state line. Birch and Pine creeks originate in Oregon, but their confluence with the Walla Walla River is in Washington. Cottonwood Creek flows into Yellowhawk Creek in Washington. Mill Creek originates in Washington, flows through Oregon for approximately six miles and enters the Walla Walla River in Washington, just west of the City of Walla Walla.

The Walla Walla River population is comprised of three historical MaSAs (Walla Walla, Mill and Pine) and two historical MiSAs (Dry and Switzler). Current spawning distribution is substantially reduced relative to the historical intrinsic distribution and is concentrated in the North and South forks of the Walla Walla River, Couse Creek, Mill Creek and Dry Creek (WA).

The Walla Walla Summer Steelhead population is at moderate risk based on current abundance and productivity. Spawner abundance in recent years has been moderately variable; the most recent 10-year geomean number of natural-origin spawners was 650. During the period 1993-2000, returns per spawner for steelhead in the Walla Walla River ranged from 0.39 (1993) to 2.65 (1998). The most recent 8-year (1993-2000) geomean of returns per spawner, delimited at the median and SAR adjusted was 1.34 (Appendix B).

The current point estimate for Abundance/Productivity on the viability curve for the Walla Walla River summer steelhead population falls between the 5% and 25% risk curves (Figure 6-10). This risk rating is based on a short data series, and should be viewed with caution.

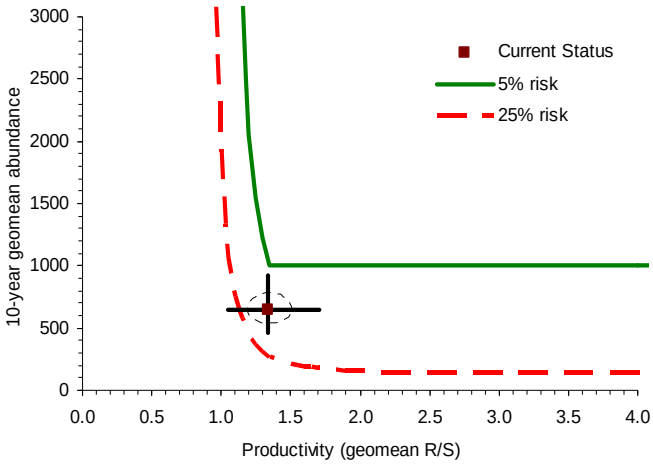


Figure 6-10. Walla Walla River Summer Steelhead population abundance and productivity compared to the viability curve for the DPS.

The integrated Spatial Structure/Diversity rating for the Walla Walla population is moderate risk. The rating for Goal A "allowing natural rates and levels of spatially mediated processes" was moderate risk. There has been significant reduction in spawner distribution that has resulted in increased gaps and loss of continuity within the population and between the Walla Walla population and other Mid-Columbia steelhead populations. The rating for Goal B "maintaining natural levels of variation" was moderate risk. Water temperature and hydrograph changes as well as barriers have likely influenced life history diversity and phenotypic expression. Out-of-

DPS spawners have put the population in the moderate risk category for the spawner composition metric. Within basin habitat changes have likely resulted in selective mortality at multiple life stages resulting in a moderate risk rating.

Overall Risk Rating
The Walla Walla Summer Steelhead population does not currently meet ICTRT criteria for viable status, although it does meet the criteria for a "maintained" population. The abundance/productivity values are at moderate risk and the time series is short resulting in considerable uncertainty. The 10-year geomean abundance of 650 is well below the minimum threshold of 1,000 for viable status. However, current abundance exceeds the 500 minimum recommended by the ICTRT for maintained status of an "intermediate" size population. We need additional brood years to demonstrate sustained recruits per spawner and abundance values above the low risk criteria level. Significant improvements to spatial structure and diversity are needed to improve the risk level.

6.11 Major Population Groups Viability Assessments

The status of each MPG is assessed based on the status of the constituent populations. Viability assessment findings for the three Mid-C steelhead MPGs that contain Oregon populations are summarized below.

Cascades Eastern Slope Tributaries MPG
To achieve viable status in the Cascades Eastern Slope Tributaries MPG, the Fifteenmile Creek, Deschutes River Eastside, Deschutes River Westside, and Klickitat populations must all achieve viable status. The Cascades Eastern Slope Tributaries MPG is below viable status because the Deschutes River Westside population did not meet viability criteria, and the Deschutes Crooked River population is extinct. (Table 6-1).

Table 6-1. Viability assessment results for Mid-C steelhead populations in the Cascades Eastern Slope Tributaries MPG.

Population	Extant/ Extinct	Abundance		Productivity		A/P Risk	Goal A Natural Processes Risk	Goal B Diversity Risk	Integrated SS/D Risk	Overall Population Viability Rating
		Mean	Lower 90% CI	Mean	Lower 90% CI					
Fifteenmile Creek	Extant	703	481	1.82	1.23	Low	Very Low	Low	Low	Viable
Deschutes River Eastside	Extant	1,599	896	1.89	1.10	Low	Low	Moderate	Moderate	Viable
Deschutes River Westside	Extant	456	306	1.05	0.76	High	Low	Moderate	Moderate	High Risk
Deschutes Crooked River	Extinct	0	NA	0	NA	Extinct	NA	NA	NA	Extinct

John Day River MPG
To achieve viable status in the John Day River MPG, the Lower Mainstem John Day River, North Fork John Day River, and either the Middle Fork John Day River or Upper Mainstem John Day River populations must achieve viable status. The John Day River MPG is below viable

status. The North Fork population is highly viable, however all of the other John Day River populations were below viable status (Table 6-2).

Table 6-2. Viability assessment results for Mid-C steelhead populations in the John Day River MPG.

Population	Extant/ Extinct	Abundance		Productivity		A/P Risk	Goal A Natural Processes Risk	Goal B Diversity Risk	Integrated SS/D Risk	Overall Population Viability Rating
		Mean	Lower 90% CI	Mean	Lower 90% CI					
Lower Mainstem John Day River	Extant	1,800	1,065	2.99	1.91	Moderate	Very Low	Moderate	Moderate	Maintained
North Fork John Day River	Extant	1,740	1,375	2.41	1.62	Very Low	Very Low	Low	Low	Highly Viable
Middle Fork John Day River	Extant	756	508	2.45	1.81	Moderate	Low	Low	Low	Maintained
South Fork John Day River	Extant	259	168	2.06	1.26	Moderate	Very Low	Low	Low	Maintained
Upper Mainstem John Day River	Extant	524	399	2.14	1.15	Moderate	Very Low	Moderate	Moderate	Maintained

Umatilla/Walla Walla Rivers MPG

To achieve viable status in the Umatilla/Walla Walla Rivers MPG, the Umatilla River population and either the Walla Walla River or Touchet River population must achieve viable status. The Umatilla/Walla Walla Rivers MPG is below viable status because neither the Umatilla River or Walla Walla River populations meet viability criteria (Table 6-3).

Table 6-3. Viability assessment results for Mid-C steelhead populations in the Umatilla/Walla Walla Rivers MPG.

Population	Extant/ Extinct	Abundance		Productivity		A/P Risk	Goal A Natural Processes Risk	Goal B Diversity Risk	Integrated SS/D Risk	Overall Population Viability Rating
		Mean	Lower 90% CI	Mean	Lower 90% CI					
Willow Creek	Extinct	0	NA	0	NA	Extinct	NA	NA	NA	Extinct
Umatilla River	Extant	1,472	988	1.50	1.11	Moderate	Moderate	Moderate	Moderate	Maintained
Walla Walla River	Extant	650	459	1.34	1.05	Moderate	Low	Moderate	Moderate	Maintained

6.12 DPS Viability Assessment

All major population groups must achieve viable status for the DPS to be considerable viable. The Mid-C steelhead DPS is below viable status because none of the MPGs currently achieve viable status.

Section 7 Viability Gaps

In the previous two sections we described viability criteria and presented results of the current status assessments. The status assessments provide a visual and narrative comparison of the current status relative to the abundance/productivity and spatial structure/diversity criteria. In this section, we present the results of ICTRT (2007a) abundance/productivity gap analysis and our spatial structure/diversity gap analyses.

7.1 Gaps Approach

This section provides a brief overview of the methods to establish a general understanding of the approach. Detailed methods for abundance/productivity gaps determination are provided in ICTRT (2007a).

The abundance/productivity gap is defined as the quantitative relative amount of change in survival or capacity that is required for a population to improve from current status to a specific viability level. The purpose of determining gaps is to inform planners and managers how much change is required to improve current status to a specific viability level. Observed gaps represent the amount of improvement needed assuming that the climate/environmental conditions and average survivals that occurred during the time period of the status assessments (generally 1980-2001) will be the same in the future. The gap analysis provides estimates of the magnitude of survival or capacity change that are needed to reach viability criteria for 25% (moderate risk), 5% (low risk) and 1% (very low risk) probability of extinction over a 100-year timeframe as defined by the viability curves. Beyond estimating observed gaps, the ICTRT used a modeling approach to evaluate the influence of alternative climate regimes and hydrosystem scenarios on observed gaps.

We only present observed gaps in this section. The influence of alternative ocean survival scenarios, hydrosystem scenarios, and other management actions on observed gaps is presented in Section 10 "Management Action Effectiveness." In addition to the gaps calculated for the current A/P status point estimate, gaps are also calculated to address the uncertainty criteria. Estimates of current abundance and productivity of a population are based on sampling data and are therefore subject to statistical uncertainty. The level of uncertainty, especially for the productivity, can have a substantial impact relative to confidence in the empirical difference between current status and specific risk levels. We incorporate an uncertainty gap into our analyses to minimize the potential of a substantial underestimate in the gap between the current A/P estimate and the specific risk levels. For Mid-C steelhead, we applied the following uncertainty criteria in our viability assessments: To achieve the 5% risk criteria (low risk), the lower end of the productivity 90% confidence interval needed to be above the 25% risk curve; and, to meet the 1% risk criteria (very low risk), the lower end of the 98% confidence interval needed to be above the 25% risk curve. We calculated gaps for both the 5% and 1% uncertainty criteria.

The ICTRT described a four-step process for determining observed abundance/productivity gaps. We summarize the steps below and encourage readers to view ICTRT (2007a) for a more extensive explanation.

1. *Estimate current intrinsic productivity and natural-origin abundance* (method previously described).

2. *Estimate adult spawner population size that achieves juvenile production capacity*. The ICTRT used population specific stock recruitment data fitted to a Hockey-Stick function to estimate current capacity. The full range of data for each population was used in the analyses. Simple cohort analyses were used to generate broodyear specific estimates of spawners. Spawner numbers were standardized to reflect average recent SARs and harvest rates to remove the substantial variation in ocean survival and harvest rates. Population specific estimates of spawners at capacity were highly variable. To address the effects of sampling variability, populations were grouped by species and the estimated capacity was regressed against the independent estimates of capacity derived from the intrinsic habitat potential analyses. The ultimate estimate of capacity was derived as the mean of the population specific stock-recruitment estimate and the corresponding regression-based estimate. This estimate is referred to as Model Capacity in the equations below.

3. *Assign populations to categories based on the point estimate position relative to the abundance/productivity variability curve*. Many of the Oregon Mid-C steelhead populations clustered together in a zone (ICTRT Zone C) where the abundance/productivity point estimates fell below the viability curve, substantially to the right (greater than) of the minimum productivity values. Those Mid-C steelhead populations that did not reside in Zone C were populations that had either abundance/productivity point estimates above the viability curve including Fifteenmile Creek, Deschutes River Eastside, and North Fork John Day River, or productivity and abundance values below the minimum criteria including the Deschutes River Westside population.

4. *Calculate the gap as the minimum distance for the current abundance/productivity point estimate (observed gap) to each viability curve and from the lower end of the 90% and 98% CI's to the 25% risk curve*. In cases where the uncertainty criteria gap was greater than the A/P point estimate gap, the uncertainty criteria gap was used. All of the Oregon Mid-C populations that did not meet A/P viability criteria, except the Deschutes River Westside population, exhibited current productivity above minimums needed at threshold abundance with recent average abundance below the threshold. The ICTRT concluded that these populations were strongly affected by density dependence.

The method for calculating gaps for populations with moderate to high productivity and relatively low abundance is detailed in ICTRT 2007a. The gaps are estimated based on estimated difference in observed abundance and estimated capacity relative to the threshold abundance level specific to the population.

The gap was calculated as:

Survival Gap = Threshold Abundance ÷ EQ capacity – 1
where EQ Capacity = Model Capacity + 10-year geomean abundance ÷ 2

The calculated gaps are expressed as the proportional increase in productivity, but can also be considered the proportional increases needed in effective capacity of the population. Because the threshold abundance levels are equal at the 5% and 1% risk levels, populations that reside in Zone C have the same point estimate gaps at these two risk levels.

Uncertainty gaps are calculated in a different way because they only address required changes in productivity. Uncertainty gaps are calculated as the relative proportional change in productivity required to move the lower end of the 90% confidence interval to the 25% risk curve for the low risk criteria, and to move the lower end of the 98% confidence interval to the 25% risk curve for the very low risk criteria.

The ICTRT has not provided specific guidance on how to define Spatial Structure/Diversity gaps; therefore we developed the following steps and criteria for identifying these gaps.

1) Identify for each population all spatial structure and diversity metrics with ratings of moderate or high risk.
2) For the metrics rated moderate, determine if the rating is a result of changed status from intrinsic conditions or if the rating is a result of an intrinsic moderate risk for the metric.
3) Characterize spatial structure and diversity gaps for each population as those metrics that are rated high risk and those metrics that are rated moderate risk because the current status is impaired relative to the intrinsic condition.

7.2 Population Specific Viability Gaps

The results of gaps analyses for Oregon Mid-C steelhead populations are discussed below and shown in Table 7-1.

7.2.1 Fifteenmile Creek Population Gaps

Abundance/Productivity
The recent 10-year geomean natural-origin abundance of 703 spawners exceeds the minimum threshold abundance of 500. The current productivity estimate of 1.82 recruits per spawner resides between the 5% and 1% risk curves. There is no observed gap or uncertainty gap for the 5% risk level. The observed and uncertainty gaps for the 1% risk level are 0.03 and 0.09 respectively (Table 7-1).

Spatial Structure/Diversity
The overall Spatial Structure/Diversity rating was low risk. All of the Spatial Structure and Diversity metrics were rated very low or low risk, therefore there are no Spatial Structure/Diversity gaps for this population.

Table 7-1. Abundance/Productivity statistics, risk ratings, and observed and uncertainty gaps for Oregon Mid-C Steelhead populations. Observed gaps are calculated from current status point estimates. Uncertainty gaps are for achieving uncertainty criteria and are only presented when they exceed the observed gaps. Negative gaps indicate that current abundance/productivity exceeds the criteria. Gap data are from ICTRT (2007a).

	Current Status		Equilibrium	A/P Risk	SS/D Risk	Gaps				
						Observed (point estimate)			Uncertainty	
Population	Abundance	Productivity	Abundance	Rating	Rating	25%	5%	1%	5%	1%
Fifteenmile Cr.	703	1.82	632	Low	Low	-.41	-.21	.03		.09
Deschutes R. Eastside	1,599	1.89	1,501	Low	Moderate	-.46	-.34	-.20		.05
Deschutes R. Westside	456	1.05	448	High	Moderate	.14	.78	.92		
Lower Mainstem John Day R.	1,800	2.99	2,019	Moderate	Moderate	.00	.11	.11		
North Fork John Day R.	1,740	2.41	1,689	Very Low	Low	-.58	-.49	-.38		
Middle Fork John Day R.	756	2.45	928	Moderate	Low	.00	.08	.08		
South Fork John Day R.	259	2.00	409	Moderate	Low	-.02	.22	.22		.23
Upper Mainstem John Day R.	524	2.14	730	Moderate	Moderate	-.02	.37	.37		
Umatilla River	1,472	1.50	1,371	Moderate	Moderate	-.32	.09	.09		
Walla Walla River	650	1.34	625	Moderate	Moderate	-.08	.34	.45		

7.2.2 Deschutes River Eastside Population Gaps

Abundance/Productivity

The recent 10-year geomean natural-origin abundance of 1,599 spawners substantially exceeds the minimum threshold abundance of 1,000. The current productivity estimate of 1.89 resides in the very low risk zone and, thus, there are no observed abundance/productivity gaps. The lower end of the productivity 98% confidence interval is below the 25% risk curve resulting in a 0.05 gap to meet uncertainty criteria for 1% risk level. The abundance/productivity dataset is a relatively short time series which results in a larger 90% CI than is typical of most other Oregon Mid-C populations. Additional brood years will likely decrease the uncertainty around the productivity point estimate (Table 7-1).

Spatial Structure/Diversity

The overall Spatial Structure/Diversity rating was moderate risk. Spatial structure/diversity gaps were identified for the following metrics:

Phenotypic variation

Metric rated moderate risk due to likely reduction in juvenile and adult migration patterns resulting from flow and temperature changes in tributary production areas.

Spawner composition

Out-of-DPS spawners. Metric rated high risk due to the high proportion of Snake River strays spawning naturally in the population.

Out-of-population spawners within the MPG. Metric rated moderate risk due to the proportion of Round Butte Hatchery fish spawning naturally in the population.

7.2.3 Deschutes River Westside Population Gaps

Abundance/Productivity

The recent 10-year geomean natural-origin abundance of 456 spawners is well below the abundance threshold of 1,000, the threshold abundance for currently available habitat. The current productivity estimate of 1.05 recruits per spawner is well below the minimum of 1.35 required at the threshold abundance. The observed gaps, that are greater than uncertainty gaps, for the 5% and 1% risk levels are 0.78 and 0.92 respectively. This gap is by far the largest observed gap of all the Oregon Mid-C populations. The large gap results from the substantial difference in the equilibrium abundance (448) and the threshold abundance, as well as the low productivity (Table 7-1).

Spatial Structure/Diversity

The overall Spatial Structure/Diversity rating was moderate risk. Spatial Structure/Diversity gaps were identified for the following metrics:

Spatial extent or range of population

Metric rated moderate risk because spawner distribution is substantially reduced from historical due to blocked access to Whychus Creek and the Metolius River.

Increase or decrease in gaps or continuity

Metric rated moderate risk due to loss of occupancy in areas above Pelton-Round Butte Complex.

Genetic variation

Metric rated moderate risk because there are limited genetics data available and the samples that have been analyzed show similarity to out-of-DPS hatchery strays.

Spawner composition

Out-of-DPS spawners. Metric rated high risk because out-of-DPS strays have comprised a significant proportion of the natural spawners in this population for many generations.

7.2.4 Lower Mainstem John Day River Population Gaps

Abundance/Productivity

The recent 10-year geomean natural-origin abundance of 1,800 spawners is 72% of the threshold abundance of 2,250. The current productivity of 2.99 recruits per spawner is well above the minimum required at threshold abundance to meet the 1% risk level. The lower end of the 98%

CI also resides above the minimum needed to meet the 1% risk level. The observed abundance/productivity gap to reach the 5% and 1% risk levels is 0.11. This gap is a result of the difference in the equilibrium abundance (2,019) and the threshold abundance (Table 7-1).

Spatial Structure/Diversity
The overall Spatial Structure/Diversity rating was moderate risk. Gaps were identified for the following Spatial Structure/Diversity metrics:

Major life history strategies
Metric rated moderate risk because habitat changes have resulted in reduced juvenile life history diversity and restricted summer rearing distribution.

Genetic variation
Metric rated moderate risk because there are no genetics data and due to potential genetic effects of the high proportion of out-of-DPS spawners.

Spawner composition
Out-of-DPS spawners. Metric rated high risk due to high proportion and increasing trend of out-of-DPS spawners.

7.2.5 North Fork John Day River Population Gaps

Abundance/Productivity
The recent 10-year geomean natural-origin abundance of 1,740 spawners exceeds the threshold abundance of 1,500. The current productivity of 2.41 recruits per spawner is well above the value needed to meet the 1% risk level. The lower end of the 90% CI resides above the 1% risk level. There are no abundance/productivity gaps for the 5% or 1% risk levels (Table 7-1).

Spatial Structure/Diversity
The overall Spatial Structure/Diversity rating was low risk. All metrics were rated very low or low risk, except for the following:

Spawner composition
Out-of-DPS spawners. Metric rated high risk due to the high estimated proportion of Snake River hatchery strays within this population. In addition, there is considerable uncertainty regarding the hatchery fraction estimates for this population.

7.2.6 Middle Fork John Day River Population Gaps

Abundance/Productivity
The recent 10-year geomean natural-origin abundance of 756 spawners is 75.6% of the threshold abundance of 1,000. The current productivity of 2.45 recruits per spawner is above the minimum needed at threshold abundance. The lower end of the 90% CI is well above the 25% risk level. The observed abundance/productivity gap to reach the 5% and 1% risk levels is 0.08. This gap is a result of the difference in equilibrium abundance (928) and threshold abundance (Table 7-1).

Spatial Structure/Diversity
The overall Spatial Structure/Diversity rating was low risk. All metrics were rated very low or low risk, except for the following:

Spawner composition
Out-of-DPS spawners. Metric rated high risk due to the high estimated proportion of out-of-DPS strays within this population.

7.2.7 South Fork John Day River Population Gaps

Abundance/Productivity
The recent 10-year geomean natural-origin abundance of 259 spawners is 51.8% of the threshold abundance of 500. The current productivity of 2.00 recruits per spawner is greater than the minimum required at the abundance threshold. The lower end of the 90% CI extends well below the 25% risk level. The observed abundance/productivity gap to reach the 5% and 1% risk levels is 0.22. Uncertainty gap for the 1% risk level is 0.23. The gaps are primarily a result of the difference between the equilibrium abundance (409) and the threshold abundance (Table 7-1).

Spatial Structure/Diversity
The overall Spatial Structure/Diversity rating was low risk. All metrics were rated very low or low risk, except the following:

Spawner composition
Out-of-DPS spawners. Metric rated high risk due to the high estimated proportion of out-of-DPS strays within this population.

7.2.8 Upper Mainstem John Day River Population Gaps

Abundance/Productivity
The recent 10-year geomean natural-origin abundance of 524 spawners is only 52.4% of the threshold abundance of 1,000. The current productivity of 2.14 recruits per spawner is well above the minimum required at the threshold abundance. The lower end of the 90% CI resides above the 25% risk level. The observed abundance/productivity gap to reach the 5% and 1% risk levels is 0.37. The uncertainty gaps are less than the observed gaps. The gap is primarily a result of the difference in the equilibrium abundance (730) and threshold abundance (Table 7-1).

Spatial Structure/Diversity
The overall Spatial Structure/Diversity rating was moderate risk. Gaps were identified for the following Spatial Structure/Diversity metrics:

Major life history strategies
Metric rated moderate risk due to reduced opportunities for juvenile movement patterns and reduced summer rearing distribution that has resulted from altered mainstem and tributary habitats.

Spawner composition
Out-of-DPS spawners. Metric rated high risk due to the high proportion of out-of-DPS strays and uncertainty in the estimates of hatchery fraction.

7.2.9 Umatilla River Population Gaps

Abundance/Productivity
The recent 10-year geomean natural-origin abundance of 1,472 spawners is 98.1% of the threshold abundance of 1,500. The current productivity of 1.50 recruits per spawner is above the minimum of 1.26 required at the threshold abundance. The lower end of the 90% CI resides slightly above the 25% risk level. The observed abundance/productivity gap for the 5% and 1% risk levels is 0.09. The uncertainty gaps are less than the observed gaps (Table 7-1).

Spatial Structure/Diversity
The overall Spatial Structure/Diversity rating was moderate risk. Gaps were identified for the following Spatial Structure/Diversity metrics:

Spatial extent or range of population
Metric rated moderate risk because the current spawner distribution is substantially reduced from the historical distribution. Loss of spawning in the Butter Creek and McKay Creek watersheds has resulted in the reduced distribution. There is considerable uncertainty regarding occupancy of the Alder and Glade MaSAs.

Increase or decrease in gaps and continuity
Metric rated moderate risk because of increased gaps and changed continuity resulting from losses of occupancy in the Butter Creek and McKay Creek watersheds.

Major life history strategies
Metric rated moderate risk as a result of reduced opportunity for life history expression for juvenile and adult life stages. This reduced opportunity has resulted from significant habitat changes in the Umatilla Basin.

Phenotypic variation
Metric rated moderate risk due to effects of flow and temperature on adult and juvenile migration characteristics.

Spawner composition
Overall rating is high risk due to two moderate ratings for the component metrics.

Out-of-DPS spawners. Metric rated moderate risk due to the estimated level of strays observed at Three-mile Falls Dam over the last three generations.

Within-population spawners. Metric rated moderate risk due to the proportion and duration of Umatilla Hatchery fish spawning in the basin.

Selective change in Natural Processes-Habitat
Metric rated moderate risk due to the selective effects of tributary temperature and flow changes on juvenile and adult migration characteristics and the effect of mainstem Columbia River temperature and flow on adult migration, survival, and straying.

7.2.10 Walla Walla River Population Gaps

Abundance/Productivity
The recent 10-year geomean natural-origin abundance of 650 spawners is well below the threshold abundance of 1,000. The current productivity of 1.34 recruits per spawner is slightly less than the minimum of 1.35 required at the threshold abundance. The lower end of the 90% CI extends well below the 25% risk level. The observed gaps for abundance/productivity at the 5% and 1% risk levels were 0.34 and 0.45 respectively. The uncertainty gaps at the 5% and 1% risk levels were less than the observed gaps. These gaps should be viewed cautiously because there is only a short data series available to estimate productivity (Table 7-1).

Spatial Structure/Diversity
The overall Spatial Structure/Diversity rating was moderate risk. Gaps were identified for the following Spatial Structure/Diversity metrics:

Spatial extent or range of population
Metric rated moderate risk because the current distribution is substantially reduced from the historical distribution. Loss of spawning in the Pine Creek MaSA and Switzler MiSA has resulted in reduced distribution.

Increase or decrease in gaps and continuity
Metric rated moderate risk because of increased gaps and changed continuity resulting from loss of occupancy in the Pine Creek MaSA.

Major life history strategies
Metric rated moderate risk due to changes in juvenile and adult movement patterns as well as reduced juvenile rearing distribution relative to historical opportunities. The reduced life history strategies have resulted from significant flow and temperature changes within the basin.

Phenotypic variation
Metric rated moderate risk due to effect of flow and temperature changes on phenotypic variation. Adult and juvenile migration patterns have been significantly altered due to these habitat changes.

Spawner composition
Out-of-DPS spawners. Metric rated moderate risk due to the proportion and duration of out-of-DPS spawners in the population.

Selective change in Natural Processes-Habitat

Metric rated moderate risk due primarily to tributary flow and temperature effects on juvenile and adult migration and movement patterns and the effect of mainstem Columbia River temperature and flow effects on adult migration, survival, and straying.

Section 8 Limiting Factors and Threats

This section describes limiting factors and threats to the viability of Mid-C steelhead in Oregon. The limiting factors and threats analyses serve as an essential foundation for the development and prioritization of management actions across the entire lifecycle. Findings were identified based on many sources of information, including the Mid-C steelhead Expert Panel's report, subbasin plans, ODEQ reports, ICTRT reports, NOAA's limiting factors modules, ODFW reports, hydrosystem biological opinion remand documents, and numerous other sources.

Section 8.1 provides a broad level perspective of the primary limiting factors and threats across and within Oregon's Mid-C steelhead populations. This broader look is followed by more detailed, in-depth discussions of limiting factors and threats in Section 8.2 (Tributary Habitat), 8.3 (Hydrosystem), 8.4 (Estuarine and Plume Habitat), 8.5 (Harvest), 8.6 (Hatchery), 8.7 (Predation and Competition) and 8.8 (Climate Change).

8.1 Primary Limiting Factors and Threats Across and Within Populations

This section describes the primary factors and threats constraining the viability of Oregon's Mid-C steelhead populations throughout their life cycles. It summarizes the findings of the Mid-C Expert Panel, the Mid-C recovery planning team, other groups and published information regarding the significance of these various factors and threats both across and within the populations. We used the following definitions of limiting factors and threats for our assessment:

> **Limiting factors:** The physical, biological, or chemical conditions of the environment and associated ecological processes and interactions (e.g., habitat connectivity, water quality, physical habitat quality, etc.) that influence Mid-C steelhead viable salmonid population parameters, including abundance, productivity, spatial structure, and diversity.
>
> **Threats:** Human actions (e.g., fishing, operation of hatcheries, operation of hydrosystem, land use practices, etc.) or natural events (e.g., flood, drought, volcano, etc.) that cause or contribute to limiting factors. Threats may influence one or multiple life stages and may occur in the present or future or have occurred in the past.

The Mid-C Expert Panel, created by ODFW for this purpose, consisted of 12 biologists with significant knowledge of the limiting factors and threats influencing steelhead production in the Mid-C steelhead DPS. Panelists examined limiting factors and threats for the ten independent steelhead populations, and then identified common key and secondary threat themes for all of the populations. They used a systematic process, similar to a Delphi process, during their deliberations. The Panel's approach in their deliberations and findings are discussed in the report Limiting Factors and Threats to the Recovery of Steelhead in the Oregon Portion of the Mid-Columbia Distinct Population Segment: Results of Expert Panel Deliberations (Mid-C Expert Panel 2006).

8.1.1 Primary Limiting Factors and Threats across Populations

Several factors and threats play a critical role in restricting viability across Oregon's Mid-C steelhead populations.

Land Use
We acknowledge that land use practices have improved significantly over the past few decades. In the tributary watersheds land managers, local land owners, and others have improved habitat management in an effort to enhance watershed conditions to support steelhead recovery. Actions to improve watershed conditions from the uplands to the floodplain are allowing, in some cases, natural ecosystem functions to recover. Although many steps have been taken, there are many more needed to achieve recovery goals. Tributary habitat degradation from past and/or present land use remains a key concern for all of the populations. Steelhead have been adversely affected by modified and reduced streamflows, impaired water quality due to elevated water temperatures and agricultural chemicals, impaired upstream and downstream fish passage, degraded channel structure and complexity (including riffles, pools and large woody debris), loss of riparian vegetation, reduced floodplain connectivity, and excessive levels of fine sediments caused by altered sediment routing. Threats contributing to these factors include agricultural, forestry and grazing practices that negatively impact steelhead growth and survival, dams and other barriers, water withdrawals, roads and channel manipulations.

The Mid-C Expert Panel identified land use as having the most key concerns of any of the threat categories. Depending on the population, the Panel listed the following as either key or secondary concerns attributable to land use: 1) impaired upstream and downstream movement of juvenile and adult steelhead; 3) impaired physical habitat quality; 4) impaired water quality due to elevated water temperatures and agricultural chemicals; 5) reduced water quantity and/or modified hydrologic processes. Listed as secondary concerns for all populations were the impacts of fine sediment on steelhead eggs and alevins, and the impact of predation by birds on pre-smolts and smolts in the estuary as a result of habitat alterations resulting from the creation of dredge spoil islands. Panelists noted that current land use practices are considerably improved over historical practices.

Hatcheries
Out-of-DPS hatchery strays pose significant risk to several of Oregon's Mid-C steelhead populations, particularly to the Eastside and Westside Deschutes and John Day populations. Viability assessments, summarized in Section 6 of this document and presented in Appendix B, identified that a significant proportion of spawners in the Deschutes River and John Day River populations were out-of-DPS strays. In addition, these populations were rated at high risk for spawner composition due to the abundance of strays. Biologists remain especially concerned regarding the continuing detrimental impact of stray out-of-DPS hatchery fish in natural spawning areas on the genetic traits and productivity of these natural populations. Hatchery programs operated within the Mid-C steelhead DPS — including the Umatilla, Walla Walla and Westside Deschutes subbasins — also create some risks. The Mid-C Expert Panel ranked the impact of hatchery strays as a key concern to the Eastside and Westside Deschutes and Lower John Day populations, and as a secondary concern to the Umatilla and Walla Walla populations.

Hydrosystem
The mainstem Columbia River hydrosystem is considered a primary threat to the viability of Oregon's Mid-C steelhead populations. Specific viability concerns identified by the Mid-C Expert Panel related primarily to effects of delayed upstream passage (adults), direct and indirect mortality on downstream migrants (juveniles), alteration of the hydrograph (mainstem and estuary flow regime), depletion of historically available nutrients, and degraded rearing and food resources for both presmolts and smolts in the Columbia.

Results of the BiOp Framework Work Group support this conclusion. This work group was created by NMFS to provide scientific expertise during development of its Biological Opinion (BiOp) evaluating effects of operations of the FCRPS. One work group task was to estimate the relative magnitude of human-caused mortality factors influencing Interior Columbia River salmon and steelhead populations, including Mid-C steelhead. During this evaluation, the work group found that the FCRPS hydrosystem had the greatest relative impact on the Mid-C steelhead populations compared with other human-induced mortality effects (Step 4 Report 2006) (Table 8-1). The ICTRT reached a similar conclusion in September 2006, when members rated the mainstem Columbia River hydrosystem as a major limiting factor for all populations in the DPS. Oregon's recovery planning team also determined that the mainstem hydropower system represents a primary threat to the viability of Oregon Mid-C steelhead populations. The Expert Panel's findings were generally consistent with the BiOp Framework Work Group's findings on magnitude of human-induced mortality, however, the Expert Panel considered the mainstem Columbia hydrosystem a threat of moderate concern to the populations and generally considered legacy and current land use as a greater threat than the hydrosystem.

Impacts from the mainstem Columbia River hydrosystem increase somewhat for each of the populations in direct relation to the number of dams the fish must pass during their migration to and from the Pacific Ocean. Oregon's Mid-C steelhead populations pass from one to four Columbia River dams: the Fifteenmile Creek population passes one dam; Deschutes River populations pass two dams; John Day River and Umatilla River populations pass three dams; and the Walla Walla River population passes four dams.

Several hydroelectric dams on Columbia River tributaries also pose significant threats to the viability of specific populations. The Expert Panel listed the impact of the Pelton-Round Butte Complex as a key concern for Westside Deschutes and Crooked River populations

Harvest
Given current management regulations for mainstem Columbia River and tributary fisheries, harvest is not considered a primary or secondary threat due to the low impact on viability. The ICTRT identified harvest-related effects as a secondary level limiting factor and the Mid-C Expert panel did not identify harvest as either a key or secondary concern for Oregon's Mid-C steelhead populations. The panel, however, did express concerns over the impact that mortality associated with catch and release fisheries have on Westside and Eastside Deschutes populations.

Predation
Predation by non-native piscivorous fish on pre-smolts and smolts in the mainstem Columbia was listed by the Expert panel as a secondary concern for all Mid-C steelhead populations.

Predation is a primary concern for juvenile and adult steelhead in the Columbia River estuary and plume. Estuary habitat modifications have increased the number and/or predation effectiveness of Caspian terns, cormorants, and gull species (Fresh et al. 2005). The increasing abundance of native pinnipeds has resulted in increased predation on adult salmonids to a point of concern.

Table 8-1. Ranges of proportional reduction in survival for human-induced mortality factors that influence Oregon's Mid-Columbia River steelhead. Negative values are truncated to zero (Step 4 Report 2006).

Location Population	FCRPS Hydro (juvenile)	FCRPS Hydro Latent	FCRPS Hydro (adult)	Tribal In-River Harvest	Non-Tribal In-River Harvest	Indirect and Additional Harvest	Tributary Habitat	Tributary Habitat Delayed	Hatchery	Estuary	Avian Estuary Predation (smolts)	Pinniped Predation (adult)
Above McNary Dam Walla Walla River	.47	.05 -.29	0 -.02	0 -.10	.03	0 -.07	.25	0 -.03	.02 -.05	.04	.12	.05
Above John Day Dam Umatilla River John Day Subbasin (5 populations)	.39	.06 -.22	0 -.02	0 -.10	.03	0 -.07	.25	0 -.03	.02 -.05	.04	.12	.05
Above The Dalles Dam Deschutes River (2 populations)	.24	.08 -.15	0 -.02	0 -.10	.03	0 -.07	.20	0 -.03	.02 -.05	.04	.12	.05
Above Bonneville Dam Fifteenmile Creek	.15	.08	0 -.02	0 -.10	.03	0 -.07	.20	0 -.03	.02 -.05	.04	.12	.05

8.1.2 Primary Limiting Factors and Threats Within Populations

During the recovery planning process, the recovery planning team and the Mid-C Expert Panel conducted separate evaluations of limiting factors and threats for the ten independent steelhead populations throughout their life cycles, and then identified the primary, or key and secondary, constraints limiting population viability. The limiting factors and threats assessment in this plan reflects information gained from many sources including subbasin plans, water quality reports, ICTRT assessments, NOAA limiting factors modules and ODFW reports. The results from the two evaluations, which are generally similar, are summarized below.

Fifteenmile Creek Winter Steelhead Population
The Mid-C recovery planning team identified the following limiting factors and threats to the Fifteenmile Creek steelhead population:

> **Primary Limiting Factors:** *Tributary Habitat*: low flows, high water temperatures, degraded riparian condition, sediment routing, degraded floodplain, degraded channel structure (channel confinement and overall habitat diversity); *Hydro:* mainstem passage.
>
> **Primary Threats:** Current land use practices (including roads, residential development, agricultural practices and forest practices) and the Columbia River mainstem hydropower system.
>
> **Primary Life Stages Affected:** Fry, summer parr, winter parr, smolts.
>
> **VSP Characteristics Impacted:** Abundance, productivity, spatial structure, diversity.

The Mid-C Expert Panel (2006) determined that current land use practices are the primary threat to the viability of the Fifteenmile Creek steelhead population (Table 8-2).

Table 8-2. Key and secondary threats to viability of the Fifteenmile Creek steelhead population (Mid-C Expert Panel 2006).

Fifteenmile Creek
Key Threats
Current Land Use Practices • *Limiting factor(s) primarily affected:* Impaired physical habitat quality; elevated water temperatures; agricultural chemicals in tributaries; reduced water quantity and/or modified hydrograph. • *Life stage(s) primarily affected:* fry, summer parr and winter parr. • *Specific threat(s):* Current land use practices (agriculture, and forest practices, road maintenance) that negatively impact steelhead growth and survival in tributary streams. Improvement of some habitat conditions is expected to occur in the future, based on current land use practices that are much improved over historical practices.
Secondary Threats
Current Mainstem Columbia Hydropower System: Direct mortality of pre-smolts and smolts at dams; delayed upstream migration of returning adults over dams; cumulative impact of system on mainstem and estuary habitat for pre-smolts and smolts. **Land Use Practices:** Cumulative impact of past and present activities on estuarine habitat for pre-smolts and smolts; predation by birds on pre-smolts and smolts in estuary because of creation of dredge spoil islands; increased fine sediment from past and present agricultural and forestry practices reduces survival of eggs and alevins in tributary streams. **Introduced Species:** Predation by non-native piscivorous fish on pre-smolts and smolts in mainstem Columbia.

Deschutes River Eastside Summer Steelhead Population
The Mid-C recovery planning team identified the following limiting factors and threats to the Deschutes River Eastside steelhead population:

> **Primary Limiting Factors**: *Tributary Habitat*: degraded riparian condition, low flows, high water temperatures, degraded channel structure/complexity and floodplain connectivity, impaired fish passage; *Hatchery*: effects of naturally spawning stray hatchery fish on viability; *Hydro*: mainstem passage.
>
> **Primary Threats:** Hatchery management that results in high proportions of stray hatchery fish in natural spawning areas; current land use practices (grazing, roads, residences, forestry and agricultural practices that simplify habitats and irrigation withdrawals); the Columbia River mainstem hydropower system.
>
> **Primary Life Stages Affected:** Spawners, fry, summer parr, winter parr, smolts.
>
> **VSP Characteristics Impacted:** Abundance, productivity, spatial structure, diversity.

The Mid-C Expert Panel (2006) determined that current hatchery and land use practices are the primary threats to the viability of the Deschutes River Eastside steelhead population (Table 8-3).

Table 8-3. Key and secondary threats to viability of the Deschutes River Eastside steelhead population (Mid-C Expert Panel 2006).

Deschutes – Eastside Tributaries
Key Threats
Current Hatchery Practices • *Limiting factor(s) primarily affected:* Straying of hatchery steelhead into spawning grounds. • *Life stage(s) primarily affected:* Spawners. • *Specific threat(s):* Management designed to produce returns of hatchery summer steelhead to the Deschutes and many other upstream Columbia River tributaries results in significant proportions of stray hatchery steelhead spawning naturally in this population. The principal concern relates to a continuing detrimental impact of stray hatchery fish in natural spawning areas on the genetic traits and productivity of naturally produced steelhead. **Current Land Use Practices** • *Limiting factor(s) primarily affected:* Reduced water quantity and/or modified hydrograph; impaired physical habitat quality; elevated water temperatures. • *Life stage(s) primarily affected:* fry, summer parr, winter parr. • *Specific threat(s):* Current land use practices (agriculture, grazing, forest practices, road maintenance, etc.) that impact steelhead growth and survival, or modify natural hydrographs during critical periods in tributary streams. Improvement of some habitat conditions is expected to occur in the future, based on current land use practices that are much improved over historical practices.
Secondary Threats
Current Mainstem Columbia Hydropower System: (See discussion for Fifteenmile Creek population.) **Land Use Practices:** (See discussion for Fifteenmile Creek population.) **Harvest:** Mortality of returning adults in tributary streams from catch and release fishery. **Introduced Species***:* (See discussion for Fifteenmile Creek population.)

Deschutes River Westside Summer Steelhead Population
The Mid-C recovery planning team identified the following limiting factors and threats to the Deschutes River Westside steelhead population:

Primary Limiting Factors: *Tributary Habitat:* degraded channel structure and complexity, altered sediment routing, high water temperature, low flows and lack of fish passage over PRBC; *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage and tributary passage to blocked areas above Pelton-Round Butte Complex.

Primary Threats: Hatchery management that results in high rates of straying hatchery fish in natural spawning areas; current land use practices (grazing, roads, residences, forestry and agricultural practices that simplify habitats and irrigation withdrawals); the Columbia River mainstem hydropower system.

Primary Life Stages Affected: Spawners, fry, summer parr, winter parr, smolts.

VSP Characteristics Impacted: Abundance, productivity, spatial structure, diversity.

The Mid-C Expert Panel (2006) determined that current hatchery practices, hydropower influences, and land use practices are the primary threats to the viability of the Deschutes River Westside steelhead population (Table 8-4).

Table 8-4. Key and secondary threats to viability of the Deschutes River Westside steelhead population (Mid-C Expert Panel 2006).

Deschutes – Westside Tributaries
Key Threats
Current Hatchery Practices • *Limiting factor(s) primarily affected:* Stray hatchery steelhead spawn with wild population. • *Life stage(s) primarily affected:* Spawners. • *Specific threat(s):* Management designed to produce returns of hatchery summer steelhead to the Deschutes and many other upstream Columbia River tributaries results in significant proportions of stray hatchery steelhead spawning naturally in this population. Straying of these hatchery fish into natural spawning areas threatens the genetic traits and productivity of naturally produced steelhead. **Current Hydropower:** • *Limiting factor(s) primarily affected:* Impaired downstream migration through Lake Billy Chinook; blocked migration above Pelton Dam. • *Life stage(s) primarily affected:* Smolts and returning adults. • *Specific threat(s):* Fish passage currently blocked at Pelton Dam on the Deschutes, eliminating access by steelhead to a significant portion of the historical distribution of this population. **Current Land Use Practices** • *Limiting factor(s) primarily affected:* Impaired physical habitat quality. • *Life stage(s) primarily affected:* fry, summer parr, winter parr. • *Specific threat(s):* Current land use practices (agriculture, grazing, forestry, road maintenance) that negatively impact steelhead growth and survival in tributary streams. Improvement of some habitat conditions is expected to occur in the future, based on current land use practices that are much improved over historical practices.
Secondary Threats
Current Mainstem Columbia Hydropower System: (See discussion for Fifteenmile Creek population.) **Land Use Practices***:* Cumulative impact of past and present activities on estuarine habitat for pre-smolts and smolts; predation by birds on pre-smolts and smolts in estuary because of creation of dredge spoil islands; elevated water temperatures and increased fine sediment from past and present agricultural and forestry practices reduce survival of eggs and alevins in tributary streams; reduced water quantity and/or modified hydrograph impacts growth and survival of fry and summer parr in tributaries. **Harvest***:* Mortality of returning adults in tributary streams from catch and release fishery. **Introduced Species***:* (See discussion for Fifteenmile Creek population.)

Crooked River Summer Steelhead Population

Members of the Mid-C recovery planning team identified the following limiting factors and threats to the Crooked River steelhead population:

> **Primary Limiting Factors:** *Tributary Habitat*: degraded channel structure and complexity, floodplain connectivity, degraded riparian condition, altered sediment routing, high water temperatures, low flows, and passage barriers. *Hydro*: mainstem Columbia river passage and passage in the Deschutes River mainstem to blocked areas above Pelton-Round Butte Complex.
>
> **Primary Threats:** Current land use practices (including grazing, roads, residential development, forestry and agricultural practices that simplify habitats and irrigation withdrawals); the Pelton-Round Butte Complex and the Columbia River mainstem hydropower system; passage barriers that block access to tributary spawning and rearing habitat.
>
> **Primary Life Stages Affected:** Spawners, fry, summer parr, winter parr, smolts and adult migrants.
>
> **VSP Characteristics Impacted:** Abundance, productivity, spatial structure, diversity.

The Mid-C Expert Panel (2006) determined that current land use practices and the Pelton-Round Butte Complex are primary threats to viability of the Crooked River steelhead population (Table 8-5).

Table 8-5. Key and secondary threats to viability of the extinct Deschutes Crooked River steelhead population (Mid-C Expert Panel 2006).

Deschutes – Crooked River (Extinct population)
Key Threats
Current Hydropower • *Limiting factor(s) primarily affected:* Impaired downstream migration; blocked upstream migration, hydrograph, water quantity. • *Life stage(s) primarily affected:* smolts and returning adults. • *Specific threat(s):* Fish passage is currently blocked at Pelton Dam on the mainstem Deschutes, thereby entirely eliminating access by steelhead to the historic distribution of this population. **Current Land Use Practices/Irrigation System** • *Limiting factor(s) primarily affected*: Fish migration; impaired physical habitat quality; elevated water temperatures; reduced water quantity and/or modified hydrograph, population traits. • *Life stage(s) primarily affected:* fry, summer parr, winter parr, adults. • *Specific threat(s):* Current land use practices (agriculture, grazing, forestry, road maintenance, etc.) that impact steelhead growth and survival in tributaries; irrigation diversions. These conditions would impair the likelihood of re-establishing a self-sustaining population of steelhead in the future. Improvement of some habitat conditions is expected to occur in the future, based on current land use practices that are much improved over historic practices. Maintenance of an irrigation water storage system in the Crooked River alters the seasonal hydrograph (lower summer flows, higher autumn flows) and increases summer water temperatures. These conditions would impair the likelihood of re-establishing a self-sustaining population of steelhead in the future.
Secondary Threats
Current Mainstem Columbia Hydropower System: Direct mortality of pre-smolts and smolts at The Dalles and Bonneville dams; delayed upstream migration of returning adults over dams; cumulative impact of system on mainstem and estuary habitat for pre-smolts and smolts. **Land Use Practices***:* Cumulative impact of past and present activities on estuarine habitat for pre-smolts and smolts; predation by birds on pre-smolts and smolts in estuary because of creation of dredge spoil islands; increased fine sediment from past and present agricultural and forestry practices reduce survival of eggs and alevins in tributary streams. **Introduced Species:** Predation by non-native piscivorous fish on pre-smolts and smolts in mainstem Columbia.

Lower Mainstem John Day River Summer Steelhead Population

The Mid-C recovery planning team identified the following limiting factors and threats to the Lower Mainstem John Day River steelhead population:

Primary Limiting Factors: *Tributary Habitat*: degraded channel structure and complexity (habitat quantity and diversity), altered sediment routing, water temperature, and altered hydrology. Impaired fish passage is also a high priority limiting factor in Bridge, Butte, Kahler, Muddy, Rock, and Thirtymile creeks; *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage.

Primary Threats: Hatchery management that results in high rates of straying hatchery fish in natural spawning areas; current land use practices (agricultural and grazing practices, removal of overstory trees and bank vegetation from the riparian corridor, water withdrawals, wetland draining and conversion, and stream channelization and diking; the Columbia River mainstem hydropower system.

Primary Life Stages Affected: Juvenile rearing, egg incubation, egg-to-fry, fry-to-smolt, smolts.

VSP Characteristics Impacted: Abundance, productivity, spatial structure, diversity.

The Mid-C Expert Panel (2006) determined that current hatchery and land use practices are the primary threats to viability of the Lower Mainstem John Day River steelhead population (Table 8-6).

Table 8-6. Key and secondary threats to viability of the Lower Mainstem John Day River steelhead population (Mid-C Expert Panel 2006).

John Day River – Lower Mainstem
Key Threats
Current Hatchery Practices • *Limiting factor(s) primarily affected:* Straying of hatchery steelhead into tributaries. • *Life stage(s) primarily affected:* Spawners. • *Specific threat(s):* Management designed to produce returns of hatchery summer steelhead to upstream Columbia River tributaries results in significant proportions of stray hatchery steelhead spawning naturally in this population. Straying of hatchery fish into natural spawning areas poses risks to the genetic traits and productivity of naturally produced steelhead. **Current Land Use Practices** • *Limiting factor(s) primarily affected:* Impaired physical habitat quality; elevated water temperatures. • *Life stage(s) primarily affected:* Fry, summer parr and winter parr. • *Specific threat(s):* Past and/or current land use practices (agriculture, grazing, forest practices) that impart steelhead growth and survival in tributaries. Improvement of some habitat conditions is expected to occur in the future, based on current land use practices that are much improved over historical practices.
Secondary Threats
Current Mainstem Columbia Hydropower System: Direct mortality of pre-smolts and smolts at John Day, The Dalles and Bonneville dams; delayed upstream migration of returning adults over dams; false attraction of returning adults over Mc Nary Dam; cumulative impact of system on mainstem and estuary habitat for pre-smolts and smolts. **Land Use Practices**: Cumulative impact of past and present activities on estuarine habitat for pre-smolts and smolts; predation by birds on pre-smolts and smolts in estuary from creation of dredge spoil islands; increased fine sediment from agricultural and forestry practices reduces egg and alevin survival tributaries; reduced water quantity and/or modified hydrograph that impact growth and survival of fry and summer parr in tributaries. **Introduced Species**: Predation by non-native piscivorous fish on pre-smolts and smolts in mainstem Columbia.

North Fork John Day River Summer Steelhead Population

The Mid-C recovery planning team identified the following limiting factors and threats to the North Fork John Day River steelhead population:

> **Primary Limiting Factors**: *Tributary Habitat*: degraded floodplain connectivity and function, degraded channel structure and complexity (key habitat quantity, habitat diversity, channel stability), altered sediment routing, water temperature, and low flows; *Hatchery*: effects of naturally spawning stray hatchery fish on viability; *Hydro*: mainstem passage.
>
> **Primary Threats:** Hatchery management that results in high rates of straying hatchery fish in natural spawning areas; current land use practices (riparian disturbance, stream channelization and relocation, grazing, forest practices, road building, irrigation withdrawals, mining and dredging); the Columbia River mainstem hydropower system.
>
> **Primary Life Stages Affected:** Parr-to-smolt survival, egg-to-fry survival, smolts.
>
> **VSP Characteristics Impacted:** Abundance, productivity, diversity.

The Mid-C Expert Panel (2006) concluded that current land use practices are the primary threat to viability of the North Fork John Day River steelhead population (Table 8-7).

Table 8-7. Key and secondary threats to viability of the North Fork John Day River steelhead population (Mid-C Expert Panel 2006).

John Day River – North Fork
Key Threats
Current Land Use Practices • *Limiting factor(s) primarily affected*: Impaired physical habitat quality; elevated water temperatures. • *Life stage(s) primarily affected:* fry, summer parr, winter parr. • *Specific threat(s):* Past and current land use practices (agriculture, grazing, forestry, road maintenance) that impact steelhead growth and survival in tributary streams. Improvement of some habitat conditions is expected in the future, based on current land use practices that are much improved over historical practices.
Secondary Threats
Current Mainstem Columbia Hydropower System: (See discussion for Lower Mainstem John Day population.) **Land Use Practices**: (See discussion for Lower Mainstem John Day population.) **Introduced Species**: (See discussion for Lower Mainstem John Day population.)

Middle Fork John Day River Summer Steelhead Population

The Mid-C recovery planning team identified the following limiting factors and threats to the Middle Fork John Day River steelhead population:

> **Primary Limiting Factors:** *Tributary Habitat:* degraded channel structure and complexity (habitat quantity and diversity), degraded floodplain function and connectivity, altered sediment routing, altered hydrology, and water temperature; *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage.
>
> **Primary Threats:** Hatchery management that results in high rates of straying hatchery fish in natural spawning areas; current land use practices (riparian disturbance, stream channelization and relocation, grazing, forest practices, road building, passage barriers, irrigation withdrawals, mining and dredging); the Columbia River mainstem hydropower system.
>
> **Primary Life Stages Affected:** fry-to-smolt, egg incubation; egg-to-parr, smolts, adult spawning.
>
> **VSP Characteristics Impacted:** Abundance, productivity, diversity.

The Mid-C Expert Panel (2006) concluded that current land use practices are the primary threat to viability of the Middle Fork John Day River steelhead population (Table 8-8).

Table 8-8. Key and secondary threats to viability of the Middle Fork John Day River steelhead population (Mid-C Expert Panel 2006).

John Day River – Middle Fork
Key Threats
Current Land Use Practices • *Limiting factor(s) primarily affected*: Impaired physical habitat quality; elevated water temperatures • *Life stage(s) primarily affected:* fry, summer parr, winter parr. • *Specific threat(s):* Past and current practices (grazing, forest practices, road maintenance) that impact steelhead growth and survival in tributaries. Improvement of some habitat conditions is expected to occur in the future, based on current land use practices that are much improved over historical practices.
Secondary Threats
Current Mainstem Columbia Hydropower System: (See discussion for Lower Mainstem John Day population.) **Land Use Practices**: (Factors identified in discussion for Lower Mainstem John Day population, plus push-up dams that impair upstream passage of returning adults and upstream and downstream movement of fry and summer parr.) **Introduced Species**: (See discussion for Lower Mainstem John Day population.)

South Fork John Day River Summer Steelhead Population

The Mid-C recovery planning team identified the following limiting factors and threats to the South Fork John Day River steelhead population:

> **Primary Limiting Factors:** *Tributary Habitat*: altered sediment routing, degraded channel structure and complexity (habitat quantity and diversity), altered hydrology and low flow, water temperature, and impaired fish passage; *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage.
>
> **Primary Threats:** Hatchery management that results in high rates of straying hatchery fish in natural spawning areas; current land use practices (riparian disturbance, stream channelization and relocation, grazing, forest practices, road building, fish passage barriers (culverts, and other seasonal barriers), and irrigation withdrawals); the Columbia River mainstem hydropower system.
>
> **Primary Life Stages Affected:** Juvenile rearing, adult spawning, egg incubation, egg-to-parr survival, smolts.
>
> **VSP Characteristics Impacted:** Abundance, productivity, diversity.

The Mid-C Expert Panel (2006) determined that current land use practices pose the primary threat to viability of the South Fork John Day River steelhead population (Table 8-9).

Table 8-9. Key and secondary threats to viability of the South Fork John Day River steelhead population (Mid-C Expert Panel 2006).

John Day River – South Fork
Key Threats
Current Land Use Practices • *Limiting factor(s) primarily affected:* Reduced water quantity and/or modified hydrograph; impaired physical habitat quality; impaired fish passage; elevated water temperatures. • *Life stage(s) primarily affected:* fry, summer parr, winter parr, returning adults. • *Specific threat(s):* Current land use practices (agriculture, push-up dams that provide irrigation water, grazing, etc.) that impact steelhead growth and survival in tributaries; push-up dams that block or impair fish movement. Improvement of some habitat conditions is expected in the future, based on current land use practices that are much improved over historical practices.
Secondary Threats
Current Mainstem Columbia Hydropower System: (See discussion for Lower Mainstem John Day population.) **Land Use Practices**: Cumulative impact of past and present activities on estuarine habitat for pre-smolts and smolts; predation by birds on pre-smolts and smolts in estuary because of creation of dredge spoil islands; increased fine sediment from agricultural and forestry practices reduces egg and alevin survival tributaries. **Introduced Species**: (See discussion for Lower Mainstem John Day population.)

Upper Mainstem John Day River Summer Steelhead Population

The Mid-C recovery planning team identified the following limiting factors and threats to the Upper Mainstem John Day River steelhead population:

> **Primary Limiting Factors:** *Tributary Habitat:* degraded channel structure and complexity (habitat quantity and diversity), degraded riparian areas and LWD recruitment, altered sediment routing, water temperatures, altered hydrology and degraded floodplain function and connectivity. Impaired fish passage is also a priority limiting factor in Beech and Laycock creeks; *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage.
>
> **Primary Threats:** Hatchery management that results in high rates of straying hatchery fish in natural spawning areas; current land use practices (agricultural practices, livestock overgrazing, removal of large trees from the riparian corridor, wetland draining and conversion, stream channelization/diking); the Columbia River mainstem hydropower system.
>
> **Primary Life Stages Affected:** Juvenile rearing, egg incubation, egg-to-parr survival, smolts, adult spawning.
>
> **VSP Characteristics Impacted:** Abundance, productivity, spatial structure, diversity.

The Mid-C Expert Panel (2006) determined that current land use practices pose the primary threat to viability of the Upper Mainstem John Day River steelhead population (Table 8-10).

Table 8-10. Key and secondary threats to viability of the Upper Mainstem John Day River steelhead population (Mid-C Expert Panel 2006).

John Day River – Upper Mainstem
Key Threats
Current Land Use Practices • *Limiting factor(s) primarily affected:* Reduced water quantity and/or modified hydrograph; impaired physical habitat quality; elevated water temperatures. • *Life stage(s) primarily affected:* fry, summer parr, winter parr. • *Specific threat(s):* Current land use practices (agriculture, forestry, push-up dams that provide irrigation water, grazing, etc.) that impact steelhead growth and survival in tributaries. Improvement of some habitat conditions is expected in the future due to current practices that are much improved over historical practices.
Secondary Threats
Current Mainstem Columbia Hydropower System: (See discussion for Lower Mainstem John Day population.) **Land Use Practices**: (See discussion for South Fork John Day population.). **Introduced Species**: (See discussion for Lower Mainstem John Day population.)

Umatilla River Summer Steelhead Population

The Mid-C recovery planning team identified the following limiting factors and threats to the Umatilla River steelhead population:

> **Primary Limiting Factors:** *Tributary Habitat*: high water temperature, sediment routing, impaired fish passage, degraded channel structure and complexity and low flows; *Hatchery*: effects of naturally spawning stray hatchery fish on viability; *Hydro*: mainstem passage.
>
> **Primary Threats:** Hatchery management that results in high rates of straying hatchery fish in natural spawning areas; current land use practices that reduce habitat quality, quantity and disrupt ecosystem functions; the Columbia River hydropower system.
>
> **Primary Life Stages Affected:** fry, summer parr, winter parr, smolts.
>
> **VSP Characteristics Impacted:** Abundance, productivity, spatial structure, diversity.

The Mid-C Expert Panel (2006) determined that current land use practices pose the primary threat to viability of the Umatilla steelhead population (Table 8-11).

Table 8-11. Key and secondary threats to viability of the Umatilla River steelhead population (Mid-C Expert Panel 2006).

Umatilla
Key Threats
Current Land Use Practices • *Limiting factor(s) primarily affected:* Reduced water quantity and/or modified hydrograph; impaired physical habitat quality; impaired fish movement and habitat access; elevated water temperatures. • *Life stage(s) primarily affected:* fry, summer parr, winter parr. • *Specific threat(s):* Current land use practices (agriculture, un-screened irrigation diversions, maintenance of the irrigation impoundment system that provides irrigation water and flow control, forest practices, grazing) that impact steelhead growth and survival in tributaries. Improvement of some habitat conditions is expected to occur in the future, based on current land use practices that are much improved over historical practices.
Secondary Threats
Current Mainstem Columbia Hydropower System: Direct mortality of pre-smolts and smolts at John Day, The Dalles and Bonneville dams; delayed upstream migration of returning adults over dams; cumulative impact of system on mainstem and estuary habitat for pre-smolts and smolts. **Hatchery Practices**: Stray hatchery steelhead spawn in tributaries with wild population creating a risk of genetic introgression. **Land Use Practices**: Cumulative impact of past and present activities on estuarine habitat for pre-smolts and smolts; predation by birds on pre-smolts and smolts in estuary because of creation of dredge spoil islands; increased fine sediment from agricultural and forestry practices reduces egg and alevin survival in tributaries. **Introduced Species**: Predation by non-native piscivorous fish on pre-smolts and smolts in mainstem Columbia.

Walla Walla River Summer Steelhead Population

The Mid-C recovery planning team identified the following limiting factors and threats to the Walla Walla River steelhead population:

> **Primary Limiting Factors:** *Tributary Habitat*: high water temperature, sediment routing, impaired fish passage, degraded channel structure and complexity, degraded floodplain connectivity and function, and low flow; *Hatchery:* effects of naturally spawning stray hatchery fish on viability; *Hydro:* mainstem passage.
>
> **Primary Threats:** Hatchery management that results in high rates of straying hatchery fish in natural spawning areas; current land use practices that reduce habitat quality, quantity and disrupt ecosystem functions; the Columbia River mainstem hydrosystem.
>
> **Primary Life Stages Affected:** fry, summer parr, winter parr, smolts.
>
> **VSP Characteristics Impacted:** Abundance, productivity, spatial structure, diversity.

The Mid-C Expert Panel (2006) determined that current land use practices pose the primary threat to viability of the Walla Walla River steelhead population (Table 8-12).

Table 8-12. Key and secondary threats to viability of the Walla Walla River steelhead population (Mid-C Expert Panel 2006).

Walla Walla
Key Threats
Current Land Use Practices • *Limiting factor(s) primarily affected*: Reduced water quantity and/or modified hydrograph; impaired physical habitat quality; impaired fish movement and habitat access; elevated water temperatures. • *Life stage(s) primarily affected:* fry, summer parr, winter parr. • *Specific threat(s):* Current land use practices (agriculture, un-screened irrigation diversions, push-up dams, maintenance of the irrigation impoundment system that provides irrigation water and flow control, forest practices, grazing) that impair steelhead growth and survival in tributaries. Improvement of some habitat conditions is expected in the future, based on current practices that are much improved over historical practices.
Secondary Threats
Current Mainstem Columbia Hydropower System: Direct mortality of pre-smolts and smolts at John Day, The Dalles and Bonneville dams; delayed upstream migration of returning adults over dams; cumulative impact of system on mainstem and estuary habitat for pre-smolts and smolts. **Hatchery Practices**: Stray hatchery steelhead spawn in tributaries with wild population creating a risk of genetic introgression. **Land Use Practices**: Cumulative impact of past and present activities on estuarine habitat for pre-smolts and smolts; predation by birds on pre-smolts and smolts in estuary because of creation of dredge spoil islands; increased fine sediment from agricultural and forestry practices reduces egg and alevin survival in tributaries. **Introduced Species**: Predation by non-native piscivorous fish on pre-smolts and smolts in mainstem Columbia.

8.2 Tributary Habitat

Historically, habitat conditions in the Fifteenmile, Deschutes, John Day, Umatilla, and Walla Walla subbasins supported productive and viable steelhead populations. Natural processes created diverse instream habitats with deep pools and strong connections to floodplains. Many stream channels contained abundant large wood from surrounding riparian hardwood galleries, including cottonwood, aspen, willow, and upstream conifer forests. Stream temperatures were generally sufficient to support all steelhead life stages throughout the year, as upland and riparian conditions allowed for the storage and release of cool water during the dry, summer months and provided shaded sufficient to keep water temperatures cool. Extensive and abundant riparian vegetation armored streambanks, providing protection against erosion.

Conditions in these tributary drainages have changed considerably over the last 150 years. Together, past land use practices across the region contributed significantly to causing the factors now limiting abundance, productivity, and diversity of Mid-C steelhead. As noted by the Expert Panel, and indicated by the EDT limiting factors analyses, historical spawning and rearing areas are now often degraded restricting steelhead abundance, productivity, spatial structure and diversity. However, while harmful land use practices continue today, many landowners now understand the advantages of good conservation practices and have changed their approaches to farming, grazing, forest practices and other activities so that important ecosystem processes and functions can recover. In addition, a suite of regulatory programs have been implemented to protect and restore steelhead habitat conditions. Many people are also voluntarily protecting and restoring stream corridors, wetlands, and other natural features that influence the viability of salmonid populations. Such changes are slowly improving habitat conditions for Mid-C steelhead and other species, while also restoring overall watershed health.

Nevertheless, two emerging threats — forest health and land use conversion — need to be acknowledged. Management actions of the past, including unregulated forest practices, poorly managed livestock grazing, and fire suppression have modified patterns of vegetation in forest and range habitats. These changes have resulted in alteration of important ecosystem processes such as fire, insects and succession. In some cases, current conditions are a significant departure from historical. Fire suppression and silvicultural practices in some Mid-C forests have modified the historical fire regimes and contributed to unnaturally heavy fuel loads. A significant proportion of the forested landscape in the Westside Deschutes, North Fork John Day, Middle Fork John Day, and Upper Mainstem John Day populations is now characterized by such conditions and is classified by the USFS (Schmidt et al. 2002) as condition class 3 with severely altered fire regimes and vegetation attributes significantly altered from the historical conditions (Figure 8-1). Unless improved, areas within these significantly altered landscapes will likely experience intensive wild fires that can impact steelhead recovery efforts, at least in the short term.

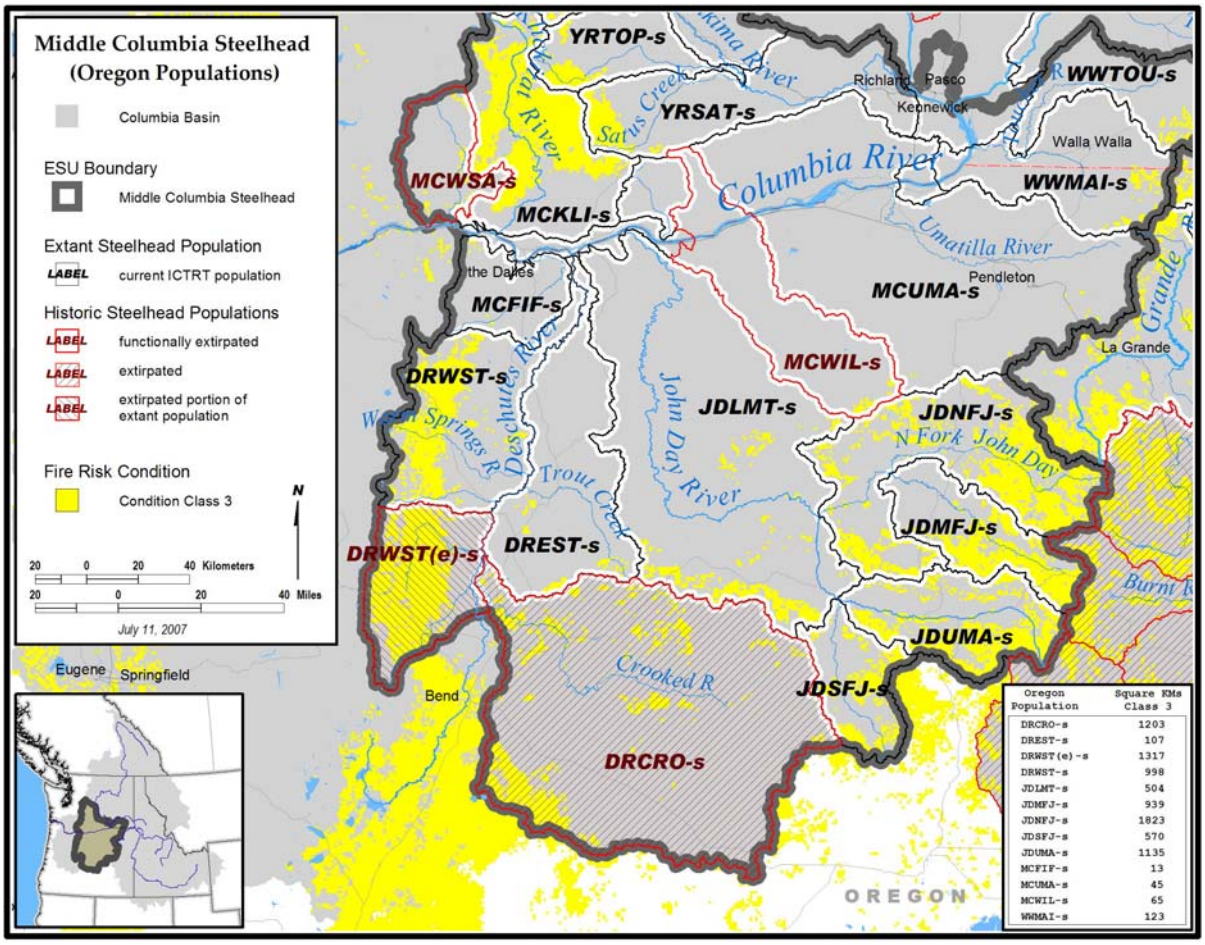


Figure 8-1. Areas within Oregon Mid-C steelhead populations that have significantly altered fire regimes and vegetative attributes that are altered from the historical condition (USFS condition class 3).

Although significant proportions of the forested landscape in these four populations are classified as condition class 3, the degree of threat to the viability of steelhead is uncertain. Much of the research over the past 15 years has demonstrated that, in general, episodic wildfires and post-fire flood events tend to produce long-term habitat benefits for salmonids. The immediate adverse impacts, when they occur, are relatively short term in duration (Howell, 2006; Rieman et al. 1997; Sestrick, 2005; Dunham et al. 2003). However, particularly after large intensive wildfires, water temperatures may increase where streamwide vegetation is destroyed and post-fire channel reorganizing flood events occur, though this does not occur in all cases. In cases where temperatures rise, they can remain elevated for periods of ten years or longer, but rainbow trout quickly repopulate such areas post-fire when fish passage has not been obstructed, and populations maintain their distributions (Dunham et al. 2007). Soil erosion and sediment losses may also increase significantly after intense wildfires, depending on area topography, precipitation, and restoration efforts, adversely impacting spawning and rearing habitats and increasing the short-term risks to viability of some populations (Rieman et al. 2000).

Strategic restoration efforts aimed at restoring such landscapes back to their natural vegetative conditions and their historical fire regimes could help enhance watershed function and forest health. Such approaches will most likely be effective only in areas where existing road systems can facilitate restoration activities without additional disturbance or impact (Rieman et al. 2000).

Rieman et al. (2000 and 2001) concluded that alteration of fire regimes did little to affect outcomes at the scale of the Interior Columbia River Basin and that aggressive active management could result in short-term fish habitat degradation. Specific to Mid-C steelhead populations in Oregon, Rieman et al. (2000) concluded that only in the Westside Deschutes River population and a few other locations would intensive forest restoration activities be potentially compatible with restoration of aquatic conditions, and only under very specific guidelines. The USFS specifically addressed the issue of fuels treatment as an action contributing to recovery of ESA listed salmonids. They concluded that any evaluation of trade-offs to ESA listed salmonids from fuel treatments will be dependent on local conditions and successful integration of both forest and aquatic system restoration objectives. Site specific multi-scale analyses to evaluate benefits and risks of fuels treatments are necessary to assess potential value or detriment to recovery (Appendix J).

In addition to previously described forest health issues, western juniper has expanded across a large area within the DPS. The estimated acres of juniper forest and savanna in Oregon increased since the 1930's from about 1.5 million acres to 6.5 million acres. The expansion of juniper across the landscape has had an uncertain and unquantified affect on aquatic habitat. Junipers may use more water than other vegetation and can outcompete native vegetation. The overall results are potential reduction in streamflow and altered hydrological processes.

Land use conversion is also an emerging threat. Oregon has had a statewide land use program since 1973. In spite of this effort, areas within the Mid-C DPS, such as the Deschutes subbasin, have experienced a high rate of conversion from resource land to developed land. Deschutes County has been one of the fastest growing counties in the Northwest. The extent to which this conversion has influenced aquatic habitat in the recent past, and the future impact of land use conversion on Mid-C steelhead has not been quantified. Although we did not identify forest

health and land use conversion as primary or secondary threats, there are a number of management actions to address these threats in the management actions section.

We defined seven general types of tributary habitat factors that limit the viability of Oregon's ten steelhead populations in the Mid-C DPS and listed the key contemporary threats to each population at specific life stages.

Degraded floodplain connectivity and function: The loss, impairment or degradation of floodplain connectivity; access to previously available habitats (seasonal wetlands, off-channel habitat, side channels); and a connected and functional hyporheic zone. This factor includes reduced overwinter habitat and channel habitat. Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

Degraded channel structure and complexity: The loss, impairment or degradation of channels; a suitable distribution of riffles and functional pools; functional amounts and sizes of large woody debris or other channel structure. Includes reduced summer rearing habitat, degraded spawning habitat, reduced diversity and structure (wood, boulders, etc.), inadequate quantity or depth of pools, loss of side and braided channels. Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

Degraded riparian areas and LWD recruitment: The loss, degradation or impairment of riparian conditions important for production of food organisms and organic material, shading, bank stabilizing by roots, nutrient and chemical mediation, control of surface erosion, and production of large-sized woody material. Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

Altered hydrologic processes: Changes in the hydrograph that alter the natural pattern of flows over the seasons, causing inadequate flow, scouring flow, or other flow conditions that inhibit the development and survival of salmonids. Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

Degraded water quality: Degraded or impaired water quality due to abnormal temperature, or levels of suspended fine sediment, dissolved oxygen, nutrients from agricultural runoff, heavy metals, pesticides, herbicides and other contaminants (toxics). Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

Altered sediment routing: Altered sediment routing leading to an overabundance of fine-grained sediments, excess of course-grained sediments, inadequate course-grained sediments and/or contaminated sediment. Includes excessive fine sediment that reduces spawning gravel or increases embeddedness. Life stages affected: egg-to-parr survival.

Impaired fish passage: The total or partial human-caused blockage to previously accessible habitat that eliminates or decreases migration ability or alters the range of conditions under which migration is possible. This may include seasonal or periodic total migration blockage. Includes dams, culverts, seasonal push up dams, unscreened

diversions, and entrainment in irrigation diversions. Life stages affected: smolt migration, adult migration, juvenile upstream migration due to thermal blockage or water availability.

These habitat limiting factors are often interrelated. For example, degraded riparian condition often results in channel straightening, elimination of off-channel habitat, loss of large woody debris, reduced channel roughness, increased water temperatures, and increased sedimentation. Changes in the hydrograph — such as through loss of storage on connected riparian areas, floodplains and uplands — often lead to higher peak flows and lower summer flows, which can impair water conditions and temperatures, or restrict fish movement between habitat reaches.

8.2.1 Fifteenmile Creek Winter Steelhead, Tributary Habitat Limiting Factors

The primary habitat-related limiting factors identified by the recovery planning team for the Fifteenmile Creek steelhead population are low flows, high water temperatures, sedimentation, channel confinement and overall habitat loss due to degraded channel structure and complexity.

Degraded floodplain connectivity and function
By 1910, irrigated farms and pastures occupied the floodplains of Fifteenmile, Eightmile, and Fivemile creeks. Development of irrigated farms and pastures on the floodplain and throughout the valley floor, and associated channel straightening and confinement, reduced available off-channel habitat and floodplain connectivity within the Fifteenmile subbasin. Off-channel habitat and floodplain connectivity declined further with the loss of beaver and from channel straightening and debris removal associated with flood restoration (NPCC 2004a). Stream straightening and debris removal increased stream energy and channel downcutting, causing streams to abandon floodplains and associated off-channels.

Degraded channel structure and complexity
In-channel large wood in the subbasin has declined considerably from historical levels due to channel cleanout and removal of source trees, and resulted in reduced pool frequency and quality. Stream straightening and debris removal led to increased bank erosion and a higher width/depth ratio. Streambank erosion has increased considerably over background levels resulting in direct input of large volumes of sediment and a corresponding increase in width/depth ratio. EDT analysis shows that habitat complexity ─ including habitat diversity, key habitat quantity, and channel stability ─ have been degraded by the straightening and channelization of streams, and other factors. EDT results rated most of the Fifteenmile Creek watershed, except Dry Creek, as a moderate priority for restoring habitat diversity for spawning, active rearing of all age-classes, juvenile migration, winter inactivity, and prespawning holding (NPCC 2004a).

Habitat conditions in the Fifteenmile Creek watershed have begun to improve because of habitat restoration projects conducted since the 1980s. Recent large wood placement and riparian restoration within the Fifteenmile Creek watershed will increase off-channel habitat and floodplain connectivity by encouraging channels to aggrade, but more work is needed. Large wood placement will function to restore processes in the short term, and riparian restoration will help stabilize streambanks and restore ecological processes over the long term. As more large

wood is placed or is naturally recruited, structures that can accommodate movement of large wood will be needed.

Impaired fish passage
While many physical barriers in the Fifteenmile Creek watershed have at least been partially fixed, some remain. Fish screens have been installed on 80 diversions and 5 fish ladders have been installed at diversion structures. Although the fish ladders are no longer barriers to adults, they may still be barriers to upstream juvenile migration (NPCC 2004a). A 1998 ODFW culvert survey identified 11 culverts not meeting fish passage criteria on intermittent streams.

Degraded riparian communities and large wood recruitment
Development of farms, pastures and residential areas in the Fifteenmile subbasin considerably impacted riparian condition and connectivity. Roads were also located in many riparian areas, confining stream channels and eliminating riparian vegetation. Below the forested areas, riparian vegetation and large woody debris was nearly gone well before 1980 due to extensive management associated with residences, agriculture, flood control, livestock grazing, and roads (NPCC 2004a). Riparian impacts were also present in forested areas, but to a lesser extent.

Riparian buffer programs and various restoration projects have been implemented to protect and restore riparian habitat. Timber harvest on national forest land has declined sharply since adoption of the Northwest Forest Plan in 1990. Since 1980, the Forest Service has been working to replace large wood in channels and on floodplains (NPCC 2004a). Roads have largely been eliminated in riparian area on national forest lands, though the middle and lower portions of the watershed still contain extensive riparian roads. In addition, riparian buffers have been established in many parts of the Fifteenmile Creek watershed, areas. Riparian conditions are improving in the lower parts of the watershed through ODFW and USDA programs, and beavers have started re-colonizing the lower watershed. Approximately 126 miles of stream in the watershed has some protection through some form of riparian buffer, either through the NWFP on federal lands, the Forest Practices Act on private forest lands, or programs available to private landowners. Currently, about 30 miles of anadromous habitat lack a forested buffer in the watershed.

Degraded water quality
High water temperatures restrict steelhead production in the Fifteenmile Creek subbasin, particularly in the lower watershed. While spawning occurs in most presettlement spawning areas, temperatures become too high to support one or more life stages. Portions of the middle and lower watershed cannot support any steelhead life stages during late summer due to high water temperatures or dry streams (NPCC 2004a). Water temperatures can also create thermal barriers that prevent fish from moving to cooler reaches. Water temperatures in late summer in lower Fifteenmile Creek, Eightmile Creek, and Fivemile Creek are too high to allow for passage of any life stages. Several reaches in the subbasin are on the 303(d) list for temperature, including Fifteenmile, Ramsey, Dry, Eightmile and Fivemile creeks. Some areas in the watershed exceed the cold-water and rearing standards and are believed to exceed the spawning standard as well, although most of the temperature monitoring has occurred during the summer.

Water quality in the Fifteenmile Creek watershed is also degraded by suspended sediment associated with erosion from land management activities, and possibly chemical contaminants and nutrients. While there is currently not enough data to determine if chemical contaminants and nutrient are a problem, both are likely above presettlement levels because of fertilizer and pesticide use for agriculture.

Altered hydrologic processes

Forest practices, conversion of shrub-steppe habitat to agricultural land, loss of beaver, and road development in the Fifteenmile Creek drainage have affected the subbasin's natural hydrologic regime, resulting in higher peak flows and lower base flows. Peak flows increased by as much as 600% between 1850 and 1950 as very little water was being retained in the soil. On forest lands, runoff increased by 1 to 6% due to forest practices and roads (NPCC 2004a). Below the forest boundary, irrigation withdrawals and the dry climate result in very low flows in most Fifteenmile subbasin streams during the summer. At the time of low summer flow, streamflow has been nearly fully appropriated for irrigation since the early 1900s. The change in base flows causes most lower elevation tributaries to become intermittent during summer months, with flows in some smaller tributaries drying up completely. The shallow water depths can prevent fish passage. The lower portions of Fifteenmile, Eightmile, and Fivemile creeks have been the most impacted by low flows, high water temperatures, and overall habitat loss.

Peak flows have the greatest potential for recovering native vegetation; however, peak flows have partially recovered with the adoption of no-till techniques. Over half of the agricultural land in the watershed has been converted to direct-seed/no-till systems that reduce runoff and erosion by increasing infiltration, leaving 50,000 to 60,000 acres that could be converted (NPCC 2004a).

Altered sediment routing

The geology in the Fifteenmile Creek subbasin lends itself to erosion so any management that disturbs the soil increases fine sediment production. Fine sediment in spawning gravel is a primary concern in the subbasin. Extensive soil loss associated with tilled agriculture has contributed to increased fine sediment in spawning gravel. By 1950, soil loss due to water erosion associated with tilled agriculture in the Fifteenmile Creek watershed was as high as 20 tons per acre per year. Steep slopes and clean tillage were largely responsible for the soil loss (NPCC 2004a). Fifteenmile and Ramsey creeks are on the 303(d) list for sedimentation, and EDT modeling identified sedimentation as one of the key factors inhibiting steelhead production (NPCC 2004a). The adoption of minimum-till and no-till techniques on well over half of the tilled acreage in the watershed has reduced erosion and fine sediment delivery to streams in recent years. Rates of erosion and sediment delivery, however, remain elevated above presettlement rates.

In addition, riparian road densities are highest on private land adjacent to Fivemile, Eightmile, and lower Fifteenmile creeks, with more than a half mile of road per mile of stream within 200 feet of the stream. Forest Service pebble counts have found elevated levels of sand and fine sediment in streams throughout the watershed (NPCC 2004a).

Table 8-13 shows the primary limiting factors identified in the EDT Diagnostic Report for the Fifteenmile Creek winter steelhead population. A summary of the major limiting factors and threats by geographic area is presented in Table 8-14.

Table 8-13. Limiting factors and priorities for protection and restoration as defined by EDT for Fifteenmile Creek Winter Steelhead.

Geographic area priority			Attribute class priority for restoration																
Geographic area	Protection benefit	Restoration benefit	Channel stability	Chemicals	Competition (w/ hatch)	Competition (other sp)	Flow	Food	Habitat diversity	Harassment/poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment load	Temperature	Withdrawals	Key habitat quantity
Fifteenmile Cr-1							●		●			●	●	●	●	●		●
Fifteenmile Cr-2																		
Fifteenmile Cr-3		○	●				●	●	●	●		●	●		●	●		●
Eightmile Cr-1		○	●		●		●	●	●	●			●		●	●		●
Fivemile Cr-1		○	●		●		●	●	●	●			●			●		●
Fivemile Cr-2		○	●				●	●	●	●			●	●		●	●	●
Fivemile Cr-3		◯	●		●		●	●	●	●			●	●		●	●	●
Fivemile Cr-4	○	◯	●				●		●	●					●	●		●
Fivemile Cr SF-1							●		●									●
Fivemile Cr MF-1	○	○	●				●		●									●
Fivemile Cr MF-2											●							
Fivemile Cr MF-3			●				●		●									
Eightmile Cr-2		○	●		●		●	●	●	●			●	●	●	●		●
Eightmile Cr-3		○	●		●		●	●	●	●			●		●	●		●
Eightmile Cr-4		○	●				●	●	●	●			●		●	●		●
Eightmile Cr-5		○	●		●		●	●	●	●			●		●	●		●
Eightmile Cr-6		◯	●		●		●	●	●	●			●		●	●		●
Eightmile Cr-7	○	○	●				●	●	●	●						●		●
Eightmile Cr-8	◯	◯	●				●	●	●						●			●
Eightmile Cr-9	○		●				●		●						●			●
Eightmile Cr-10	◯	○	●				●		●						●			●
Eightmile Cr-11																		
Eightmile Cr-12			●				●		●						●			●
Eightmile Cr-13		○									●							
Eightmile Cr-14							●		●						●			●
Fifteenmile Cr-4		○	●		●		●	●	●	●		●	●		●	●		●
Fifteenmile Cr-5		◯	●		●		●	●	●	●		●	●		●	●		●
Fifteenmile Cr-6		○	●		●		●	●	●	●		●	●		●	●		●
Dry Cr-1		○	●		●		●	●	●	●			●		●	●		●
Dry Cr-2		○	●		●		●	●	●				●	●		●		●
Fifteenmile Cr-7		○	●		●		●	●	●	●			●		●	●		●
Fifteenmile Cr-8	○	○	●		●		●	●	●	●			●			●		●
Ramsey Cr-1		○	●				●	●	●	●			●		●	●		●
Ramsey Cr-2	○		●				●	●	●	●					●	●		●
Ramsey Cr-3	○	○	●				●		●						●			●
Ramsey Cr-4	◯	○					●		●									
Ramsey Cr-5											●							
Ramsey Cr-6			●				●		●						●			●
Ramsey Cr-7											●							
Ramsey Cr-8			●				●		●						●			●
Fifteenmile Cr-9	○	◯	●		●		●	●	●	●					●	●		●
Fifteenmile Cr-10	○		●				●		●						●	●		●
Fifteenmile Cr-11	○	○	●				●		●						●	●		●
Fifteenmile Cr-12	◯	○																●
Fifteenmile Cr-13	◯	○							●									●
Cedar Cr	○		●				●		●									●
Fifteenmile Cr-14	◯								●									●
Fifteenmile Cr-15	○																	●
Fifteenmile Cr-16	○		●						●									●

Key to strategic priority (corresponding Benefit Category letter also shown)

1/ "Channel stability" applies to freshwater areas only.

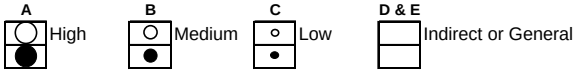


Table 8-14. Habitat limiting factors summary for the Fifteenmile Creek steelhead population.

Population MaSA and MiSA	Major Limiting Factors	Sites Affected*	VSP Characteristics Impacted	Threats	Life Stages Affected
FIFTEENMILE CREEK POPULATION					
Fifteenmile Creek Population	Altered hydrology (low flows); Water quality (temps); altered sediment routing; degraded floodplain; degraded channel structure (channel confinement, overall habitat loss), degraded riparian condition	MaSAs and MiSAs	Productivity, abundance, spatial structure, diversity	Roads, residential development, agricultural practices and forest practices, irrigation diversions, and loss of beaver	All life stages
Upper Fifteenmile Creek MaSA	Degraded floodplain and channel structure (shorter/steeper, diversity, stability); degraded riparian community; altered sediment routing; altered hydrology; degraded water quality (temp); blocked or impaired fish passage	Fifteenmile [F, CS, R, T (RM 0-40), H (mouth to Pine Cr.), S (RM 0-52.7)]; Dry Creek [F, CS, T (RM 0-16.6),H]; Ramsey Creek [F, CS, BP (on Mt. Hood NF block 2,357 feet of habitat), T (RM 0-5.4), H, S (RM 0-13.2)]; Long Hollow, Douglas Hollow, Standard Hollow, Mays Canyon [IP (culverts)]	Productivity, abundance, spatial structure and diversity	Roads, residential development, agricultural and forest practices, irrigation diversions, and loss of beaver	All life stages are affected.
Eightmile Creek MaSA	Water quality (temp); altered hydrology; degraded riparian communities; altered sediment routing; impaired fish passage	Eightmile Cr. [F, CS, IP (culverts at campground and RM 10), T (RM 0-22), R, H, S (RM 0-34.5)]; Japanese Hollow [IP]	Productivity, abundance, spatial structure and diversity	Roads, residential development, agricultural and forest practices, irrigation diversions, and loss of beaver	All life stages are affected.
Fivemile Creek MaSA	Water quality (temp); altered hydrology; altered sediment routing; degraded riparian communities; impaired fish passage	Fivemile Creek [F, CS, R, T, H, S]; Middle Fork Fivemile Cr [F, CS, BP (culvert), IP,T, R, H]	Productivity, abundance, spatial structure and diversity	Road building, legacy forest roads, residential development, agricultural and forest practices, irrigation diversions, and loss of beaver	All life stages are affected.

* Abbreviations for limiting factors: degraded floodplain connectivity and function (F), degraded channel structure and complexity (CS); degraded riparian communities (R); altered hydrology (H); degraded water quality (WQ), high water temperatures (T); altered sediment routing (S); man-made block to migration (BP); impaired fish passage (IP).

8.2.2 Deschutes River Eastside Population, Tributary Habitat Limiting Factors

The primary tributary habitat limiting factors identified by the recovery planning team for the Deschutes Eastside steelhead population are degraded riparian condition, low flows, high water temperatures, degraded channel structure/complexity and floodplain connectivity, impaired fish passage.

Degraded floodplain connectivity and function
Off-channel habitats, including wet meadows, oxbows and backwater areas have been reduced by floodplain degradation and loss of beaver. These areas provided juvenile rearing habitat and helped moderate streamflows and water temperature alterations.

Degraded channel structure and complexity
Habitat complexity is generally impaired in most stream reaches used by the Deschutes Eastside steelhead population. Large wood and pool habitat is lacking, thus limiting salmonid production. During summer low flows, a small number of pools with little cover provide the only available habitat for juveniles and adults. The lack of pool habitat confines large numbers of fish to small areas with very little cover, exposing them to potential predation (NPCC 2004b).

EDT results identified reduced habitat diversity as a major factor limiting steelhead in the Buck Hollow, Bakeoven, and Trout creek systems. Reduced habitat diversity ranked as extreme or high for several reaches. Other major limiting for these streams include the loss of instream habitat complexity and pool habitat for rearing, reduced spawning habitat diversity and high temperatures for egg incubation and 0-age rearing, and low flow for 0- to 2-age rearing (NPCC 2004b). EDT results also identified habitat diversity for spawning and rearing and channel stability as major habitat constraints in the smaller tributaries (NPCC 2004b).

Degraded riparian communities and large wood recruitment
Streams on the lower eastside of the Deschutes have been considerably impacted by beaver harvest, irrigation, roads, and cattle grazing; particularly since soils in many eastside stream systems are not very permeable and are prone to landslides. With the loss of riparian vegetation, streams began eroding vertically and horizontally during storm events. Roads were located in many of the riparian areas within the subbasin (NPCC 2004b). Channel downcutting contributed to lowering the water table, which exacerbated the loss of riparian vegetation (NPCC 2004b). Riparian vegetation is recovering in many areas because the impacts associated with grazing have been reduced through improved livestock management practices, including early season use, better livestock distribution, shorter use duration, lower intensity of use, and installation of livestock exclosures (NPCC 2004b). With the recovery of riparian vegetation, beavers have started recolonizing the eastside tributaries (NPCC 2004b).

Degraded water quality
Water temperatures in the eastside tributaries naturally rise more quickly and reach higher levels than westside tributaries because of warmer air temperatures and more arid conditions (NPCC 2004b). Temperatures have increased because of land use practices, and now typically exceed State water quality criteria for salmonid rearing during summer months. Buck Hollow Creek (RM 0-37.7) is on the 303(d) list for temperature and Trout Creek (RM 0-50.7) and tributaries Tenmile, Auger, Big Log, Bull Cartwright, Dick, Dutchman and Potlid creeks are on the 303(d) list for temperature and sedimentation. In Buck Hollow Creek, summer water temperatures often rise above 75° F, except in areas of cool water refuge where seeps and springs enter the channel, or where widely scattered deep pools are recharged with cool subsurface flow. In Trout Creek, water temperatures usually surpass recommended levels by late May and can remain high through October (NPCC 2004b). Bakeoven Creek also experiences high water temperatures and other water quality problems, including turbidity, low dissolved oxygen and nutrients.

Altered hydrologic processes
The eastside streams are very flashy due to their high average slope, high drainage densities, and occasional severe thunderstorms (NPCC 2004b). The uplands are generally degraded by grazing and agriculture; reducing the soil's ability to collect and store moisture, contributing to the flashy nature of the streams. Approximately 370,000 acres of contiguous interior grassland that existed in the upper Bakeoven, Buck Hollow, and Antelope watersheds has been lost to encroachment by other habitat types and land use (NPCC 2004b). There has also been an increase in the drainage network due to roads. Roads and ditches increase runoff by intercepting ground water from cut slopes and collecting precipitation and routing it directly to stream channels.

Combined upland and riparian degradation has resulted in an altered flow regime with higher peak flows and lower base flows. In places where juniper encroachment has resulted in woodland stands, hydrologic processes have likely been altered. The Natural Resource Conservation Service estimates that current peak flows in some segments of the Trout Creek system are two to three times greater than under pre-settlement conditions (Jefferson County SWCD 1996). Some streams are intermittent in summer months. EDT results identified low flows for 0- to 1-age rearing as a major habitat constraint in the smaller tributaries (NPCC 2004b).

Altered sediment routing
Substrate has been degraded by fine sediment deposition from tilling practices associate with dry cropland farming. However, no-till techniques, which have greatly reduced erosion and sediment delivery to substrate, are being adopted (NPCC 2004b). EDT results identified sediment during egg incubation as a major habitat constraint in the smaller tributaries (NPCC 2004b). Buck Hollow is a gravel-rich system, but fine sediment levels are elevated.

Blocked or impaired fish passage
A road crossing on Stag Canyon impairs fish passage. On the Trout Creek system, numerous push-up dams block fish passage during the irrigation season, including on Trout Creek between Little Trout Creek and Board Hollow Creek, on Antelope Creek between the mouth and Ward Creek, and on Clover Creek. Most irrigation diversions have been screened or replaced with infiltration galleries. Road culverts affect fish passage. Mud Springs Creek contains a high gradient concrete box culvert in section 15 that is a barrier, and a culvert just upstream of Gateway that is a barrier. Relocation of Hay Creek has created a barrier cascade in the SW corner of section 17 near the mouth of Hay Creek. Other barriers in Hay Creek include storage reservoirs (NPCC 2004b).

Table 8-15 shows limiting factors and priorities identified by EDT Diagnostic Reports for the Deschutes Eastside steelhead population. A summary of major limiting factors and threats by geographic area is presented in Table 8-16.

Table 8-15. Limiting factors and priorities for restoration as defined by EDT for Deschutes River Eastside steelhead population.

Geographic area priority			Attribute class priority for restoration																	
Geographic area	Protection benefit	Restoration benefit	Channel stability	Chemicals	Competition (w/ hatch)	Competition (other sp)	Flow	Food	Habitat diversity	Harassment/poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment load	Temperature	Withdrawals	Key habitat quantity
L Deschutes MS-1					●				●					●				●
L Deschutes MS-2	○				●				●					●				●
Fall Canyon							●		●									●
L Deschutes MS-3					●				●					●				
L Deschutes MS-4	○				●		●		●					●				
Macks Canyon			●				●		●									●
L Deschutes MS-5		○			●		●		●					●	●	●		
Ferry Canyon							●		●						●			●
L Deschutes MS-6		◯			●		●		●					●	●			
Jones Canyon			●				●		●									●
L Deschutes MS-7		○			●		●		●					●	●			
Oak Canyon			●				●		●									●
L Deschutes MS-8		◯			●		●		●					●	●			
Buck Hollow Cr-1	○	◯	●				●		●					●	●	●		●
Finnegan Canyon			●				●		●						●			●
Buck Hollow Cr-2		○	●				●		●					●	●	●		●
Hauser Canyon							●		●									●
Buck Hollow Cr-3	○	◯	●				●		●				●	●		●		●
Macken Canyon							●		●									
Buck Hollow Cr-4		○	●				●		●					●		●		●
Thorn Hollow	○	◯	●				●		●					●		●		●
Buck Hollow Cr-5							●		●					●		●		●
L Deschutes MS-9					●		●		●									●
L Deschutes MS-10																		
L Deschutes MS-11					●				●					●				●
White R MS-1							●		●					●				●
L Deschutes MS-12	○	○	●		●		●		●					●				
Bakeoven Cr-1	○	○	●				●		●					●		●		●
Trail Hollow Cr			●				●		●									●
Bakeoven Cr-2		○	●				●		●					●		●		●
Booten Cr			●				●		●							●		●
Bakeoven Cr-3		○	●				●		●					●		●		●
Robin Cr			●				●		●									●
Bakeoven Cr-4		◯	●				●		●				●	●		●		●
Deep Cr-1 (Bakeoven)		◯	●				●		●				●	●		●		●
Cottonwood Cr-1		○	●				●		●				●	●		●		●
Ochoco Gulch Cr							●		●							●		●
Cottonwood Cr-2			●				●		●					●		●		●
Deep Cr-2 (Bakeoven)		◯	●				●		●				●	●		●		●
Maupin Trail Canyon			●				●		●				●	●		●		
Deep Cr-3 (Bakeoven)		○	●				●		●				●	●		●		●
Bakeoven Cr-5			●				●		●					●		●		●
L Deschutes MS-13	○	○	●		●		●		●	●			●	●		●		
Stag Canyon			●				●		●				●	●		●		
L Deschutes MS-14	○	○	●		●		●		●					●				●
Wapinitia Cr-1							●		●					●	●			●
L Deschutes MS-15	◯	○			●		●		●					●				
Nena Cr-1			●				●		●					●		●		●
L Deschutes MS-16	◯	◯					●		●									
Eagle Cr			●				●		●					●		●		●
L Deschutes MS-17	◯	◯	●		●		●		●					●				
Skookum Cr							●		●							●		●
L Deschutes MS-18	○	○	●		●		●		●					●				
Warm Springs MS-1					●		●		●				●					
L Deschutes MS-19	◯	○			●		●		●					●				
Trout Cr-1			●				●		●					●		●		●

Table 8-15 cont.

Geographic area priority			Attribute class priority for restoration																
Geographic area	Protection benefit	Restoration benefit	Channel stability	Chemicals	Competition (w/ hatch)	Competition (other sp)	Flow	Food	Habitat diversity	Harassment/poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment load	Temperature	Withdrawals	Key habitat quantity
Trout Cr-7		A	C				A		C				B	B	C	A		A
Trout Cr-8		A	C				A		C				B	B	C	A		A
Trout Cr-9		C	C				A		C				B	B	C	A		A
Wapinitia Cr-1	C	A	C				A		C					B	B	A		A
Wapinitia Cr-2		C	C				A		C				C	C	C	A		A
Ward Cr-1	C	C	C				A		A					B		A		
White R MS-1					C		A		C					C		C		C
Amity Cr		C	C				A		C				B	B	C	A		C
Antelope Cr-1		C	C				A		C				B	B		A		A
Antelope Cr-2		C	C				A		A				B	B	C	A		
Auger Cr	C		C				A		C					C		A		
Bakeoven Cr-1	C		C				A		C					B		A		C
Bakeoven Cr-2		C	C				A		A					B		A		A
Bakeoven Cr-3		C	C				A		A					B		A		A
Bakeoven Cr-4		A	C				A		A				C	B		A		A
Beaver Cr (Trout)	C		C				A		C					C		A		
Big Log Cr-1	C		C				A		C					C		B		
Big Log Cr-2	C		C				A		C					C		B		C
Big Whetstone Cr			C				A		A					C		A		
Board Hollow Cr	C		C				A		C					C		B		C
Buck Hollow Cr-1	C	A	C				A		A					B	B	A		A
Buck Hollow Cr-2		A	C				A		A					B	B	A		A
Buck Hollow Cr-3	C	A	C				A		A				C	B		A		A
Buck Hollow Cr-4	C	A	C				A		A					B		A		A
Cartwright Cr	C		C				A		A					C		B		
Clover Cr	C		C				A		C					C		A		
Cottonwood Cr-1		A	C				A		A				C	C		A		A
Cottonwood Cr-2			C				A		A				C	C		A		A
Deep Cr-3 (Bakeoven)	C	C	C				C		C					C		A		A
Dutchman Cr	C		C				A		A					C		B		
Eagle Cr		C	C				A		A				C	B		A		A
Foley Cr-1	C		C				A		C					B		B		
Foley Cr-2	C	C	C				A		C					B		B		
Hay Cr-1			C				A		A	C			B	B		A		A

Key to strategic priority (corresponding Benefit Category letter also shown)

1/ "Channel stability" applies to freshwater areas only.

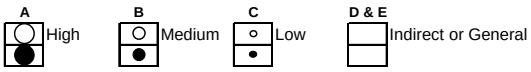


Table 8-16. Habitat limiting factors summary for the Deschutes River Eastside steelhead population.

Population MaSA and MiSA	Major Limiting Factors	Sites Affected*	VSP Characteristics Impacted	Potential Causes/Threats	Life Stages Affected
DESCHUTES EASTSIDE POPULATION					
Deschutes River Eastside Population	Degraded floodplain and channel structure (complexity, deep pools, diversity); degraded riparian communities; water quality (temp, chemical contaminants and nutrients); altered hydrology (higher peak, lower low flows); altered sediment routing	MaSAs and MiSAs	Productivity, abundance, spatial structure and diversity	Livestock grazing, roads, residences, agricultural practices that simplify habitat, irrigation withdrawals, dams and other barriers	All life stages
Buck Hollow MaSA	Degraded floodplain and channel structure; degraded riparian communities; altered hydrology, degraded water quality (temp); altered sediment routing	Buck Hollow [F, CS (mouth to Thorn Hollow), T (RM 0-37.7); H; S]; Thorn Hollow Cr. [R, F, CS (mouth to spring in section 23), S]	Productivity, abundance, spatial structure and diversity	Livestock grazing, upland agricultural practices	All life stages are affected.
Bakeoven MaSA	Degraded floodplain and channel structure; degraded riparian communities; altered hydrology; degraded water quality (temp); altered sediment routing; impaired fish passage	Bakeoven [F, CS, T, H, S (mouth to Deep Cr.), IP (road crossing at Stag Canyon)]; Deep Cr. [F, CS (especially mouth to Cottonwood Cr)]; Cottonwood Cr. [F, CS (mouth to Ochoco Cr)]	Productivity, abundance, spatial structure and diversity	Livestock grazing, upland agricultural practices, irrigation, roads	All life stages are affected.
Ward/ Antelope/Cold MaSA	Degraded floodplain and channel structure; degraded riparian communities; altered hydrology; blocked and impaired fish passage	Most drainages [F, CS, H]; Antelope Cr. [BP (push-up dams]	Productivity, abundance, spatial structure and diversity	Irrigation withdrawals, agricultural practices	All life stages are affected.
Lower Trout Cr. MaSA	Degraded floodplain and channel structure; degraded riparian communities; altered hydrology; degraded water quality (temp); altered sediment routing; blocked and impaired fish passage	Trout Cr. [H (especially below Willowdale), T (RM 0-50.7), F, CS, R, S, PB (Mud Springs Cr., Hay Cr.)]; Tenmile Cr. [T (RM 0-5.9)]; Mud Cr. [IP (culvert in section 15 and just above Gateway)]; Hay Cr. [IP (cascade near mouth, storage reservoirs, diversions)]	Productivity, abundance, spatial structure and diversity	Agricultural practices, channel simplification following flood, roads, irrigation storage reservoirs and diversions, livestock grazing	All life stages are affected.
Upper Trout Cr. MaSA	Degraded floodplain and channel structure; degraded riparian communities; altered hydrology; degraded water quality (temp); altered sediment routing; blocked and impaired fish passage	Trout Cr. [F, CS (mouth to 4,800-ft level, especially below NF boundary), R, T, S (RM 0-50.7), H (especially below Ashwood), IP (Little Trout to Board Hollow)]; Big Log Cr. [T and S (RM 0-5.5)]; Cartwright Cr. [T and S (RM 0-4.3)]; Dick Cr. [T and S (RM 0-2.2)]; Dutchman Cr. [T and S (RM 0-4.8)]; Potlid Cr. [T and S (RM 0-5.2)]; Bull Cr. [T and S (RM 0-1.8)]; all systems [F, CS]; Clover Cr. [IP].	Productivity, abundance, spatial structure and diversity	Livestock grazing, agriculture practices, building of flood control berms, channel straightening, roads	All life stages are affected.

* Abbreviations for limiting factors: degraded floodplain connectivity and function (F), degraded channel structure and complexity (CS); degraded riparian communities (R); altered hydrology (H); degraded water quality (WQ), temperature (T); altered sediment routing (S); man-made block to migration (BP); impaired fish passage (IP).

8.2.3 Deschutes River Westside Population, Tributary Habitat Limiting Factors

The primary tributary habitat limiting factors identified by the Recovery Planning Team for the Deschutes Westside steelhead population are degraded channel structure and complexity, altered sediment routing, high water temperature, low flows and lack of fish passage over Pelton-Round Butte Complex.

Degraded riparian communities and large wood recruitment
The Shitike Creek and Warm Springs River systems have experienced a slight to moderate loss of riparian vegetation and vegetative diversity due to grazing, roads and other land use practices. Habitat is primarily degraded in the lower reaches, with upper reaches in good to excellent condition (NPCC 2004b). The lower four miles of Shitike Creek have experienced substantial loss of riparian vegetation. The cottonwood gallery forest is now a fraction of its former size and contributes a smaller amount of large wood to the stream channel. Roads located in many riparian areas within the subbasin have played a major role in degrading riparian habitat in the Shitike Creek and Warm Springs River systems (NPCC 2004b). Riparian fencing in some areas of the Warm Springs River system has allowed riparian vegetation to become established that has stabilized stream banks (NPCC 2004b).

Riparian conditions along upper and lower Whychus Creek are generally good. Many sections of lower Whychus Creek have a broad riparian area comprised of floodplains, willow stands and cottonwood bottom lands. Riparian vegetation along sections of the creek's middle reach has been damaged by past grazing, channel alterations and development (NPCC 2004b).

Degraded floodplain connectivity and function
Off-channel habitats provide critical steelhead habitat. In 1995, about 68% of all steelhead spawning in the Deschutes River from the Reregulating Dam to Trout Creek occurred in side channels between islands and channel margins, despite the fact that such channels comprise less than 10% of the channel length in the reach (Zimmerman and Ratliff 2003). In tributary reaches, including the Warm Springs drainage and many small tributaries in the area, loss of connectivity with the floodplain has reduced groundwater discharge, further exacerbating problems of low flow and high water temperature. This is especially true for the lower four miles of Shitike Creek and segments of Beaver Creek where Hwy 26 has reduced floodplain connectivity.

Degraded channel structure and complexity
The results of EDT analysis identified lack of habitat diversity and complexity as major limiting factors for the Deschutes River above Trout Creek, and for several reaches on Shitike Creek and the Warm Springs River system. Habitat degradation on the stretch of the Deschutes River above the mouth of Trout Creek results primarily from recreational impacts on riparian vegetation on the east side of the river and from grazing impacts on the west side of the river. On lower Shitike Creek and the Warm Springs River, channel simplification and land use practices have accentuated flashy flows that scour the channel and reduce habitat complexity (NPCC 2004b). Some instream habitat projects have been implemented on the Warm Springs River and have increased habitat complexity (NPCC 2004b). Channelization and loss of large wood along the lower four miles of Shitike Creek have reduced channel and fish habitat heterogeneity (e.g. side channels, substrate diversity, etc.). Loss of floodplain connectivity has

resulted in increased water temperatures and the loss of off-channel juvenile rearing habitat and winter high flow refugia. EDT results identified channel instability as a major limiting factor for the Shitike and Warm Springs systems (NPCC 2004b). In the Whychus Creek drainage, channel simplification has reduced channel complexity and stability from RM 24.7 to the National Grassland Boundary (RM 5), resulting in a loss of sinuosity and stream length (NPCC 2004b).

Degraded water quality

The lower Deschutes River and several westside tributary reaches are included on the 2002 ODEQ 303(d) list of water quality limited streams (NPCC 2004b). The lower Deschutes River exceeds temperature criteria for salmonid rearing from White River to Pelton Dam. In addition, water temperatures in lower reaches of Warm Springs River and Shitike Creek can exceed 70°F from mid to late summer. EDT results identified water temperature during incubation and juvenile rearing as a major limiting factor in lower Shitike Creek, Beaver Creek, and several other reaches (NPCC 2004b). Suspended sediment further reduces water quality in smaller tributaries to the Deschutes River and in Quartz and Coyote creeks in the Warm Springs River system. Whychus Creek is also included on the 2002 ODEQ 303(d) list for exceeding water temperature criterion for salmonid spawning during summer months (NPCC 2004b).

Information regarding chemical contaminants and nutrients in streams is lacking for this area. It is likely that levels of both are above pre-settlement levels because of fertilizer and pesticide use for agriculture. Irrigation return flows to the Deschutes River and its tributaries may pose water quality problems (NPCC 2004b). Contaminants from municipal waste spill/discharge into Shitike Creek and from water lagoons and golf course at the resort on the mainstem Warm Springs River also degraded water quality.

Altered hydrologic processes

Lands in watersheds that support the Deschutes River Westside steelhead population have generally been degraded through grazing, agriculture, forest practices, and roads, and are not able to capture and slowly release precipitation as efficiently as they did historically. Headwater channel scour has reduced water storage and lowered the water table (NPCC 2004b). This is especially true for Coyote, Quartz, Tenino, Skookum, Eagle, and Nena Creeks. It is also the case on upper Beaver Creek where the creek has been channelized along Hwy 26. Flows, which are dominated by snowmelt, peak in spring and taper off through the summer to base levels in August or September. Small tributary flows are often intermittent, limiting habitat availability in the summer. EDT results identified reduced streamflows as a major limiting factor in this area.

Altered sediment routing

Fine sediment levels in spawning substrate are a concern in Shitike and Warm Springs systems and small tributaries to the Deschutes River. Several drainages, including Quartz and Coyote creeks in the Warm Springs system, contain highly erosive soils that have become more unstable due to extensive grazing, construction of logging roads, and conversion of land for tilled agriculture (NPCC 2004b). Excessive sediment loads also occur occasionally in the Warm Springs River, primarily due to runoff from lower tributaries, including Coyote and Quartz creeks in the Beaver Creek drainage, and from Charlie Canyon. Lower Whychus Creek also displays a high percentage of fine sediment associated with unstable streambanks and livestock grazing (NPCC 2004b).

The small tributaries to the Deschutes River have become incised and lost some of the steelhead spawning gravel that was historically abundant. In-channel large wood, which has decreased the ability of streams to sort and store spawning gravels, has also been reduced throughout the area (NPCC 2004b). Increased fine sediment in small tributaries results from cropland and rangeland runoff. Substrates contained less fine sediment before European settlement due to stable vegetation conditions (NPCC 2004b).

Impaired fish passage

The Pelton-Round Butte Complex on the Deschutes River at RM 100 blocks fish passage to and from historical habitats in the Metolius River, Whychus Creek and other previously accessible habitats above the complex. Fish passage facilities were constructed with the dams, but attempts to pass juveniles out of the system failed. Currently efforts are underway to restore passage as part of the FERC relicensing process (NPCC 2004b). The new downstream fish passage structure is scheduled to be functioning by 2010. Details of the proposed reintroduction are presented in the tributary hydro actions in Section 9.

Adult steelhead are also affected by structural barriers, such as culverts, irrigation diversions, roads and railroad crossings that block upstream passage. Juvenile rearing is greatly affected by all of the passage barriers.

Table 8-17 shows limiting factors and priorities identified in the EDT Diagnostic Report for the Deschutes Westside steelhead population. A summary of the major limiting factors and threats by geographic area is presented in Table 8-18.

Table 8-17. Limiting factors and priorities for restoration as defined by EDT for Deschutes River Westside steelhead population.

Geographic area priority			Attribute class priority for restoration																	
Geographic area	Protection benefit	Restoration benefit	Channel stability	Chemicals	Competition (w/ hatch)	Competition (other sp)	Flow	Food	Habitat diversity	Harassment/poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment load	Temperature	Withdrawals	Key habitat quantity
L Deschutes MS-1									●					●				
L Deschutes MS-2					●				●					●				●
L Deschutes MS-3									●					●				
L Deschutes MS-4					●				●					●				
Macks Canyon							●		●									●
L Deschutes MS-5					●				●					●				
Ferry Canyon							●		●						●			●
L Deschutes MS-6					●				●					●				
Jones Canyon			●				●		●									●
L Deschutes MS-7					●				●					●				
Oak Canyon			●				●		●									●
L Deschutes MS-8					●				●					●				
Buck Hollow Cr-1			●				●		●					●				●
L Deschutes MS-9					●		●		●									●
L Deschutes MS-10																		
L Deschutes MS-11					●		●		●					●				●
White R MS-1					●		●		●					●		●		●
L Deschutes MS-12					●				●					●				
Bakeoven Cr-1							●		●					●				●
L Deschutes MS-13					●		●		●				●	●				
Stag Canyon			●				●		●					●		●		
L Deschutes MS-14			●		●		●		●					●				●
Wapinitia Cr-1		◯	●				●		●					●	●	●		●
Paquet Gulch-1							●		●							●		●
Wapinitia Cr-2		○	●				●		●				●	●	●	●		●
L Deschutes MS-15					●				●									
Nena Cr-1		○	●				●		●				●	●		●		●
L Deschutes MS-16							●		●									
Eagle Cr		○	●				●		●				●	●		●		●
L Deschutes MS-17		○			●		●		●					●				
Skookum Cr		○	●				●		●				●	●		●		●
L Deschutes MS-18		○			●				●									
Warm Springs MS-1		◯			●		●		●									
Warm Springs MS-2		○									●							
Warm Springs MS-3		◯			●		●		●				●	●				
Beaver Cr-1 (WS)	◯	◯	●		●		●		●					●	●	●		●
Beaver Cr-2 (WS)	◯	○					●		●							●		
Beaver Cr-3 (WS)	◯	○					●		●						●	●		●
Beaver Cr-4 (WS)	◯						●									●		●
Beaver Cr-5 (WS)	○						●									●		●
Warm Springs MS-4		○			●		●		●									●
Mill Cr-1 (WS)					●		●		●									●
Boulder Cr (WS)	◯	◯	●				●		●							●		●
Mill Cr-2 (WS)	○	○	●		●		●		●					●	●			●
Warm Springs MS-5	○	○							●									
Badger Cr (WS)	○	◯					●		●							●		●
Warm Springs MS-6	○	○					●		●						●			●
Warm Springs MS-7	◯	◯					●		●						●			
Warm Springs MS-8	◯	○					●		●						●			
Bunchgrass Cr									●									●
Warm Springs MS-9	◯	◯					●		●						●			
L Deschutes MS-19					●				●									
Trout Cr-1							●		●							●		●
Trout Cr-2							●		●					●		●		●
L Deschutes MS-20	○	◯			●		●		●					●				
Shitike Cr-1	◯	◯	●		●		●	●	●						●	●		●

Table 8-18. Habitat limiting factors summary for the Deschutes River Westside steelhead population.

Population MaSA and MiSA	Major Limiting Factors	Sites Affected*	VSP Characteristics Impacted	Potential Causes/Threats	Life Stages Affected
DESCHUTES WESTSIDE POPULATION					
Deschutes River Westside Population	Degraded riparian communities; degraded floodplain and channel structure (complexity, side-channel habitat, diversity); water quality (temp); altered hydrology (low flow); altered sediment routing; blocked and impaired fish passage	MaSAs and MiSAs	Abundance, productivity, spatial structure, diversity	Primarily livestock grazing, roads, residential development and agricultural practices that simplify habitat, irrigation withdrawals, forest practices, dams and other barriers	All life stages
Lower Warm Springs MaSA	Degraded floodplain and channel structure (complexity, loss of LWD); degraded riparian communities; degraded water quality (temp); altered hydrology; altered sediment routing	Beaver Creek [R, F, CS, T, S (mouth to Wilson Cr.)]; Warm Springs R. [(F, CS and R in Ka-Nee-Ta resort area), S, R (mouth to Schoolie Cr.)]; Quartz and Coyote creeks [F, CS, S]	Productivity, abundance, spatial structure and diversity	Confinement and runoff from Hwy. 26, livestock grazing, bank armoring and confinement in Ka-Nee-Ta area	All life stages
Middle Warms Springs MaSA	Degraded riparian communities; degraded floodplain and channel structure; altered sediment routing	Badger Creek	Productivity, abundance, spatial structure and diversity	Primarily livestock grazing, roads, and agriculture practices	All life stages
Upper Warm Springs MaSA	Degraded channel structure; water quality (temp)	SF Warm Springs and Upper Warm Springs Rs	Productivity, abundance, spatial structure and diversity	Loss of LWD	All life stages
Mill Creek MaSA	Degraded floodplain and channel structure (channelization, complexity)	Mill Cr. [mouth to Old Mill Camp]	Productivity, abundance, spatial structure and diversity	Channelization	All life stages
Shitike Creek MaSA	Degraded floodplain and channel structure; degraded riparian communities; altered hydrology; degraded water quality (temp, pollutants); altered sediment routing	Shitike Cr. [F, CS, R (mouth to upper road crossing, City of Warm Springs, near Hwy. 26); WQ (Warm Springs mill site and sewage lagoons)]	Productivity, abundance, spatial structure and diversity	Livestock grazing, riparian degradation and confinement through Warm Springs, Hwy. 26, Warm Springs mill site and sewage lagoons, channelization	All life stages

* Abbreviations for limiting factors: degraded floodplain connectivity and function (F), degraded channel structure and complexity (CS); degraded riparian communities (R); altered hydrology (H); degraded water quality (WQ), high water temperatures (T); altered sediment routing (S); man-made block to migration (BP); impaired fish passage (IP).

8.2.4 Crooked River Population, Tributary Habitat Limiting Factors

The primary tributary habitat limiting factors identified for the Crooked River steelhead population are degraded channel structure and complexity and floodplain connectivity, degraded riparian condition, high water temperature, low flows and lack of fish passage over Pelton-Round Butte Complex (ODFW 1996).

The Crooked River and tributaries were historically inhabited by Mid Columbia summer steelhead. They were extirpated in the upper Ochoco Creek watershed in 1921 with the construction of Ochoco Dam approximately five miles east of Prineville. Steelhead use in the upper mainstem Crooked River including the North and South forks and Beaver and Bear creeks was terminated with the completion of Bowman Dam at Rm 70 in 1961. Limiting factors are similar for habitats upstream and downstream of the two dams. However, only the lower Crooked River watershed below the dams is identified by the Upper Deschutes Subbasin Plan amendment (ODFW 2003) for reintroduction of the species. Discussion of habitat limiting factors in the Crooked River watershed will focus on the reintroduction area followed by a section describing conditions in the upper watershed above Ochoco and Bowman dams.

Degraded riparian communities and large wood recruitment
Riparian vegetation condition in the lower Crooked River watershed is largely a function of geomorphology and land use practices. Two separate reaches of the mainstem flow through steep narrow basalt canyons and are managed by the Bureau of Land Management as Wild and Scenic Rivers. These reaches extend from the head of Lake Billy Chinook at Rm 6 to the Highway 97 crossing at Rm 17 and from Rm 62 upstream from Prineville to Bowman Dam at Rm 70. Riparian communities in these reaches are in excellent condition resulting in stable channel conditions and reduced sediment inputs. However, limited numbers of large riparian trees, lack of wood recruitment from portions of the watershed above Ochoco and Bowman Dams and periodic scouring high flow events result in these reaches lacking in large wood.

Riparian condition in the mainstem between the two Wild and Scenic reaches is extremely degraded. Past grazing and agricultural practices contributed to almost complete removal of native vegetation resulting in bank instability, minimal canopy cover and high sediment loads. Restoration efforts have had limited success due to the erosive soils, lack of vegetation, incised channel and altered hydrograph. Large wood is absent in this reach.

Ochoco Creek below Ochoco Dam is characterized by largely degraded riparian conditions resulting from livestock and agricultural practices as well as development in and around Prineville. Scattered remnant willows and cottonwoods are present but the riparian community is dominated by reed canary grass. Limited overstory canopy is present in the section of the creek that flows through Prineville. Large wood is absent. Riparian conditions in lower McKay Creek are similar to Ochoco Creek. The upper McKay watershed is on USDA Ochoco National Forest ownership. Riparian conditions are significantly improved from that of the lower watershed. Vegetation consists of both conifers and woody species. Full site potential is not realized due to livestock grazing and damage resulting from unauthorized off highway vehicle use.

Degraded floodplain connectivity and function
Floodplain interaction in the lower Crooked River was important for dissipating energy during high flow events, providing off channel refugia for juvenile salmonids and storing water for late season release. Floodplain connectivity and function is variable within the Crooked River steelhead reintroduction area. Generally, in the Wild and Scenic reaches of the mainstem and upper McKay Creek connectivity is intact. However, the middle section of the mainstem, Ochoco Creek and lower McKay Creek have limited connectivity to the floodplain. In particular, the reach of the Crooked River from Lone Pine to Prineville (Rm 31 to Rm 51) has a deeply incised channel and extremely poor floodplain connectivity resulting in chronic bank erosion that has hampered restoration efforts.

Degraded channel structure and complexity
Diverse habitats including pools and structures providing cover increase the production capacity of a stream through increased holding areas for migrating adults and particularly for juvenile steelhead rearing. The entire section of the Crooked River watershed in the steelhead reintroduction area was channelized following the 1964 floods excluding the two canyon reaches of the mainstem and the upper section of McKay Creek. Channelization resulted in severe reduction in channel complexity and width/depth and pool/riffle indices.

Degraded water quality
Water quality degradation in the Crooked River is largely from nonpoint pollution sources including livestock grazing, timber harvest, and agricultural and stormwater runoff. Primary water quality parameters limiting steelhead production are temperature, dissolved oxygen and turbidity. The Crooked River is on the Oregon Department of Environmental Quality's 303d list for not meeting water quality standards for temperature, turbidity and total dissolved gas. In particular, the Crooked River mainstem from the Highway 97 crossing (Rm 17) to the Feed Canal (Rm 51) suffers from chronically high summer temperatures often in excess of 80F. Partially treated wastewater discharged into the river near Prineville during the winter months also impairs water quality.

The hypolimnotic release of water from Bowman Dam results in cool water (52F) discharged into the Crooked River. This results in favorable summer conditions supporting a very robust redband trout population and popular tailrace fishery. Conversely, flows released from the dam in excess of 2000 cfs result in nitrogen supersaturation and dependent upon length of exposure can result in varying degrees of gas bubble disease.

Altered hydrologic processes
The natural hydrograph was largely driven by climactic patterns of the Blue Mountain physiographic province characterized by hot arid summers and cold winters. The majority of annual precipitation occurred as snowfall. Annual streamflow was determined largely by snowpack. This resulted in low to moderate year around base flow with annual spring runoff events.

The hydrology of the lower Crooked River steelhead reintroduction area has been significantly altered by construction of Ochoco and Bowman dams and management of water released from Prineville and Ochoco reservoirs, irrigation practices and removal of beaver. Reservoir

management has the greatest influence on flows in the mainstem Crooked River and Ochoco Creek. Releases of water for irrigation delivery result in flows (250 cfs – Crooked R., 20 cfs - Ochoco Cr.) exceeding natural levels from April through October in the reaches upstream of the major points of diversion: Rm 51 to Rm 70 on the Crooked and Rm 3 to Rm 10 on Ochoco Creek. At the close of irrigation season in October, water is stored in the two reservoirs and releases are reduced to 50-75 cfs in the Crooked River (legally protected flows in the non irrigation period are 10 cfs) and 5-10 cfs in Ochoco Creek. This pattern is occasionally punctuated by spring high flow events when the respective reservoirs fill and inflow is discharged downstream. This flow management has generally resulted in robust populations of redband trout in the tailrace reaches of both the Crooked River and Ochoco Creek Below the major points of diversion streamflows are critically low, particularly in the Crooked River from Rm 14 to Rm 51. Low summer flows and high temperatures (exceeding 80F) limit trout production in this reach. Below the Highway 97 crossing on the Crooked River groundwater from the east slope of the Cascades Mountains resurfaces as springs recharging the streamflow with cool water. Summer readings at the Opal gauge near Culver average 1250 cfs just upstream from Lake Billy Chinook. This results in favorable water quality and quantity conditions for resident redband trout and introduced steelhead, however, the reach is spawning gravel limited.

Hydrology in lower McKay Creek has been significantly altered as well downstream of the Ochoco National Forest boundary at Rm 14. Irrigation withdrawals frequently dewater the creek from this point downstream to Rm 5 during the irrigation season. At Rm 3.5 and Rm 5 Ochoco Irrigation District's main canals bisect McKay Creek at each of these points 1-10 cfs of water is diverted from the canal and the creek serves as a conduit to deliver irrigation water to downstream customers. This results in artificially favorable flows in this reach of McKay Creek that supports a healthy redband trout population despite relatively degraded habitat conditions.

Altered sediment routing
Sediment deposition and substrate composition in the lower Crooked River recovery area are altered through two pathways. The mainstem reach from Prineville to Lone Pine and most of the Ochoco and McKay Creek watersheds have degraded riparian areas, poorly functioning channels and unstable banks. These conditions result in high levels of fine sediment incorporated into available spawning gravel. Conversely, the mainstem reach below Bowman Dam receives little sediment impact from eroding banks but has chronic high turbidity levels resulting from fine sediments released from Prineville Reservoir. Bowman Dam also serves to limit gravel recruitment, which may limit steelhead production, into this reach. In general, the reaches with the highest water quantity and quality have limited amounts of spawning gravel, while the reaches with abundant gravel are water and sediment limited. The one reach in the reintroduction area currently with fair to good conditions for both spawning and rearing is the mainstem Crooked River from Prineville (Rm 51 to Rice Baldwin Dam Rm 55). The lower five miles of McKay Creek and the eight miles within the Ochoco National Forest as well as the ten miles of Ochoco Creek from the mouth to Ochoco Dam also have moderate potential to support each steelhead life history stage.

Impaired fish passage
Artificial barriers are a significant limiting factor for steelhead production in the Crooked River. However, ongoing efforts by ODFW, the Crooked River Watershed Council, U.S Fish and

Wildlife Service, Natural Resource Conservation Service and others are making progress at addressing several barriers. The Pelton-Round Butte Complex represents the paramount impediment to steelhead passage into upper Deschutes Basin including the Crooked River. Development of passage facilities is a FERC license condition to operate the hydroelectric project. Passage efforts here are discussed elsewhere in this document.

A second large barrier to upstream fish migration into the Crooked River is Opal Springs Dam at Rm 7, approximately one mile upstream from the Crooked River Arm of Lake Billy Chinook. This is a 24 foot high concrete dam owned and operated by Deschutes Valley Water District. It was constructed in 1982 as part of a FERC licensed hydroelectric project. At the time of licensing passage was not required. The license does not expire until 2032, however, numerous stakeholders are working collaboratively with the dam operator to construct passage facilities at Opal Springs with an estimated completion date in 2012.

There are four additional concrete irrigation dams on the mainstem Crooked River between Opal and Bowman Dams. The Crooked River Watershed Council and others completed construction of passage facilities at the Crooked River Central and People's Irrigation District Dams at Rms 44 and 51 respectively in January 2009. The Rice Baldwin and Stearns Dams remain partial barriers with the former passable by adult fish at all flows and the later passable to adults at high flows. Discussions are underway to improve passage at Stearns Dam in the near future.

Both Crooked River major tributaries, Ochoco and McKay Creeks had numerous seasonal and permanent barriers prior to the 1998 flood in Prineville. Ochoco Irrigation District alone had eleven permanent or seasonal barriers in the two creeks prior to the flood. The irrigation district worked collaboratively with ODFW, OWEB and others to replace each of these diversions with state of the art structures. Currently there is one seasonal barrier on Ochoco Creek and two permanent partial barriers on McKay Creek. ODFW and the Watershed Council are engaged with private landowners to provide passage at each of these sites.

Upper Crooked River Watershed Limiting Factors

The upper Crooked River watershed includes the mainstem, North Fork, South Fork, Bear Creek and Beaver Creek above Bowman Dam and Ochoco Creek and Mill Creek above Ochoco Dam. The entire upper subbasin was historically inhabited by summer steelhead with the exception of the North Fork Crooked River that had a largely impassable natural barrier (Lower Falls) nine miles upstream from the mouth. However, these historic habitats are not in the current Mid Columbia steelhead reintroduction area.

Limiting factors in the upper watershed are largely similar to the lower watershed. A notable exception is the water quality and quantity issues in the mainstem above Prineville Reservoir are more pervasive. Summer flow is routinely below 5 cfs with stream temperatures in the mid 80s. Suitable steelhead production areas are fragmented are largely disconnected from viable migration and rearing areas. Conversely, the upper Ochoco watershed has considerable steelhead production potential. The Mill Creek watershed in particular has had considerable restoration work and could be one of the most productive streams in the subbasin. Altered hydrology is the primary limiting factor in upper Ochoco as well.

A summary of the major limiting factors and threats for the Crooked River steelhead population by geographic area is presented in Table 8-19.

Table 8-19. Habitat limiting factors summary for the Crooked River steelhead population.

Population MaSA and MiSA	Major Limiting Factors	Sites Affected*	VSP Characteristics Impacted	Potential Causes/Threats	Life Stages Affected
CROOKED RIVER POPULATION					
Crooked River Population	Degraded riparian communities; degraded floodplain and channel structure (complexity, side-channel habitat, diversity); water quality (temp); altered hydrology (low flow); altered sediment routing; blocked and impaired fish passage	MaSAs and MiSAs	Abundance, productivity, spatial structure, diversity	Primarily livestock grazing, residential development and agricultural practices that simplify habitat, irrigation withdrawals, unauthorized OHV use, dams and other barriers, reservoir release flows	All life stages
Crooked confluence MISA (reintroduction)	Limited spawning habitat, passage	Crooked River (Rm 6 – Rm 7) BP	Productivity, abundance, spatial structure and diversity	Barrier at Opal Springs Dam	Spawning
Lone Pine MISA (reintroduction)	Limited spawning habitat	Crooked River (Rm 7 –Rm 20)	Productivity, abundance, spatial structure and diversity		Spawning
McKay MASA (reintroduction)	Degraded channel structure; water quality (temp), altered hydrology, degraded riparian communites, altered sediment routing, passage	McKay Cr. (Rm 0 - Rm 14) including Allen Cr. F, CS, R, H, S, T, BP; McKay Cr. (Rm 14-Rm 19) including Little McKay Cr.CS, R, S, WQ	Productivity, abundance, spatial structure and diversity	Past channelization, livestock grazing and agricultural practices, irrigation withdrawals, unauthorized OHV use, permanent and seasonal barriers, removal of riparian vegetation, loss of LWD	All life stages
Lower Ochoco MASA (reintroduction)	Degraded channel structure and reduced complexity, altered hydrology, degraded riparian communites, altered sediment routing,	Ochoco Cr (Rm 0 – Rm 10) F, CS, R, H, S, IP	Productivity, abundance, spatial structure and diversity	Urban development in reach through Prineville, flow management in releases from Ochoco Dam. Livestock grazing and agricultural practices in upper reach below Ochoco Dam	All life stages
Lower Crooked MASA (reintroduction)	Degraded floodplain and channel structure; degraded riparian communities; altered hydrology; degraded water quality (temp, pollutants); altered sediment routing	Crooked River (Rm 20 – Rm 56) F, CS, R ,H, WQ, T, S; Crooked River (Rm 56 – Rm 70) H, WQ, S, BP	Productivity, abundance, spatial structure and diversity	Livestock grazing and agricultural practices, past channelization, flow management or releases from Bowman Dam, irrigation withdrawals	All life stages
Upper Ochoco MASA	Degraded floodplain and channel structure; degraded riparian communities; altered hydrology; degraded water quality (temp, pollutants); altered sediment routing	Mill Creek (Rm 0-Rm 15) F, CS, H, T; considerable restoration has occurred. Ochoco Cr. (Rm 14-Rm 32) F,CS,R, H, T, S; Wolf Cr. (Rm 0 – Rm 4). CS, R; Marks Cr. (Rm 0-	Productivity, abundance, spatial structure and diversity	Livestock grazing and agricultural practices, past channelization, irrigation withdrawals, roads , forest management	All life stages

Population MaSA and MiSA	Major Limiting Factors	Sites Affected*	VSP Characteristics Impacted	Potential Causes/Threats	Life Stages Affected
		Rm 8) CS, T, S, BP			
Upper Crooked, South Fork Crooked, Beaver Cr MASAs, Bear Cr. MISA	Degraded floodplain and channel structure; degraded riparian communities; altered hydrology; degraded water quality (temp, pollutants); altered sediment routing	Crooked R (Rm 86 – Rm 125) and tribs. F,CS,R,H,T,S , BP (Horse Heaven Cr), IP; South Fk Crooked (Rm 0 – Rm 20) CS, R, H, T, S, IP; Beaver Cr.(Rm 0 – Rm 25) and tribs F,CS, R, H, T, S,; North Fk Crooked (Rm 0 – Rm 9) CS, R, H, T	Productivity, abundance, spatial structure and diversity	Livestock grazing and agricultural practices, past channelization, irrigation withdrawals, roads, forest management	All life stages

* Abbreviations for limiting factors: degraded floodplain connectivity and function (F), degraded channel structure and complexity (CS); degraded riparian communities (R); altered hydrology (H); degraded water quality (WQ), high water temperatures (T); altered sediment routing (S); man-made block to migration (BP); impaired fish passage (IP).

8.2.5 Lower Mainstem John Day River Population, Tributary Habitat Limiting Factors

The primary tributary habitat limiting factors identified for this population are: degraded floodplain and degraded channel structure (key habitat quantity and habitat diversity), altered sediment routing, water quality (temperature), and altered hydrology. Obstructions are high priority limiting factors in Bridge, Kahler, Muddy, Rock (lower in Gilliam County), and Thirtymile creeks.

Degraded floodplain connectivity and function
Land cover in the lower John Day River watershed is predominately rangeland and cropland (ODA 2004). Floodplains and riparian areas have been extensively altered by agriculture, livestock grazing, transportation corridors, and other development.

Degraded channel structure and complexity
The lower reaches of tributaries in many MaSAs and MiSAs for this population have had extensive channel modifications. Channelization and streambank hardening are extensive, affecting channel conditions and dynamics. Habitat diversity and LWD are also lacking, and overall habitat complexity is well below benchmark condition. Examples include lower Bridge, Mountain, Rock (Wheeler County), Cottonwood, Ferry Canyon, Pine Hollow, and Thirtymile**.** Conditions improve upstream in many of the streams that flow out of the Bridge Creek Wilderness, including Bridge, Mountain, and Rock (Wheeler County), as well as Cottonwood Creek, that flows out of a roadless area.

Kahler and Service creeks have low levels of LWD and overall habitat complexity. EDT results identified habitat diversity as a medium priority limiting factor and key habitat quantity as a high priority. Ferry Canyon has an incised channel that is generally unstable, though conditions have improved recently. Pine Hollow has a pipeline buried in the channel for 6.6 miles, which in

combination with the 1964 flood, contributes to a very unstable channel. Channel conditions in Thirtymile Creek are generally degraded, with low levels of LWD and habitat complexity. Habitat complexity in Butte Creek is generally higher, with rearing occurring throughout the system. Rock Creek (Gilliam County) channel conditions are degraded, with areas that have been channelized and have low levels of LWD.

Altered sediment routing
EDT findings indicated that sediment impacts in the Lower John Day watershed are higher than elsewhere in the subbasin (NPCC 2005). Sediment problems are often associated with changes in native plant communities due to wheat farming, grazing, and other activities that can cause severe streambank erosion and sedimentation. Forest and other roads, if not constructed and maintained with best management practices, can contribute to altered sediment routing. EDT results show sediment as a high priority limiting factor in Bridge, Butte, Grass Valley, Muddy, Scott Canyon, Lower and Upper Rock (Gilliam County), Thirtymile, Pine Hollow, and Mountain creeks, and gravel embeddedness as a significant limiting factor in the lower watershed.

Altered hydrologic processes
The USGS-maintained gage at McDonald Ferry, Oregon at RM 21, the oldest gage in the subbasin, has been in operation since December 1904. The lowest recorded discharge from the McDonald Ferry station was zero cfs for part of September 2, 1966, August 15 to September 16, 1973, and August 13, 14 and 19-25, 1977. Peak flow at the McDonald Ferry gaging station is typically more than 100 times greater than the lowest flows of the same year. From year to year, peak flows can vary as much as 300 to 700%. This portion of the watershed is prone to intense thunderstorms, which can scour channels down to bedrock, during summer months.

According to NMFS 2005, water withdrawals, riparian corridor alterations, grazing, channel alterations, and wetland loses have all contributed to lower base flows. Low flows are below benchmark in the lower reaches of Bridge, Cottonwood, and Mountain creeks. Flows are also below benchmark in Ferry Canyon, Pine Hollow, Thirtymile, Lower Rock (Wheeler County), and Butte. Water diversions contribute to reduced summer low flows in most of these areas.

EDT results rated "flow" as either a medium or low priority for restoration in 16 out of 18 reaches in the Lower John Day, though the subbasin planning technical team considered flow restoration a higher priority for several reaches. Flow is not a restoration priority for the lower John Day River McDonald Ferry reach since it is frequently inundated by backwaters from the John Day reservoir. Flow restoration would improve several other limiting factors addressed by EDT including habitat complexity and temperature.

Degraded water quality
From July to September, groundwater provides much of the base flow to the Lower John Day River (NPCC 2005). Elevated temperature is an important limiting factor for most stream segments for the Lower John Day population that are measured (ODA 2004).

BLM (1999) characterized temperature as "Not Properly Functioning" for all streams rated in the lower John Day. Other water quality constituents such as total phosphates, biological oxygen demand, and fecal coliform can also limit water quality in late summer when flows are lowest

and water temperatures are the greatest. Cottonwood, Rock (Wheeler Co) and Bridge have good quality water in their upper reaches, but water quality conditions, especially temperature, degrade in the lower reaches. Butte Creek has water quality that supports rearing throughout the stream. Table 8-20 shows 303(d) listed streams in the Lower John Day watershed.

Table 8-20. Lower John Day watershed 303(d) listed stream segments and parameters of concern (ODEQ 2002 cited in NPCC 2005). Waterbodies that are listed multiple times represent different locations and/or different life stages.

Waterbody Name	Parameter	Waterbody Name	Parameter
Bear Creek	Temperature	John Day River	Temperature
Bridge Creek	Temperature	John Day River	Temperature
Gable Creek	Temperature	John Day River	Fecal Coliform
Grass Valley Canyon	Temperature	John Day River	Dissolved Oxygen
Henry Creek	Temperature	Nelson Creek	Temperature
John Day River	Fecal Coliform	Pine Creek	Biological Criteria
John Day River	pH	Sorefoot Creek	Temperature
John Day River	Temperature	Stahl Canyon	Temperature
John Day River	Temperature	Thirtymile Creek	Temperature

Blocked or impaired fish passage

EDT results identified "obstructions" as a high priority limiting factor in Bridge, Kahler, Muddy, Lower Rock (Gilliam County), and Thirtymile creeks, and a medium priority in Rock Creek (Wheeler County). The passage barrier on Bridge Creek is near the town of Mitchell and is considered passable to adults. The passage barrier on Kahler Creek is low in the system and only a juvenile barrier. Irrigation diversions create passage barriers on Lower Rock Creek (Gilliam County). Some of these have been repaired, but others have not. A fish passage structure was installed recently on Thirtymile Creek. None of the passage barriers identified are complete barriers, except for the one on Muddy Creek. ODFW biologists also identified passage problems on Mountain Creek (Unterwegner 2005).

Many irrigation diversions occur within the John Day subbasin watershed and, in low-water years, fish may encounter passage and spawning difficulties in some tributary reaches due to these diversions. Flows necessary for migration may be unavailable during early summer months and low-flow conditions may limit the use of some potential spawning areas (NMFS 2003a).

Degraded riparian communities and large wood recruitment

Riparian conditions have been degraded by agriculture, grazing, stream channelization, and riparian roads, and other development and activities. EDT rated riparian habitat improvements as "high" to "very high" priorities for restoration in all reaches of the lower John Day watershed. Reaches of Lower Rock (Gilliam County), Kahler, Service, Pine Hollow, and Thirtymile have very poor riparian conditions. Riparian conditions are fairly good in the Bridge Creek Wilderness areas of Bridge, Mountain and Rock (Wheeler County) creeks and in the inventoried roadless area of Cottonwood Creek. Many reaches of Ferry Canyon and Pine Creek also have good riparian cover. Butte has generally fairly good riparian cover, except for isolated areas.

Table 8-21 shows limiting factors and priorities identified by EDT diagnostic reports for the Lower John Day steelhead population. A summary of major limiting factors and threats by geographic area is presented in Table 8-22.

Table 8-21. Limiting factors and priorities for protection and restoration as defined by EDT for the Lower Mainstem John Day River steelhead population.

Geographic area priority			Attribute class priority for restoration																
Geographic area	Protection benefit	Restoration benefit	*Channel stability*	*Chemicals*	*Competition (w/ hatch)*	*Competition (other sp)*	*Flow*	*Food*	*Habitat diversity*	*Harassment/poaching*	*Obstructions*	*Oxygen*	*Pathogens*	*Predation*	*Sediment load*	*Temperature*	*Withdrawals*	*Key habitat quantity*
Bridge Creek	C	A	D				D		B		A				A	C		A
Butte Creek	E	A	D				D		B				D		A	C		A
Fields Creek									A						E			A
Grass Valley Canyon			D				B		E				D	D	A	C		B
JDR Johnson Creek	E	A	D				B		B				D	D	B	C		B
Lower JDR Clarno	E		D		D				B				D	D	B	C		B
Lower JDR Ferry Canyon		E	D		D		B		B				D	D	B	C		B
Lower JDR Kahler Creek	E	A	D				B		B		A		D		B	C		A
Lower JDR McDonald Ferry	C				D				A					B	A	E		B
Lower JDR Muddy Creek	C	A	D				B		B		A		D	D	A	C		B
Lower JDR Scott Canyon	E	A	D		D		B		B				D	D	A	C		B
Lower JDR Service Creek		C	D				B		B				D	D	B	C		A
Lower NF JDR									D							C		B
Lower Rock Cr		E	D				B		B		A				A	E		B
Mountain Creek	C	A	A				E		B				D		B	C		B
Pine Hollow		E	D				B		B	E			D		A	C		A
Rock Creek	A	C	A				E		E		B				B	E		B
Thirtymile Creek		A	D				B		B		A		D	D	A	B		A
Upper Middle JDR	A	A	D				E		B				D		B	C		B
Upper Rock Creek		C	D				B		B						A	C		A

Key to strategic priority (corresponding Benefit Category letter also shown)

A High — B Medium — C Low — D & E Indirect or General

1/ "Channel stability" applies to freshwater areas only.

Table 8-22. Habitat limiting factors summary for the Lower Mainstem John Day River steelhead population.

Population MaSA and MiSA	Major Limiting Factors	Sites Affected*	VSP Characteristics Impacted	Threats	Life Stages Affected
LOWER MAINSTEM JOHN DAY POPULATION					
Lower Mainstem John Day Population	Altered hydrology (low flow); degraded water quality (temp); degraded floodplain and channel structure (complexity, diversity, pools); degraded riparian community; altered sediment routing	MaSAs and MiSAs	Productivity, abundance, spatial structure, diversity	Agricultural and livestock grazing practices, roads, irrigation withdrawals, wetland draining and conversion, diking and stream channelization	Juvenile rearing, egg incubation, egg-to-fry survival, fry-to-smolt survival. One-year smolts present at reduced level.
Ferry MaSA	degraded floodplain and channel structure; altered hydrology	Ferry Canyon [H, F, CS]	Productivity, abundance	Agricultural and livestock grazing practices	Juvenile rearing, egg incubation, egg-to-fry, fry-to-smolt, one-year smolts
Middle Rock (Gilliam) MaSA	Altered sediment routing; degraded water quality (temp); degraded floodplain and channel structure; altered hydrology	Rock Cr. [F, CS]	Productivity, abundance, spatial structure, diversity	Agricultural and livestock grazing practices, irrigation withdrawals	Juvenile rearing, egg incubation, egg-to-fry, fry-to-smolt, one-year smolts
Pine Hollow MaSA	Altered hydrology, degraded riparian communities; altered sediment routing; degraded water quality (temp); degraded floodplain and channel structure	Pine Hollow Cr. [F, CS (lower, pipeline), S,H,R]	Productivity, abundance, spatial structure, diversity	Agricultural activities, livestock grazing	Juvenile rearing, egg incubation, egg-to-fry, fry-to-smolt, one-year smolts
Upper Rock (Gilliam) MaSA	Altered sediment routing; degraded water quality (temp); altered hydrology; degraded floodplain and channel structure	[F, CS, S]	Reduced productivity, abundance, spatial structure, diversity	Agricultural and livestock grazing practices, irrigation withdrawals and forest practices	Juvenile rearing, egg incubation, egg-to-fry, fry-to-smolt, one-year smolts
Lower Rock MaSA	degraded riparian communities; altered sediment routing; altered hydrology; impaired fish passage; degraded floodplain and channel structure; water quality (temp)	Rock Cr. [R, IP (lower), H,S,F, CS]	Reduced productivity, abundance, spatial structure, diversity	Agricultural activities, livestock grazing, irrigation withdrawals	Juvenile rearing, egg incubation, egg-to-fry, fry-to-smolt, one-year smolts
Thirtymile MaSA	impaired fish passage; altered hydrology, degraded floodplain and channel structure; altered sediment routing; water quality (temp); degraded riparian communities	Thirtymile Cr. [F, CS (lower especially), S,H,R,IP,T]	Reduced productivity, abundance, spatial structure, diversity	Agricultural and forest practices activities, livestock grazing, irrigation withdrawals	Juvenile rearing, egg incubation, egg-to-fry, fry-to-smolt, one-year smolts
Bridge MaSA	impaired fish passage; degraded floodplain and channel structure; altered sediment routing; water quality (temp); altered hydrology	Bridge Cr. [F, CS,R,H (lower), IP (near Mitchell), S,T]	Reduced productivity, abundance, spatial structure, diversity	Agricultural and livestock grazing practices, irrigation withdrawals	Juvenile rearing, egg incubation, egg-to-fry, fry-to-smolt, one-year smolts

Population MaSA and MiSA	Major Limiting Factors	Sites Affected*	VSP Characteristics Impacted	Threats	Life Stages Affected
Mountain MaSA	degraded floodplain and channel structure; altered sediment routing; water quality (temp); altered hydrology; impaired fish passage	Mountain Cr. [F, CS, H (lower), S, IP]	Reduced productivity, abundance, spatial structure, diversity	Agricultural and livestock grazing practices, irrigation withdrawals	Juvenile rearing, egg incubation, egg-to-fry, fry-to-smolt, one-year smolts
Rock (Wheeler) MaSA	degraded floodplain and channel structure; water quality (temp); altered hydrology	Rock [F, CS (lower), H, IP]	Reduced productivity, abundance, spatial structure, diversity	Agricultural and livestock grazing practices, irrigation withdrawals	Juvenile rearing, egg incubation, egg-to-fry, fry-to-smolt, one-year smolts
Kahler MaSA	Altered hydrology; degraded floodplain and channel structure; impaired fish passage; altered sediment routing; water quality (temp); degraded riparian communities	Kahler Cr. [IP (lower), F, CS, R,]	Reduced productivity, abundance, spatial structure, diversity	Agricultural and livestock grazing practices, irrigation withdrawals	Juvenile rearing, egg incubation, egg-to-fry, fry-to-smolt, one-year smolts
Butte MaSA	Altered hydrology; degraded floodplain and channel structure; altered sediment routing; water quality (temp), degraded riparian communities in isolated reaches	Butte Cr. [H, S (lower)], R	Reduced productivity, abundance, spatial structure, diversity	Agricultural and livestock grazing practices, irrigation withdrawals	Juvenile rearing, egg incubation, egg-to-fry, fry-to-smolt, one-year smolts
Service MaSA	degraded floodplain and channel structure; degraded riparian communities; altered hydrology; altered sediment routing; water quality (temp)	Service Cr. [F, CS, R]	Reduced productivity, abundance, spatial structure, diversity	Agricultural and livestock grazing practices	Juvenile rearing, egg incubation, egg-to-fry, fry-to-smolt, one-year smolts
Cottonwood MaSA	Altered hydrology; water quality (temp)	Cottonwood Cr. [H, F, CS (lower reaches)]	Reduced productivity, abundance, spatial structure, diversity	Agricultural and livestock grazing practices, irrigation withdrawals	Juvenile rearing, egg incubation, egg-to-fry, fry-to-smolt, one-year smolts

* Abbreviations for limiting factors: degraded floodplain connectivity and function (F), degraded channel structure and complexity (CS); degraded riparian communities (R); altered hydrology (H); degraded water quality (WQ), temperature (T); altered sediment routing (S); man-made block to migration (BP); impaired fish passage (IP).

8.2.6 North Fork John Day River Population, Tributary Habitat Limiting Factors

The primary tributary habitat limiting factors identified by the recovery planning team for the North Fork John Day River steelhead population are degraded floodplain connectivity and function, degraded channel structure and complexity (key habitat quantity, habitat diversity, channel stability), altered sediment routing, water quality (temperature), and altered hydrology.

Degraded floodplain connectivity and function
Floodplain connectivity in several reaches of the Granite Creek system has, until recently, been limited by dredge piles from historical mining operations. Many of these historical dredge piles sat very near the stream and prevented the stream from overflowing into the floodplain during

high flow events. During the last five years, many of the tailing piles along Granite and Clear creeks have been leveled and floodplain connectivity has been re-established. However, a high flow event is needed to reconfigure the channel and create the necessary pool frequency.

Degraded channel structure and complexity
Most indicators of channel condition within the North Fork John Day River are "functioning at risk" (NMFS 2003). The North Fork River does not meet PACFISH pool frequency management objectives (USDA and USDI 1994 cited in NPCC 2005). Key habitat quantity is identified by the EDT analysis as the most important limiting factor to address for this population. Pool frequency and quality limit production in the Granite Creek and upper North Fork systems. Degraded channel conditions also limit steelhead production in the Big Wall Creek drainage (NMFS 2003). Middle Camas and lower Owens Creek watersheds have good potential; however, stream channels are incised, LWD is low, and habitat diversity is limited. Large pools, channel habitat, wetted width/maximum depth ratio, and streambank condition are considered properly functioning in the Granite Creek subwatershed.

Altered sediment routing
Erosion caused by forest practices and other activities affects habitat conditions in several parts of the North Fork drainage. The Wallowa Whitman National Forest (WWNF) has identified sediment as "functioning at risk" in both the Granite Creek and Upper North Fork John Day subwatersheds. The Umatilla National Forest (UNF) considers sediment to be "not properly functioning" and substrate embeddedness to be functioning at risk in the Big Wall Creek subwatershed (NMFS 2003). Big Wall Creek was listed on the 303(d) list for sediment. Sediment modeling conducted for the parts of the Big Wall Creek subwatershed indicates that only prescribed fire and instream habitat improvement posed more than negligible risk of sediment increases (NMFS 2003). Wissmar et al. (1994) noted that turbidity in Cottonwood Creek, a North Fork tributary, is notoriously high after storm events. The resulting siltation of stream beds decrease aquatic insect production and degrades spawning habitat.

Altered hydrologic processes
Water yield is generally close to benchmark conditions in most of the upper reaches and tributaries to the North Fork John Day, where much of the watershed is protected as a wilderness area. Low flows are more a problem in the lower elevation tributaries to the west including the lower reaches of Big Wall, Cottonwood, and Rudio. EDT results identified flow as a medium priority restoration need in Cottonwood Creek and as a low restoration priority for Granite, upper and lower Camas, and the lower North Fork John Day River.

The Pete Mann ditch system in the Granite Creek watershed is a complex of ditches originally constructed in the late 1800s to deliver water to local mines. Currently, the ditch system delivers water to both mines and land irrigated for agriculture. The Pete Mann ditch system often completely diverts Lightning Creek, Salmon Creek, and the East Fork Clear Creek (all steelhead streams) into the Burnt River subbasin, a non-anadromous basin. Although the Forest Service did not rate change in peak/base flows, it is likely that this indicator is functioning either "at risk" or "not properly functioning" because of this ditch system.

Degraded water quality

The North Fork has the best chemical, physical, and biological water quality in the John Day subbasin as compared to ODEQ water quality standards (USDI 2000 cited in NPCC 2004). Most of the streams in this subbasin are considered in relatively good condition, with the exception of elevated late summer water temperatures that do not meet ODEQ standards (Table 8-23). Water temperature is primarily a concern in Cottonwood Creek, the lower North Fork John Day and lower reaches of Granite Creek. Because the North Fork (including its primary tributary, the Middle Fork) contributes 60% of the flow to the mainstem John Day (OWRD 1986), the influence of the North Fork on temperature is significant.

Leaching of toxic mine waste and a high degree of stream sedimentation from highly erodible, decomposing granitic soils also create water quality problems in the North Fork. Waste from abandoned mine sites may be having serious negative effects on water quality in the upper North Fork John Day and Granite Creek watersheds, where ODFW biologists have observed dead fish and adult spring Chinook with gill lesions (NMFS 2003; Wilson et al. 2005a). The cause of this mortality is not certain, but elevated iron and heavy metal concentrations may be a contributing factor. While recent surveys conducted by the UNF and U.S. Environmental Protection Agency indicate that mercury was not present in high enough concentrations known to cause these types of effects, conditions at abandoned mine sites and abatement ponds may change yearly, increasing the amount of heavy metals released (NMFS 2003). Hot geothermal springs also exist, but their effects on water quality are not fully known (NPCC 2005).

Table 8-23. North Fork John Day River subbasin 303(d) listed stream segments and water quality parameters of concern (ODEQ 2002 cited in NPCC 2005).

Waterbody Name	Parameter	Waterbody Name	Parameter
Alder Creek	Sedimentation	Hidaway Creek	Temperature
Baldy Creek	Sedimentation	Hog Creek	Sedimentation
Bear Wallow Creek	Temperature	Indian Creek	Temperature
Beaver Creek	Temperature	Lane Creek	Temperature
Big Creek	Temperature	Mallory Creek	Temperature
Big Wall Creek	Temperature, Sedimentation	Meadow Creek	Temperature
Bowman Creek	Temperature	North Fork Cable Creek	Temperature
Bridge Creek	Temperature	North Fork John Day River	Temperature
Buck Creek	Temperature	Onion Creek	Temperature
Bull Run Creek	Temperature	Owens Creek	Temperature
Cable Creek	Temperature	Porter Creek	Sedimentation
Camas Creek	Temperature	Potamus Creek	Temperature
Clear Creek	Temperature	Rancheria Creek	Temperature
Cottonwood Creek	Biological Criteria	Skookum Creek	Temperature
Crane Creek	Temperature	South Fork Cable Creek	Temperature
Desolation Creek	Temperature	South Trail Creek	Temperature
Ditch Creek	Temperature	Sponge Creek	Temperature
East Fork Cottonwood Creek	Biological Criteria	Stalder Creek	Temperature
Fivemile Creek	Temperature	Swale Creek	Temperature, Sedimentation
Frazier Creek	Temperature	Trail Creek	Temperature
Granite Creek	Temperature, Sedimentation	Wilson Creek	Temperature, Sedimentation

Blocked or impaired fish passage
Physical barriers in the Big Wall Creek and Granite Creek drainages are considered to be "functioning at risk" (NMFS 2003). Currently a number of culverts on forest land from partial passage barriers for steelhead (USFS 2001).

Degraded riparian communities and large wood recruitment
Much of the Upper North Fork watershed is designated as wilderness and is likely at or near benchmark condition. Riparian conditions are also likely near benchmark conditions in the Potamus and Stony watersheds where access and road densities are very limited. Riparian conditions are considered to be "functioning at risk" in the Big Wall and Granite watersheds. The active recent fire history has caused some changes in riparian conditions. Large fires in Desolation Creek, Upper North Fork John Day, and Granite Creek from 1986-1996 modified stream shade and sediment routing in some locations.

Table 8-24 provides information from EDT Diagnostic Report on limiting factors for each HUC5 occupied by the North Fork John Day steelhead population. A summary of limiting factors and threats by geographic area is presented in Table 8-25.

Table 8-24. Limiting factors and priorities for protection and restoration as defined by EDT for North Fork John Day Steelhead.

Geographic area priority			Attribute class priority for restoration															
Geographic area	Protection benefit	Restoration benefit	Channel stability	Chemicals	Competition (w/ hatch)	Competition (other sp)	Flow	Food	Habitat diversity	Harassment/poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment load	Temperature	Withdrawals	Key habitat quantity
Cottonwood Creek		A	●				●		●				∘		●	●		●
Desolation Creek	A	∘	∘												∘	∘		∘
Granite Creek	B	B	∘				∘		∘						●			●
JDR Johnson Creek									∘					∘	∘			●
Lower Camas Creek	∘	∘	∘				∘		●						●	∘		●
Lower JDR Clarno	∘								∘					∘				●
Lower JDR Ferry Canyon									∘					∘				●
Lower JDR Kahler Creek	∘						∘		●							∘		●
Lower JDR McDonald Ferry	B								∘					●				
Lower JDR Muddy Creek	∘								●					∘				●
Lower JDR Scott Canyon	∘								∘					∘				●
Lower JDR Service Creek	∘						∘		●						∘	∘		●
Lower MF JDR									●							●		∘
Lower NF JDR	∘	∘	∘				∘		●				∘		●	●		●
NF JDR Big Creek	A	A	●						∘		●				∘	∘		●
NF JDR Potamus Creek	B	A	∘				∘		●						●	∘		●
Upper Camas Creek	B	∘	∘				∘		∘						●	∘		●
Upper NF JDR	A	A	●						∘						●	∘		●
Wall Creek	B	B					●		∘						●	●		●

Key to strategic priority (corresponding Benefit Category letter also shown)

A ● High
B ∘ Medium
C ∘ Low
D & E Indirect or General

1/ "Channel stability" applies to freshwater areas only.

Table 8-25. Habitat limiting factors summary for the North Fork John Day River steelhead population.

Population MaSA and MiSA	Major Limiting Factors	Sites Affected*	VSP Characteristics Impacted	Threats	Life Stages Affected
NORTH FORK JOHN DAY POPULATION					
North Fork John Day Population	degraded floodplain and channel structure (pools, connectivity, diversity); altered sediment routing; water quality (temp, toxic mine waste)	MaSAs and MiSAs	Productivity and abundance most affected; possible slightly altered spatial structure.	Riparian disturbance, stream channelization and relocation, grazing, forest practices, road building, irrigation withdrawals, mining and dredging	Parr-to-smolt survival and egg-to-fry survival. All stages affected by toxic leaching in Granite Cr. and NF John Day R.
Lower Camas MaSA	degraded floodplain and channel structure; altered sediment routing; water quality (temp)	Camas between Hideaway and Wilkins (T, F, CS, R, H, S	Productivity and abundance most affected; possible slightly altered spatial structure	Livestock grazing, forest practices, roads,	Parr-to-smolt survival and egg-to-fry survival.
Potamus MaSA	degraded floodplain and channel structure; altered sediment routing; water quality (temp)	Potamus [T,S,F,CS]	Productivity and abundance most affected; possible slightly altered spatial structure	Livestock grazing, forest practices, roads,	Parr-to-smolt survival and egg-to-fry survival.
Big Wall MaSA	degraded floodplain and channel structure; altered sediment routing; water quality (temp); altered hydrology	[H (lower), F, CS,S,T,IP,R]	Productivity and abundance most affected; possible slightly altered spatial structure	Livestock grazing, forest practices, roads,	Parr-to-smolt survival and egg-to-fry survival.
Upper NF John Day MaSA	degraded floodplain and channel structure; altered sediment routing; water quality (toxic mine waste)	[WQ (mine sites), F,CS,S,]	Productivity and abundance most affected; possible slightly altered spatial structure	Livestock grazing, forest practices, roads, mining and dredging	Primarily parr-to-smolt and egg-to-fry survival. All stages affected by toxic leaching
Desolation MaSA	degraded floodplain and channel structure; altered sediment routing; water quality (temp)	[F,CS,S,T]	Productivity and abundance most affected; slightly altered spatial structure	Livestock grazing, forest practices, roads,	Primarily parr-to-smolt and egg-to-fry survival.
Granite MaSA	degraded floodplain and channel structure; altered sediment routing; water quality (toxic mine waste); altered hydrology	[H (Pete Mann ditch system), WQ (mine sties), F,CS, S,T,R]	Productivity and abundance most affected; possible slightly altered spatial structure	forest practices, roads, mining and dredging	Parr-to-smolt and egg-to-fry survival. All stages affected by toxic leaching
Cottonwood MaSA	degraded floodplain and channel structure; altered sediment routing; water quality (temp); altered hydrology; degraded riparian communities	[H, IP (lower reaches), F,CS, S, WQ, R (biological criteria)]	Productivity and abundance most affected; possible slightly altered spatial structure	Livestock grazing, forest practices, roads, irrigation withdrawals	Primarily parr-to-smolt and egg-to-fry survival.
Owens MaSA	degraded floodplain and channel structure	[F, CS, S, T]	Productivity and abundance most affected; possible slightly altered spatial structure	Livestock grazing, forest practices, roads, irrigation withdrawals	Primarily parr-to-smolt and egg-to-fry survival.
Upper Camas MaSA	degraded floodplain and channel structure; altered sediment routing; water quality (temp)	[F, CS, S, T,]	Productivity and abundance most affected; possible slightly altered spatial structure	Livestock grazing, forest practices, roads	Primarily parr-to-smolt and egg-to-fry survival.

* Abbreviations for limiting factors: degraded floodplain connectivity and function (F); degraded channel structure and complexity (CS); degraded riparian communities (R); altered hydrology (H); degraded water quality (WQ), temperature (T); altered sediment routing (S); man-made block to migration (BP); impaired fish passage (IP).

8.2.7 Middle Fork John Day River Population, Tributary Habitat Limiting Factors

The primary tributary habitat limiting factors identified by the recovery planning team for Middle Fork John Day steelhead are degraded floodplain and channel structure (key habitat quantity and habitat diversity), altered sediment routing, altered hydrology, and water quality (temperature).

Degraded floodplain connectivity and function
Channels have become disconnected from their floodplains in several areas of the Middle Fork John Day watershed (Malheur National Forest (MNF) 1999). A number of areas with very wide grassy valley bottoms historically were likely Rosgen E-channels but have been altered to type G and C channels by past overgrazing and road construction within floodplains (MNF 1999). Known areas with this condition include the mainstem Middle Fork John Day River, Squaw Meadow, Summit Creek and Squaw Creek near their mouths, and Olmstead Creek at Olmstead meadows. Floodplains along the Middle Fork and tributaries were also altered by mining operations.

Degraded channel structure and complexity
Tributaries to the Middle Fork that flow out of the Dixie Divide between the Middle Fork John Day and the Upper John Day are generally steep and incised in the lower reaches. Long, Squaw and Camp creeks flow through low-gradient meadow systems in the upper reaches. Tributaries that flow out of the Elkhorn Mountains to the north do not generally have meadow systems in their upper reaches, and the base rock is granite. Portions of Bridge, Dry Fork Clear, Crawford, Summit, and Squaw creeks have significant lengths of their channels impacted by streamside roads. EDT results identified habitat diversity and key habitat quantity as limiting factors in all major and minor spawning areas.

Mining operations have altered many of the stream channels and floodplains along the Middle Fork and its tributaries (MNF 1999). Alterations have occurred along Elk, Davis, Deep, Vinegar, Placer Gulch, Vincent, Caribou, Beaver, Granite Boulder, Big Boulder, Ragged, Butte, Ruby, and the Middle Fork mainstem. Some of the meadow areas have incised channels, including Phipps Meadow. Road construction has altered and constricted channels in many tributaries and along the Middle Fork mainstem. Log weirs, placed in lower Camp Creek, keep the channel from re-establishing its natural morphology.

Altered sediment routing
The BLM has identified sediment/turbidity and substrate embeddedness as "functioning at risk" in the Middle Fork John Day and a number of its tributaries (NMFS 2004/00383). EDT results identified sediment loading to be a significant limiting factor in the watershed. Excessive fine sediment problems are generally located in the Middle Fork mainstem (Unterwegner 2005). Poor riparian conditions, riparian roads, grazing activities, and past forestry, mining, and channel alterations all contribute sediment to streams in the watershed.

Altered hydrologic processes
The Middle Fork drainage is susceptible to rain-on-snow events capable of producing high volume, short duration run-off surges during the late winter and early spring months. Late

season base flows are sustained by slow release of water from the soil matrix, effluent groundwater, numerous wet meadows, and perennial springs (MNF 1999). Where channels have become entrenched, water tables are lowered and water storage capacity is reduced, resulting in lower base flows.

While low flows are a problem throughout the subbasin, irrigation withdrawals are not as significant as for some other populations in the John Day subbasin, or as significant as they were a few years ago. Most water rights in the upper Middle Fork subbasin are no longer being used for irrigating pastures. Four of the five largest water users above Highway 395 have converted their consumptive rights to instream rights for either the entire year or for the most critical low flow period. Three properties in the Middle Fork subbasin above Highway 395 continue to irrigate pastures with flood irrigation. One of the properties is located on Camp Creek, one is on the Middle Fork immediately above Camp Creek, and the other is near Galena.

Degraded water quality

Water quality in the Middle Fork subbasin generally exhibits satisfactory chemical, physical, and biological quality as compared to ODEQ water quality standards (USDI 2000 cited in NPCC 2005). The Middle Fork usually has worse water quality problems than its tributaries, with the most serious water quality problem being elevated summer temperatures. Season-long cattle grazing contributes to elevated fecal coliform counts during summer. However, agricultural runoff presents a low level of potential impact to water quality (NPCC 2001 cited in NPCC 2005). Flow from Bates Pond, an old mill pond on Bridge Creek less than 200 yards from its confluence with the Middle Fork, likely increases temperatures in the Middle Fork.

ODEQ has identified several streams in the Middle Fork subbasin as water quality limited for high temperatures, dissolved oxygen, or biological criteria, with the most serious water quality problem being elevated summer temperatures caused by vegetation disturbance, stream straightening/relocation, livestock grazing, forest practices, road building, irrigation water withdrawals, and historical mining and dredging (NPCC 2005). Table 8-26 provides data on listed stream segments in the Middle Fork subbasin.

Table 8-26. Middle Fork John Day River subbasin 303(d) listed stream segments and parameters of concern in 1998 and 2002 (ODEQ 2002).

Waterbody Name	River Mile	Parameter	Season	List Date
Big Creek	0 to 11.6	Temperature	Summer	1998
Camp Creek	0 to 15.6	Temperature	Summer	1998
Caribou Creek	0 to 3.6	Temperature	Summer	1998
Clear Creek	0 to 12.7	Temperature	Summer	1998
Coyote Creek	0 to 2.5	Temperature	Summer	1998
Crawford Creek	0 to 3.5	Temperature	Summer	1998
Davis Creek	0 to 6.8	Temperature	Summer	1998
Dry Fork Clear Creek	0 to 11	Temperature	Summer	1998
Granite Boulder Creek	0 to 8.1	Temperature	Summer	1998
Little Boulder Creek	0 to 2.1	Temperature	Summer	1998
Little Butte Creek	0 to 2.6	Temperature	Summer	1998
Long Creek	0 to 36.7	Temperature	Summer	1998
Lunch Creek	0 to 4.1	Temperature	Summer	1998
Middle Fork John Day River	0 to 69.8	Temperature	Summer	1998
Middle Fork John Day River	0 to 69.8	Temperature	August 15 - July 15	2002
Mill Creek	0 to 3.1	Temperature	Summer	1998
Placer Gulch	0 to 4.2	Temperature	Summer	1998
Ragged Creek	0 to 4.1	Temperature	Summer	1998
Squaw Creek	0 to 9.4	Temperature	Summer	1998
Summit Creek	0 to 8.6	Temperature	Summer	1998
Summit Creek	0 to 8.6	Temperature	August 15 - July 15	2002
Unnamed Waterbody	0 to 2.4	Temperature	Summer	1998
Vinegar Creek	0 to 7.1	Temperature	Summer	1998

Poage et al. (1996) studied stream temperatures along the length of the Middle Fork John Day River and found they differed from other subbasins of the John Day River. The average stream temperature profile for the Middle Fork John Day River indicated that the pattern of water temperature was highly variable, with the highest average water temperatures observed at the upstream end of the study section. The authors hypothesized that the decrease in downstream temperature can be explained by cold-water inputs from cooler tributaries, including Clear Creek, and as the result of relatively cool groundwater seeping into the main stream channel (Poage et al. 1996).

Blocked or impaired fish passage

Currently a number of culverts on forest land form partial passage barriers for steelhead (Unterwegner 2005). In the past, numerous pushup dams and irrigation diversions in the upper Middle Fork and several of its tributaries created intermittent passage barriers; they also increased sedimentation, seasonally reduced flows, altered channels, and caused other water quality impacts. Many of these irrigation diversions have been converted to permanent, more fish passage friendly structures within the last ten years. Water diversions that are not properly screened to prevent intake of juvenile Mid-C steelhead may still exist in the system, particularly

on Long Creek and other tributaries of the lower Middle Fork (NPCC 2001 cited in NMFS 2004a).

Degraded riparian communities and large wood recruitment

Riparian corridors and levels of instream LWD have changed significantly from historical conditions. The reduction in large wood has resulted in fewer pools, increased stream velocities, reduced sediment trapping, and an overall reduction in channel diversity and key habitat (MNF 1999). Exceptions include the Clear Creek and Lunch Creek watersheds that contain high levels of woody material and good riparian conditions. Weir "hard structures" have been constructed in Camp, Lick, Squaw, Summit, Phipps, Dry Fork Clear creeks, and the lower portion of Clear Creek in an attempt to increase pool habitat and instream diversity (MNF 1999).

Table 8-27 provides information from EDT Diagnostic Report on limiting factors for each HUC5 occupied for the Middle Fork John Day River steelhead population. A summary of major limiting factors and threats by geographic area is presented in Table 8-28.

Table 8-27. Limiting factors and priorities for protection and restoration as defined by EDT for Middle Fork John Day River steelhead.

Geographic area priority			Attribute class priority for restoration															
Geographic area	Protection benefit	Restoration benefit	*Channel stability*	*Chemicals*	*Competition (w/ hatch)*	*Competition (other sp)*	*Flow*	*Food*	*Habitat diversity*	*Harassment/poaching*	*Obstructions*	*Oxygen*	*Pathogens*	*Predation*	*Sediment load*	*Temperature*	*Withdrawals*	*Key habitat quantity*
Big Creek	○	◯	•				•		•						●	•		●
Camp Creek	◯	◯	•				•		•						●	•		●
Cottonwood Creek			•				•		•									●
JDR Johnson Creek									•					•	•			●
Long Creek	○	○	•				●		●						●	•		◉
Lower JDR Clarno									•					•				●
Lower JDR Ferry Canyon		○							•					•				●
Lower JDR Kahler Creek	○						•		●							•		●
Lower JDR McDonald Ferry	○	○							•					●				
Lower JDR Muddy Creek									•					•				●
Lower JDR Scott Canyon		○							•					•				●
Lower JDR Service Creek									•					•				●
Lower MF JDR		○	•				•		●						●	●		●
Lower NF JDR									•							●		●
NF JDR Potamus Creek									●							●		•
Upper MF JDR	○	○	•				•		•						●			●
Wall Creek							•		•									●

Key to strategic priority (corresponding Benefit Category letter also shown)

1/ "Channel stability" applies to freshwater areas only.

A	B	C	D & E
◯ / ● High	○ / ● Medium	○ / • Low	Indirect or General

Table 8-28. Habitat limiting factors summary for the Middle Fork John Day River steelhead population.

Population MaSA and MiSA	Major Limiting Factors	Sites Affected*	VSP Characteristics Impacted	Threats	Life Stages Affected
MIDDLE FORK JOHN DAY POPULATION					
Middle Fork John Day Population	degraded floodplain and channel structure (connectivity, diversity, complexity); altered hydrology; altered sediment routing; water quality (temp); impaired fish passage	MaSAs and MiSAs	Productivity, abundance, spatial structure and diversity	Stream channelization and relocation, grazing, forest practices, road building, culverts and other passage barriers, irrigation withdrawals, mining and dredging	All life stages, especially fry-to-smolt survival, egg incubation; egg-to-parr survival, spawning
Long Creek MaSA	degraded floodplain and channel structure; altered hydrology; altered sediment routing; water quality (temp); impaired fish passage	Long Cr. [T (RM 0-36.7), IP,F,CS,H,S, R]	Productivity, abundance, spatial structure and diversity	Stream channelization and relocation, grazing, forest practices, road building, culverts and other passage barriers, irrigation withdrawals	All life stages, especially fry-to-smolt survival, egg incubation; egg-to-parr survival
Slide Creek MaSA	Degraded riparian communities, floodplain connectivity, channel structure, altered sediment routing	Slide (F,CS, S, R)	Productivity, abundance, spatial structure and diversity	Grazing management, forest practices	All life stages, especially fry to smolt survival and egg to fry survival
Rush Creek MaSA	Impaired fish passage, channel complexity, connectivity	Rush Creek irrigation diversion at RM 2.2 (IP, F,CS)	Productivity, abundance, spatial structure, diversity	Stream bottom road, effects of past grazing management	All life stages, especially fry to smolt survival and egg to fry survival
Upper MF John Day MaSA	Altered sediment routing; degraded floodplain and channel structure; altered hydrology; water quality (temp)	MF mainstem [T (RM 0-69.8), F,CS, S, H,R]	Productivity, abundance, spatial structure and diversity	Stream channelization and relocation, grazing, forest practices, road building, culverts and other passage barriers, irrigation withdrawals	All life stages, especially fry-to-smolt survival, egg incubation; egg-to-parr survival
Camp Creek MiSA	Degraded floodplain and channel structure; altered hydrology; water quality (temp); altered sediment routing	Lower Camp Cr. [T (RM 0 to 15.6), F,CS, S,T,R]	Productivity, abundance, spatial structure and diversity	Stream channelization and relocation, grazing, forest practices, road building, culverts and other passage barriers, irrigation withdrawals	All life stages, especially fry-to-smolt survival, egg incubation; egg-to-parr survival
Big Creek MiSa	Altered sediment routing; degraded floodplain and channel structure; altered hydrology; water quality (temp)	[T (RM 0-11.6), F,CS,S,T,R]	Productivity, abundance, spatial structure and diversity	Stream channelization and relocation, grazing, forest practices, road building, culverts and other passage barriers, irrigation withdrawals	All life stages, especially fry-to-smolt survival, egg incubation; egg-to-parr survival, spawning

* Abbreviations for limiting factors: degraded floodplain connectivity and function (F); degraded channel structure and complexity (CS); degraded riparian communities (R); altered hydrology (H); degraded water quality (WQ), temperature (T); altered sediment routing (S); man-made block to migration (BP); impaired fish passage (IP).

8.2.8 South Fork John Day River Population, Tributary Habitat Limiting Factors

The primary tributary habitat limiting factors identified by the recovery planning team for the South Fork John Day River steelhead population are altered sediment routing, degraded floodplain and channel structure (key habitat quantity and habitat diversity), altered hydrology, water quality (temperature) and blocked or impaired fish passage.

Degraded floodplain connectivity and function
While the extent of floodplain connectivity has not been measured, ODFW considers this attribute as not properly functioning in sections of Murderers Creek below Cabin Creek. New beaver dams are contributing to improving off-channel habitats.

Degraded channel structure and complexity
Loss of beavers, active LWD debris removal projects, road construction, riparian timber harvests, and poor grazing management have accelerated water runoff and instream velocities in the South Fork system and led to increased channel and bank erosion, with incised and unstable channels (MNF 1997). Current stream bank surveys on the lower 14.6 miles indicate that the banks of Murderers Creek are between 98 and 100% stable. A riparian fence protects the stream bank along this reach except for in six water gaps used by cattle. Stream surveys conducted by ODFW in 1960 and the Malheur National Forest in 1997 showed that most reaches of Murderers Creek were deficient in LWD. Lower reaches of Murderers Creek are likely still deficient in LWD, but this condition is expected to improve as riparian vegetation recovers within the fenced riparian areas. Murderers Creek currently has few braided channels and backwaters. As the water drops in the summer, braiding and backwaters are reduced and flow is restricted to the channel. During low water and periods of high stream temperatures, distribution of juvenile steelhead is limited to cool water areas. Today, pool habitat is closer to benchmark conditions in the South Fork than generally found in the tributaries (Unterwegner 2005). There is more beaver activity in the creek than in the 1960s and the riffle-pool ratio has likely improved.

Altered sediment routing
Results from properly functioning condition (PFC) assessments conducted by the Malheur National Forest in 2004 in the South Fork and tributaries showed that sediment conditions in pool and riffle habitats were generally "not properly functioning" (MNF 2004). The MNF (2004) also noted that ongoing management of the existing road network associated with Reach 1 of Deer Creek is continuing to contribute excess gravel to the channel. The Forest Service lands within Deer Creek HUC5s have road densities of 4.14 miles of road/mile^2. This high road density may contribute to elevated sediment levels and embedded substrates in the South Fork and its tributaries.

The MNF (2004) also collected substrate embeddedness data for 40 streams in the South Fork watershed that showed substantial problems with embeddedness throughout the watershed. Out of 26 summaries, 21 were found to have more than 50% of the unit embedded (MNF 2004).

Roads might be the single most important threat causing the increases in sedimentation of streams (MNF 1997) because of density, location, and maintenance. Road densities on Forest Service lands in various HUC5s of the South Fork drainage are; 2.75 miles/mile² in Murderers Creek; 4.14 miles/mile² in Deer Creek; 4.25 miles/mile² in Middle South Fork; and 3.27 miles/mile² in Upper South Fork. The most heavily roaded areas are coincident with sedimentary soils in the upper watershed (MNF 1997). Surveys from 1992 to 1997 identified a number of reaches in the Murderers Creek watershed that were contributing excessive sediment to stream channels including, Beaver and North Fork Beaver, Miner, Grapefruit, Orange, Charley Mack, South Fork Murderers, Bark Cabin, Murderers (reach between Stewart's Cabin and Murderers Creek Guard Station), Oregon Mine, and Tennessee creeks.

Altered hydrologic processes
Livestock grazing, logging, road construction, beaver removal and fire suppression have all contributed to changes in peak/base flows in the South fork drainage. Further changes in the area's hydrology resulted from intensive stream channelization, flow modifications and drainage (including some tiling of drainage ditches) projects in the South Fork between 1943 and 1951. Irrigation withdrawals also reduce summer low flows in some reaches; however, overall, irrigation withdrawals and agricultural impacts in steelhead occupied reaches of the South Fork drainage are not as significant as for Upper Mainstem John Day or Lower John Day steelhead populations.

Low-flow conditions in Murderers Creek and other South Fork tributaries may limit the use of some potential spawning areas, even in unaltered habitat, due to the lack of water in early summer months. In some years, flows fall below recommended levels for successful spawning in Murderers Creek as early as May. Water temperatures and unsuitable habitat associated with naturally occurring low water conditions in Murderers Creek likely alter or temporarily block movement of juveniles during summer months (Harcombe and Unterwegner 2005).

Tributaries such as Black Canyon remain a source of good quality, cool water to the mainstem South Fork. The loss of beaver in the John Young Meadows in the upper South Fork Murderers Creek, where beavers were very active historically, has reduced the water storage capacity and led to entrenched channels downstream of the meadows (MNF 1997). MNF (1997) describes the Murderers Creek watershed as having a higher density of springs than most of the Bear Valley Ranger District. However, many of the tributaries flow only intermittently during the summer.

Degraded water quality
Elevated water temperatures during the summer months are considered a major limiting factor in the South Fork John Day River, Deer Creek, North Fork Deer Creek and Murderers Creek. All four streams are on the ODEQ's 303(d) list (ODEQ 2000). Monitoring by the stream gage near the mouth of Murderers Creek shows that water temperatures exceed 64ºF, 54% of the time (65 days out of 122 days) between July 1 and September 30, averaged over the 5-year period (ODFW 2005a). Elevated stream temperatures are also a problem in other major tributaries. Water withdrawals and agricultural impacts above Izee Falls contribute to water quality problems in occupied reaches of the lower South Fork (Unterwegner 2005).

Blocked or impaired fish passage

Izee Falls, at RM 28.5, is a complete natural block to steelhead migration. Water diversion structures and thermal barriers restrict juvenile steelhead passage at times. Irrigation withdrawals can also hinder upstream adult migration during late spring in very low water years.

Degraded riparian communities and large wood recruitment

Riparian areas are typically managed as part of range operations, and many have been altered from their natural state by water diversions, channelization, vegetation changes and the like (NPCC 2005). Grazing activities on the forest and private lands have impacted riparian functions by reducing or eliminating native plant communities, altering soil conditions and infiltration rates (MNF 1997; Kauffman 2004). Private, state and Federal forest practices have also altered riparian vegetation. These activities have reduced instream large wood concentrations and the potential for future large wood contributions. The MNF (2004) measured LWD in the South Fork watershed. Out of 28 streams, 15 streams met NMFS criteria of >20 pieces per mile of LWD >35 feet in length.

Table 8-29 provides information from EDT Diagnostic Report on limiting factors for the South Fork John Day River steelhead population. A summary of major limiting factors and threats by geographic area is presented in Table 8-30.

Table 8-29. Limiting factors and priorities for protection and restoration as defined by EDT for South Fork John Day River steelhead population.

Geographic area priority			Attribute class priority for restoration															
Geographic area	Protection benefit	Restoration benefit	*Channel stability*	*Chemicals*	*Competition (w/ hatch)*	*Competition (other sp)*	*Flow*	*Food*	*Habitat diversity*	*Harassment/poaching*	*Obstructions*	*Oxygen*	*Pathogens*	*Predation*	*Sediment load*	*Temperature*	*Withdrawals*	*Key habitat quantity*
Fields Creek									●					●	●			⬤
JDR Johnson Creek	○						●		⬤						●	●		⬤
Lower JDR Clarno	○								●					●				⬤
Lower JDR Ferry Canyon	○								●					●				⬤
Lower JDR Kahler Creek	○								⬤							●		⬤
Lower JDR McDonald Ferry	○								●					⬤				
Lower JDR Muddy Creek	○								●					●				⬤
Lower JDR Scott Canyon	○								●					●				⬤
Lower JDR Service Creek	○								●					●				⬤
Lower NF JDR									●							⬤		⬤
Lower SF JDR	◯	◯	●				●		●						⬤	⬤		⬤
Middle SF JDR	○	○	●				●		●						⬤	●		⬤
Murderers Creek	○	○	●				●		●						⬤	●		⬤
Rock Creek									●							●		⬤
Upper Middle JDR							●		⬤							●		⬤

Key to strategic priority (corresponding Benefit Category letter also shown)

1/ "Channel stability" applies to freshwater areas only.

A ◯ / ⬤ High — B ○ / ● Medium — C ○ / ● Low — D & E Indirect or General

***** Fields Creek, which is tributary to the JDR upstream of the SFJD, was included in the EDT analysis as part of the SFJD, but the TRT considers it a MiSA to the UJD population and it was discussed in the UJD population.

Table 8-30. Habitat limiting factors summary for the South Fork John Day River steelhead population.

Population MaSA and MiSA	Major Limiting Factors	Sites Affected*	VSP Characteristics Impacted	Threats	Life Stages Affected
SOUTH FORK JOHN DAY POPULATION					
South Fork John Day Population	Degraded floodplain and channel structure (lack of deep pools, habitat diversity); degraded riparian communities; water quality (temp); hydrologic alterations; sediment routing dysfunction; impaired fish passage	MaSAs and MiSAs	Productivity, abundance, spatial structure.	Riparian disturbance, stream channelization and relocation, roads, grazing, forest practices, culverts and other barriers, irrigation withdrawals, beaver removal	Juvenile rearing, spawning, egg incubation, egg-to-parr survival
Murderers Creek MaSA	Degraded floodplain and channel structure (lack of deep pools); hydrologic alterations; sediment routing dysfunction; water quality (temp); degraded riparian communities	Upper/Middle SF Murderers Cr. [F/CS, H, S, R]; Murderers Cr. [S, R, F/CS, T)	Productivity, abundance, spatial structure.	Riparian disturbance, stream channelization and relocation, roads, grazing, forest practices, culverts and other barriers, fire suppression, irrigation withdrawals, beaver removal	Juvenile rearing, spawning, egg incubation, egg-to-parr survival
Upper SF John Day MaSA	Degraded floodplain and channel structure; sediment routing dysfunction water quality (temp); hydrologic alterations; degraded riparian communities; impaired fish passage	Deer Cr. [Sed., R, F,T]; Upper SF John Day [T, F, S, BP, IP, R]	Productivity, abundance, spatial structure.	Irrigation withdrawals, agricultural practices, livestock grazing, stream channelization, road density	Juvenile rearing, spawning, egg incubation, egg-to-parr survival
Lower SF John Day MaSA	Degraded floodplain and channel structure; sediment routing dysfunction; water quality (temp)	Lower South Fork [T, S, F/CS]	Productivity, abundance, spatial structure.	Irrigation withdrawals and agricultural practices above Izee Falls, stream channellization, livestock grazing	Juvenile rearing, spawning, egg incubation, egg-to-parr survival

* Abbreviations for limiting factors: degraded floodplain connectivity and function (F); degraded channel structure and complexity (CS); degraded riparian communities (R); altered hydrology (H); degraded water quality (WQ), temperature (T); altered sediment routing (S); man-made block to migration (BP); impaired fish passage (IP).

8.2.9 Upper Mainstem John Day River Population, Tributary Habitat Limiting Factors

The primary tributary habitat limiting factors identified by the recovery planning team for the Upper Mainstem John Day River steelhead population are degraded floodplain and channel structure (key habitat quantity and habitat diversity), altered sediment routing, water quality (temperature) and altered hydrology. Impaired fish passage is also a priority limiting factor for Beech and Laycock creeks.

Degraded floodplain connectivity and function
There has been a loss of off-channel and side-channel habitats that once provided habitat for spawning and rearing, and refugia from high flows. Degraded floodplain connectivity and function has led to more extreme flows and summer water temperatures.

Degraded channel structure and complexity
EDT results rated key habitat quantity as either a high or medium priority restoration need for all areas of the Upper Mainstem John Day River population and habitat diversity ranked as either a medium or low priority restoration need in all Upper John Day reaches (NPCC 2005). In addition, the Malheur National Forest rated LWD conditions and potential recruitment as "functioning at risk" in their Environmental Baseline for the Upper John Day (MNF 2004). Levels of big LWD are well below benchmark conditions for all areas outside wilderness boundaries (Unterwegner 2005, personal communication). Beech, Laycock, Fields, and Strawberry creeks are areas where restoration needs are highest for key habitat quantity and habitat diversity. Removal of beaver and their associated dams has reduced habitat complexity, floodplain function, and the amount of stored water. Livestock grazing has contributed to increased channelization, reductions in LWD, cover and bank stability, particularly in lower reaches of tributaries.

Altered sediment routing
Canyon Creek has a large supply of spawning gravels, with most good spawning habitat in upper meadow reaches. However, surveys of substrate embeddedness for the Upper John Day watershed show that, for measured streams, more than 50% of their summaries showed >35% embeddedness. Substrate embeddedness is a problem in 5 of 8 Canyon Creek reaches measured and 10 of 32 mainstem John Day reaches measured (MNF 2004).

Altered hydrologic processes
The upper John Day River experienced intensive stream channelization, flow modifications and drainage (including some tiling of drainage ditches) projects between 1943 and 1951. These and other activities altered the routing and timing of water delivery to streams; often increasing peak flows and reducing summer low flows. Irrigation withdrawals further reduce summer low flows, especially considering that the vast majority of the irrigation is from surface waters of the John Day and its tributaries (NPCC 2005). Livestock grazing, logging, road construction, beaver removal and fire suppression have all contributed to altered flow regimes. Today, summer low streamflows are below what would have existed historically. Water withdrawals dewater the lower reaches of Pine, Strawberry, Indian, Riley, Moon, McClellan, Laycock, and Fields creeks.

Degraded water quality
Water quality is fair in the upper watershed during most of the year, as compared to ODEQ water quality standards (USDI 2000 cited in NPCC 2005). Low summer flows on the mainstem John Day River above Dayville contribute to elevated temperatures; higher streamflows during the winter/spring and streambank erosion contribute to turbidity. Problematic eutrophication in the mainstem John Day River is a partial result of irrigation return flow and possibly cattle feedlots (NPCC 2001 from NPCC 2005). Table 8-31 lists stream segments within the Upper John Day watershed included on ODEQ's 303(d) list. Elevated stream temperatures are common to almost all the streams in the Upper John Day watershed. Historical mining has added to water quality problems by removing riparian vegetation, simplifying stream channels and changing stream substrate composition, all of which contribute to increased water temperatures.

Table 8-31. Upper John Day River watershed 303(d) listed stream segments and parameters of concern (ODEQ 2002). Waterbodies that are listed multiple times represent different locations and/or different life stages.

Waterbody Name	Parameter	Waterbody Name	Parameter
Badger Creek	Temperature	Grub Creek	Temperature
Battle Creek	Temperature	Indian Creek	Temperature
Bear Creek	Temperature	Little Pine Creek	Temperature
Canyon Creek	Temperature	McClellan Creek	Temperature
Corral Creek	Biological Criteria	Mountain Creek	Temperature
Cottonwood Creek	Temperature	Murderers Creek	Temperature
Dads Creek	Temperature	North Fork Deer Creek	Temperature
Dans Creek	Temperature	Pine Creek	Temperature
Deardorff Creek	Temperature	Rail Creek	Temperature
Deer Creek	Temperature	Reynolds Creek	Temperature
Dog Creek	Temperature	Reynolds Creek	Temperature
East Fork Canyon Creek	Temperature	Rock Creek	Temperature
Ennis Creek	Temperature	Slyfe Creek	Temperature
Ennis Creek	Temperature	South Fork John Day River	Temperature
Fields Creek	Temperature	Strawberry Creek	Temperature
Fields Creek	Temperature	Sunflower Creek	Temperature
Flat Creek	Temperature	Tex Creek	Temperature
Flat Creek	Temperature	Tex Creek	Temperature
Grasshopper Creek	Temperature	Tinker Creek	Temperature
Grasshopper Creek	Temperature	Utley Creek	Biological Criteria
		Utley Creek	Dissolved Oxygen

Blocked or impaired fish passage

Strawberry Creek has numerous unscreened ditches that may strand fish. Water withdrawals dewater the lower reaches of Pine, Indian, Strawberry, Moon, Laycock, McClellan, Riley, and Field creeks and create passage problems for juvenile fish. Diversions and low flows in Strawberry Creek create passage problems for adults as well. Push-up dams and other irrigation structures throughout the Upper John Day watershed often obstruct or delay fish passage. Culverts on national forest, state, county and private lands also create passage barriers in many areas. EDT results identified obstructions as high priority restoration needs in Beech and Laycock creeks**.** Panama Ditch crosses Beech Creek approximately one mile above its convergence with the John Day River forming a juvenile passage barrier, and possibly an adult barrier, at certain flows. High water temperatures in numerous tributaries and portions of the mainstem alter or sometimes block juvenile steelhead movements in the summer months.

Degraded riparian communities and large wood recruitment

Riparian conditions are generally degraded in the Upper John Day watershed. Roads along riparian corridors have altered riparian functions; the Malheur National Forest has identified 123.8 miles of roads within RHCAs in the Upper John Day watershed (MNF 2004). Forest practices on private and public lands have altered riparian vegetation and reduced LWD recruitment potential. Grazing activities on the forest and private lands have reduced or eliminated native plant communities, altering soil conditions and infiltration rates (Kauffman 2004).

Table 8-32 shows the primary limiting factors identified in the EDT Diagnostic Report for the Upper Mainstem John Day population. A summary of major limiting factors and threats is presented in Table 8-33.

Table 8-32. Limiting factors and priorities for protection and restoration as defined by EDT for the Upper Mainstem John Day River steelhead population.

Geographic area priority			Attribute class priority for restoration															
Geographic area	Protection benefit	Restoration benefit	*Channel stability*	*Chemicals*	*Competition (w/ hatch)*	*Competition (other sp)*	*Flow*	*Food*	*Habitat diversity*	*Harassment/poaching*	*Obstructions*	*Oxygen*	*Pathogens*	*Predation*	*Sediment load*	*Temperature*	*Withdrawals*	*Key habitat quantity*
Beech Creek	○	○	●				●		●		●				●	●		●
Canyon Creek	○	○	●				●		●						●	●		●
Fields Creek	○	◯	●				●		●						●	●		●
JDR Johnson Creek									●						●	●		●
Laycock Creek	○	◯	●				●		●		●				●	●		●
Lower JDR Clarno									●					●				●
Lower JDR Ferry Canyon									●					●				●
Lower JDR Kahler Creek	○								●					●		●		●
Lower JDR McDonald Ferry	○								●					●				
Lower JDR Muddy Creek									●					●				●
Lower JDR Scott Canyon									●					●				●
Lower JDR Service Creek	○								●					●				●
Lower SF JDR									●						●			●
Rock Creek							●		●							●		●
Strawberry Creek	○	◯	●				●		●		●				●	●		●
Upper JDR	◯	○					●		●		●				●	●		●
Upper Middle JDR							●		●							●		●

Key to strategic priority (corresponding Benefit Category letter also shown)

1/ "Channel stability" applies to freshwater areas only.

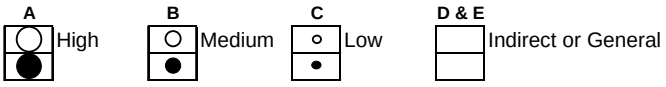


Table 8-33. Habitat limiting factors summary for the Upper Mainstem John Day River steelhead population.

Population MaSA and MiSA	Major Limiting Factors	Sites Affected*	VSP Characteristics Impacted	Threats	Life Stages Affected
UPPER MAINSTEM JOHN DAY POPULATION					
Upper Mainstem John Day Population	Degraded floodplain and channel structure (loss of cover, pools, LWD, overall habitat diversity, connectivity); water quality (temp);altered sediment routing; degraded riparian communities; altered hydrology; impaired fish passage	MaSAs and MiSAs	Productivity, abundance, spatial structure.	Agricultural practices, livestock grazing, removal of large trees from riparian corridor, wetland draining and conversion, stream channelization and diking, mining and dredging, irrigation withdrawals	Juvenile rearing, egg incubation, egg-to-parr survival, spawning
Up. John Day MaSA	Degraded floodplain and channel structure; altered hydrology; water quality (temp); altered sediment routing; degraded riparian communities; impaired passage	Mainstem and tribs [F,CS, S, H, T); Strawberry [H (lower), F,CS]; Pine [H (lower)}; Indian [H (lower)]; IP (pushup dam sites	Productivity, abundance, spatial structure.	Agricultural practices, livestock grazing, irrigation withdrawals, beaver removal, roads	Juvenile rearing, egg incubation, egg-to-parr survival, spawning
Beech MaSA	Degraded floodplain and channel structure; altered hydrology; water quality (temp); altered sediment routing; impaired passage	IP (Panama Ditch), F,CS (lower reaches, next to Hwy 395), H (lower reaches of Riley, Moon, McClellan, Laycock and Fields crs.); S,T	Productivity, abundance, spatial structure.	Hwy 395, forest roads, irrigation withdrawals, livestock grazing	Juvenile rearing, egg incubation, egg-to-parr survival, spawning
Canyon MaSA	Degraded floodplain and channel structure; altered hydrology; water quality (temp); altered sediment routing	F,CS (Hwy 395, forest roads), S,T,H	Productivity, abundance, spatial structure.	Hwy 395, forest roads, irrigation withdrawals, livestock grazing	Juvenile rearing, egg incubation, egg-to-parr survival, spawning

* Abbreviations for limiting factors: degraded floodplain connectivity and function (F); degraded channel structure and complexity (CS); degraded riparian communities (R); altered hydrology (H); degraded water quality (WQ), temperature (T); altered sediment routing (S); man-made block to migration (BP); impaired fish passage (IP).

8.2.10 Umatilla River Population, Tributary Habitat Limiting Factors

The primary tributary habitat limiting factors identified by the recovery planning team for the Umatilla River steelhead population are water quality (temperature), sediment routing dysfunction, blocked and impaired fish passage, degraded floodplain and channel structure (key habitat quantity and habitat diversity) and hydrologic alterations.

Degraded floodplain connectivity and function

Intensive land uses within Umatilla subbasin flood plains and upslope habitats have led to dramatic changes in waterway characteristics since arrival of Euro-American pioneers to the area during the middle 1800's. Dikes, levies, and roads border many streams in the subbasin and limit connectivity between streams and their floodplains.

Degraded channel structure and connectivity

The mainstem Umatilla River from Wildhorse Creek to the forks and sections of 17 tributaries of the mainstem are 303(d) listed because of habitat (including substrate) problems. Habitat benchmarks developed by ODFW were used to list stream reaches based upon standardized habitat surveys (Moore et al.1999 cited in NPCC 2004c). Parameters measured in these surveys include habitat features known to be important to salmonids such as presence and amount of large woody debris, pool frequency, presence of eroding streambanks, type of riparian vegetation, stream channel form and pattern, and the proportion of the substrate composed of fine materials. Key habitat quantity and habitat diversity are also identified as medium impact limiting factors that are pervasive throughout the subbasin. Channel stability is frequently noted as a low impact limiting factor.

Overall, instream habitat has been simplified and pool habitat has decreased. Some stream reaches have been channelized in agricultural fields to prevent flooding of fields and natural channel movement into fields. Channelization greatly decreases winter habitat (e.g., braided channels, sloughs) for juvenile salmon and steelhead. This habitat is very important for overwinter survival and juvenile growth. The loss of this type of habitat in the Umatilla River and its tributaries is thought to be one of the most significant causes of the reduction in naturally surviving salmonid and steelhead (personal communication: C. Contor, CTUIR, April 2004 cited in NPCC 2004c). Other primary causes of low habitat diversity/complexity include past forest practices that removed conifers from riparian areas, and the ongoing removal of LWD from streams to prevent flooding and streambank erosion.

Altered sediment routing

The Umatilla River receives large amounts of sediment, much of which originates from weathered basalt and unconsolidated loess deposits — the dominant geology in the subbasin. Primary sources include bank and upland erosion of tributaries and tributary watersheds, which may be accelerated by land uses (ODEQ et al. 2001). Peak sedimentation usually occurs during rainstorms or snowmelts associated with freeze and thaw periods (CTUIR and ODFW 1990).

The entire Umatilla mainstem from the mouth to the forks is 303(d) listed for either sediment or turbidity. One sediment-impaired stream segment that significantly deviated from the target standard for turbidity was Wildhorse Creek (at its confluence with the Umatilla River) that had a peak turbidity value of over 5,000 nephelometric turbidity units (NTU) measured on April 23,1997. High levels were also measured in McKay Creek. Wildhorse Creek turbidity mainly results from spring runoff, while McKay's turbidity is mostly a result of bottom withdrawal of water from the reservoir for flow augmentation. Composite samples of turbidity, collected at various stations during the winter of 1997-1998, show that Tutuilla, Birch, and five sites on the Umatilla mainstem exceeded standards on numerous occasions (ODEQ et al. 2001).

Surveys conducted by ODFW and CTUIR throughout the Umatilla River subbasin found that 19 of 42 stream reaches had fine sediment as the dominant substrate (Boyd et al.1999 cited in NPCC 2004c). In the Patawa/Tutuilla watershed, fine sediment made up the dominant substrate in 9 of 19 reaches surveyed (Watershed Professionals and Duck Creek Associates 2003 cited in NPCC 2004c). Substrate sediment is less of a problem in the upper Umatilla subbasin; a survey of the upper Umatilla River and Meacham Creek by the Umatilla National Forest (2001) in

which substrate embeddedness was measured directly found that only two sub-watersheds of 18 had embeddedness levels greater than 35% (a level of embeddedness considered detrimental to salmon) (NPCC 2004c). EDT analyses also showed that sediment is a large limiting factor in many areas of the Umatilla, especially in Butter and Wildhorse creeks, in the lower reaches of the Umatilla, and in reaches of Umatilla mainstem from Mission Bridge to Meacham Creek.

Altered hydrologic processes

Flow patterns observed in the Umatilla/Willow subbasin are the result of snow melt and rain in late winter and early spring that cause peaks in flow. Water runoff peaks in April, while base flows generally occur in September. The average monthly discharge of the Umatilla River near its mouth (measured at RM 2.1) varies from 23 cfs in July to 1,095 cfs in April (low flow at the mouth occurs in July rather than September because of upstream removals for irrigation). Summer baseflows can be extremely low and many of the larger tributaries lose all surface flow during the summer through parts of their lengths. Flows in sections of Birch, McKay, Butter, Meacham, Wildhorse and Iskuulpa creeks are subsurface during low flow periods (ODEQ 1998 cited in NPCC 2004c).

Past evaluations of the Umatilla River have identified summer low flows as a primary limiting factor to salmonid natural production throughout all life stages (Boyce 1985, Contor et al. 1995, and CTUIR 1994 cited in White et al. 2004). EDT identifies flow as either a medium or low impact limiting factor in almost all reaches of the Umatilla subbasin.

Fluctuation of flows related to Umatilla Basin Project operations, for both the winter-spring storage and spring-fall release periods, is identified as a possible concern for juvenile steelhead and the food web on which they depend (BOR 2001). Significant fluctuations in flows on a weekly, daily, or even hourly basis may cause cyclic dewatering and rewatering of near shore habitats, riffles, and pools, which reduces biotic productivity and strands salmonid fry (BOR 2001), particularly in McKay Creek. Currently, there are six major irrigation diversions in the lower Umatilla River that withdraw approximately 129,000 acre-feet on an average year (Umatilla River Subbasin Local Agricultural Water Quality Advisory Committee et al. 1999). The irrigation withdrawals dewater the river below Dillon Dam, resulting in an average daily flow over a 14-day period of less than 1 cfs.

During late spring through late fall (April to November), water is released from McKay Reservoir to supply water for irrigation and instream uses. Summer discharge has more than tripled from RM 52.0 to 27.2 since the early 1900s; however, the river has been virtually de-watered from RM 27.2 to the confluence with the Columbia River (White et al. 2004). Streamflows below McKay Dam fluctuate greatly depending on flood water releases, irrigation releases, and other operations from McKay Reservoir (BOR 2001). BOR modeling results indicated that these water releases would increase Umatilla River flows. The model predicted that water releases in the late spring would aid juvenile steelhead in their out-migration, and that water releases in the summer and fall would aid juvenile summer rearing and adult upstream migration. The model also predicted that increased flows would connect pool and riffle habitat, increase the width and depth of flow, and improve velocity, water temperature, rearing space, and food production. Despite these predictions, however, actual July and August streamflows in the lower Umatilla River fall well below the recommended levels, with or without the operation

of the Umatilla Basin Project, and often dewater the lower three miles of the Umatilla River completely from July 1 to August 15. These conditions delay steelhead entry into the Umatilla Subbasin (BOR 2001; ODEQ et al. 2001).

Degraded water quality

Summer water temperatures in the lower Umatilla River frequently exceed the incipient lethal limit for salmonids of 21°C (ODEQ et al. 2001; White et al. 2004). Water temperature is a concern throughout most of the Umatilla subbasin during periods of low flow (May until early November). On the 1998 303(d) list, 287 miles of the Umatilla River and its tributaries were listed as impaired for elevated water temperatures including the entire mainstem Umatilla River (ODEQ et al. 2001 cited in NPCC 2004c) (Table 8-34). The highest water temperatures have been recorded in late July and early August when ambient air temperatures are high. During this period, the Umatilla River warms rapidly from the headwaters to the mouth, reaching sub-lethal (64-74°F, 20-23°C) and incipient lethal temperatures (70-77°F, 21-25°C) for its entire length (Boyd et al.1999; Contor and Crump 2003 cited in NPCC 2004c). White et al. (2004) noted that during 2002, mean weekly water temperature at RM 2.1 on the Umatilla River ranged from 39.2°F to 88.5°F. Daily mean water temperatures exceeded 75.2°F for 55 days in 2002, with 31 of those days at or above 82.0°F (White et al. 2004). Many of its tributaries also reach sub-lethal and incipient lethal ranges for salmonids (Boyd et al.1999; CTUIR 2004).

Water releases from McKay Reservoir during summer generally cool temperatures in reaches of the Umatilla River below the McKay Creek confluence (RM 50.5). Surveys determined that hypolimnetic releases of cool water from the reservoir during early summer months kept temperatures suitable for salmonids in areas between the McKay Creek confluence and Westland Dam (RM 27.2) (Contor et al.1997 cited in NPCC 2004c). However, releases from McKay Reservoir for fish are not made from July 1 to approximately September 15, though water is released to provide for irrigation. In addition, warmer epilimnetic waters can be discharged upon the depletion of the hypolimnion and can contribute to unsuitable habitat conditions for salmonids (Contor et al.1997 cited in NPCC 2004c).

The Umatilla subbasin's coolest mid-summer recorded temperatures are in the North Fork of the Umatilla River, where maximum summer temperatures usually do not exceed the state standard of 64°F (17.8°C). For example, in the summer of 2002, maximum water temperature in the North Fork did not exceed 60.8°F (16.0°C) (Contor and Crump 2003 cited in NPCC 2004c). The South Fork of the Umatilla River experiences higher summertime temperatures often above 64°F, though rarely above 70°F. Data indicate a significant increase (approximately 5° F) in temperature from the Umatilla River east of the Gibbon site (RM 80.0) to the Umatilla River at Cayuse Bridge (RM 69.4). This increase in temperature is attributed to Meacham Creek that enters the Umatilla Mainstem at RM 79. Summer water temperatures in Meacham Creek are frequently in the high 60s ºF. However, maximum summer temperatures drop further downstream (at RM 50) as a result of cold water releases from McKay Reservoir.

Wildhorse Creek is one of the warmest tributaries of the Umatilla River. This drainage regularly experiences excessive summertime stream temperatures throughout the entire stream length. Headwaters often exceed 70˚F for long periods in the summer, while lower Wildhorse Creek can often experience stream temperatures exceeding 85˚F.

The lower Umatilla River and the North Hermiston Drain are in violation of EPA ammonia standards, primarily because of excessive temperatures and pH during the summer months (ODEQ et al. 2001). Other problem areas include Butter Creek, where ammonia concentrations have been measured at 0.3 to greater than 0.4mg/L (ODEQ 1998).

Excessive growth of attached algae (periphyton) and attendant increases in pH are common during summer months throughout much of the mainstem Umatilla River (from Speare Canyon, RM 44, to the forks) (ODEQ et al. 2001). Large periphyton mats can be found in this section of the Umatilla River in the summer, affecting river odor, aesthetics, contact recreation, and pH. As periphyton obtains carbon dioxide for cell growth it decreases bicarbonate levels in the water. This has the effect of increasing pH levels that can be stressful to fish. Because periphyton growth is positively influenced by water temperature, patterns in summer water pH are influenced by water temperature. pH increases from the forks to RM 58, where it frequently exceeds 9.0 (the water quality standard); pH drops at RM 49 because of inputs of cold water from McKay Reservoir and then increases downstream where it routinely exceeds the water quality standard at Yoakum Bridge (RM 37.2)(ODEQ et al. 2001 cited in NPCC 2004c). Elevated summertime temperatures and excessive algal growth are also likely contributors to high pH levels recorded in Willow Creek, from the mouth upstream to Heppner.

Table 8-34. Impaired stream reaches from the 1998 303(d) list and used for development of the 2001 Umatilla Subbasin TMDL (ODEQ et al. 2001).

Parameter	Stream	Segment (boundaries)	Criterion
Temperature	Birch Creek	Mouth to headwaters	Rearing 64°F
	Buckaroo Creek	Mouth to headwaters	
	E. Birch Creek	Mouth to Pearson Creek	
	EF Meacham Creek	Mouth to headwaters	
	McKay Creek	Mouth to McKay Reservoir	
	Meacham Creek	Mouth to headwaters	
	NF McKay Creek	Mouth to headwaters	
	NF Meacham Creek	Mouth to headwaters	Oregon Bull Trout
	NF Umatilla River	Mouth to headwaters	
	Shimmiehorn Creek	Mouth to headwaters	
	SF Umatilla River	Mouth to headwaters	
	Squaw Creek	Mouth to headwaters	Rearing 64°F
	Umatilla R.	Mouth to Lick Creek	
	W. Birch Creek	Mouth to headwaters	
	Westgate Canyon	Mouth to headwaters	
	Wildhorse Creek	Mouth to headwaters	
Sediment	Beaver Creek	Mouth to headwaters	See Narrative
	Birch Creek, WF	Mouth to headwaters	
	Boston Canyon Creek	Mouth to headwaters	
	Coonskin Creek	Mouth to headwaters	
	Cottonwood Creek	Mouth to headwaters	
	Line Creek	Mouth to headwaters	
	Little Beaver Creek	Mouth to headwaters	
	Lost Pin Creek	Mouth to headwaters	
	McKay Creek, NF	Mouth to headwaters	
	Meacham Creek	East Meacham Creek to headwaters	
	Mill Creek	Mouth to headwaters	

Parameter	Stream	Segment (boundaries)	Criterion
	Mission Creek	Mouth to headwaters	
	Moonshine Creek	Mouth to headwaters	
	Rail Creek	Mouth to headwaters	
	Sheep Creek	Mouth to headwaters	
	Twomile Creek	Mouth to headwaters	
	Umatilla River	Wildhorse Creek to Forks	
Turbidity	Umatilla River	Mouth to Mission Creek	>30 NTU
pH	Umatilla River	Speare Canyon to Forks	pH 6.5-9.0
Nitrate	Wildhorse Creek	Mouth to headwaters	>10mg/L
	Spring Hollow Creek	Mouth to headwaters	
Ammonia	Umatilla River	Mouth to RM 5	pH dependent
	North Hermiston Drain	Mouth to headwaters	
Bacteria	McKay Creek	Mouth to McKay Reservoir	Water Contact Recreation (fecal coliform 96-Std)
	Umatilla River -- Summer	Mouth to Speare Canyon	
Aquatic Weeds/Algae	Umatilla River	Speare Canyon to Forks	Growth considered to be deleterious to aquatic, public, recreation, industry
Flow Modification	Birch Creek	Mouth to Headwaters	
	Umatilla River	Mouth to Speare Canyon	
Habitat Modification	Bell Cow Creek	Mouth to Headwaters	ODFW Habitat Benchmarks
	Boston Canyon Creek	Mouth to Speare Canyon	
	Calamity Creek	Mouth to Headwaters	
	Coonskin Creek	Mouth to Headwaters	
	Cottonwood Creek	Mouth to Headwaters	
	Darr Creek	Mouth to Headwaters	
	E. Birch Creek	Mouth to Headwaters	
	Line Creek	Mouth to Headwaters	
	Little Beaver Creek	Mouth to Headwaters	
	Lost Pin Creek	Mouth to Headwaters	
	Meacham Creek	Mouth to Headwaters	
	Mill Creek	Mouth to Headwaters	
	Mission Creek	Mouth to Headwaters	
	Moonshine Creek	Mouth to Headwaters	
	N.F. McKay Creek	Mouth to Headwaters	
	N.F. Meacham Creek	Mouth to Headwaters	
	Rail Creek	Mouth to Headwaters	
	Umatilla River	Mouth to Headwaters	
	Wood Hollow Creek	Mouth to Headwaters	

Blocked or impaired fish passage

In the Umatilla River subbasin, 36 barriers were identified in the Umatilla Subbasin Plan and these are listed in Table 8-35, along with their priority for removal. While it is not mentioned in the list, McKay Dam was not designed to include fish passage facilities, and blocks steelhead and salmon access to approximately 108 miles of highly productive tributary habitat in upper McKay Creek (CTUIR 2001). Historical abundance of steelhead in McKay Creek is unknown, but CTUIR tribal members report that a high number of steelhead spawned in McKay Creek before the construction of McKay Dam and Reservoir in 1927 (CTUIR 2001).

A number of significant passage barriers remain, particularly in Birch, and Butter creeks. Unscreened water diversions can also have a substantial impact on anadromous fish. All known gravity feed diversions in steelhead habitat areas of the Umatilla subbasin are screened, but it is not known to what extent pump diversions have been screened in the habitat areas.

Table 8-35. Barriers to upstream passage on streams in the Umatilla River Subbasin.

Stream	River Mile	Barrier Type	Step Height Est. (m)	Degree	Recommended Action	Priority
Umatilla R.	1.5	Channel Mod.	0.7	Partial	Modify	L
Umatilla R.	2.4	Irrigation Dam	1.0	Partial	Modify	M
Umatilla R.	49	Irrigation Dam	1.2	Partial	Remove	M
Butter Creek	7.9	Flash Boards	2.3	Complete	Modify	L
Butter Creek	27.2	Irrigation Dam	1.4	Complete	Modify	L
Butter Creek	43.0	Irrigation Dam	1.2	Complete	Modify	L
Johnson Cr. (Butter)	0.3	Culvert	0.8	Partial	Modify	M
Birch Creek	0.5	Pipe Casing	1.4	Partial	Modify	M
Birch Creek	2.5	Irrigation Dam	1.5	Partial	Modify/Remove	H
Birch Creek	5.0	Irrigation Dam	1.2	Partial	Modify/Remove	H
Birch Creek	10.0	Irrigation Dam	1.0	Partial	Remove	M
Birch Creek	11.0	Irrigation Dam	0.7	Partial	Remove	L
Birch Creek	12.0	Irrigation Dam	1.0	Partial	Modify	M
Birch Creek	15.0	Irrigation Dam	1.7	Partial	Remove	H
West Birch Cr.	1.0	Irrigation Dam	?	Partial	Modify	M
West Birch Cr.	3.5	Irrigation Dam	2.1	Partial	Modify	H
West Birch Cr.	3.8	Bridge	1.2	Partial	Modify	H
West Birch Cr.	5.5	Irrigation Dam	1.4	Partial	Remove	H
West Birch Cr.	8.5	Irrigation Dam	1.5	Partial	Remove	H
Bridge Cr. (W. Birch)	2.0	Culvert	?	Complete	Modify	H
East Birch Cr.	4.0	Irrigation Dam	0.7	Partial	Remove	L
East Birch Cr.	9.0	Irrigation Dam	1.0	Partial	Remove	L
Jungle/Windy Spr. (Pearson)	0.1	Culvert	0.15	Partial	Modify	L
Wildhorse Cr.	0.1	Irrigation Dam	0.7	Partial	Modify	L
Wildhorse Cr.	18.8	Bridge	1.0	Partial	Modify	L
Greasewood Cr.	0.4	Irrigation Dam	0.6	Partial	Modify	L
Mission Cr.	0.9	Bedrock Drop	0.5	Partial	Modify	M
Mission Cr.	3.3	Bridge/Culvert	0.7	Partial	Modify	M
Coonskin Cr.	0.3	Bridge	0.5	Partial	Modify	M
Coonskin Cr.	0.9	Pipe Casing	1.1	Partial	Modify	M
Whitman Spr.	0.1	Culvert	0.5	Complete	Modify	L
Red Elk Can.	0.2	Culvert	0.8	Partial	Modify	L
Minthorn Spr.	0.1	Culvert	0.5	Partial	Modify	L
Unnamed Trib to SF Umatilla at RM 1.5	0.1	Culvert	0.5	Complete	Modify	M
Camp Creek	0.25	Irrigation Dam	1.3	Partial	Remove	M
Unnamed trib to Umatilla R. at RM 81.2	0.1	Culvert	0.6	Partial	Modify	L
Twomile Creek	1.25	Culvert	?	?	Modify	L

Degraded riparian communities and large wood recruitment

Riparian vegetation on the mainstem Umatilla River and many tributaries is in poor condition, with 70% of 422 miles inventoried identified as needing riparian improvements (CTUIR and ODFW 1990 cited in NPCC 2004c). Losses of riparian vegetation are particularly high in the lower subbasin; Kagan et al. (2000) estimated these losses at greater than 95% as compared to pre-settlement conditions (c. 1850).

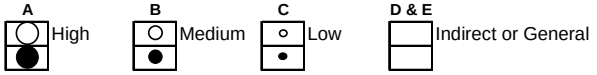
Table 8-36 shows key limiting factors for Mid-C steelhead in the Umatilla River drainage based on EDT findings. Table 8-37 summarizes major limiting factors and threats.

Table 8-36. Limiting factors and priorities for protection and restoration as defined by EDT for Umatilla River summer steelhead population.

Geographic area priority			Attribute class priority for restoration																
Geographic area	Protection benefit	Restoration benefit	Channel stability	Chemicals	Competition (w/ hatch)	Competition (other sp)	Flow	Food	Habitat diversity	Harassment/poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment load	Temperature	Withdrawals	Key habitat quantity
GA1		○	●		●		●		●					●	⬤	⬤		●
GA2	○	○	●		●		●		●				●	●	⬤	●		
GA3			●				⬤		⬤						⬤			⬤
GA4		○	⬤				⬤		⬤	●					⬤	⬤		⬤
GA5		◯	⬤				⬤		⬤	●	⬤		●		⬤	⬤		⬤
GA6		○	●				⬤		⬤	●					⬤			⬤
GA7			⬤				●		●				●		⬤	⬤		⬤
GA8			⬤				●		●				●		⬤	⬤		⬤
GA9	○	○	●		●		●		⬤					●	●	●		
GA11			●		●		●		●					●	●	●		
GA12	○	◯	⬤				●		●		⬤		●		●	⬤		⬤
GA13		○	⬤				⬤		⬤	●	⬤		●		●	⬤		⬤
GA14	○	○	⬤				●		●						●	●		⬤
GA15	○	○	⬤				●		●		⬤				●	●		⬤
GA16			⬤				●		●							●		⬤
GA17		○	⬤				●		●	●					●	⬤		⬤
GA18	○	○	⬤				●		●						●	●		⬤
GA19	○	○	●				●		●							●		⬤
GA20		○	●				●		●	⬤				●	●	●		⬤
GA21		○	⬤				●		⬤		⬤		⬤	●	●	⬤		⬤
GA22			⬤				●		●				●			⬤		⬤
GA24			⬤				●		●							⬤		⬤
GA25			●		●		●		●					●	⬤	●		
GA26			●				●		●						⬤	●		●
GA27		○	⬤				⬤		●						⬤	⬤		●
GA28	○	◯	⬤		●		●		●				●	●	●	⬤		●
GA29		○	●				●		●				●		⬤	⬤		⬤
GA30			⬤				●	●	●							⬤		⬤
GA31		○	⬤				●	●							●	⬤		⬤
GA32		○	⬤				●	●	●						●	⬤		⬤
GA33	○	○	⬤		●		●	●	●					●		⬤		⬤
GA34	○	○	⬤		●		●		●					●	●			●
GA35	○	○	●		●		●		●		⬤			●		●		●
GA36	○	○	⬤		●		●		●					●		⬤		⬤
GA37	○		●		●		●		●					●				⬤
GA38		○	⬤		●		●		⬤					●	⬤			⬤
GA39			●		●		●				●			●	⬤			⬤
GA40	◯	○	⬤				●		●							⬤		●
GA41			⬤				●	●	●									⬤
GA42	◯	○	⬤															
GA43	○	○	⬤				●	●	●									
GA44	○		●				●											
GA45	○	○	⬤				●	●	●									⬤
GA46	○	○	⬤				●		●									

Key to strategic priority (corresponding Benefit Category letter also shown)

1/ "Channel stability" applies to freshwater areas only.



Key to geographic areas: Planners identified the following geographic areas in the Umatilla subbasin as EDT geographic areas during the Northwest Power and Conservation Council's recent subbasin planning process (NPCC 2004c): GA1-2: Lower Umatilla, GA4-8: Butter Creek and tributaries, GA9-11: Mainstem Umatilla from Butter Creek to McKay Creek, GA12-19: Birch Creek and its tributaries, GA20-24: McKay Creek and its tributaries, GA25: Umatilla

mainstem from McKay Creek to Mission Bridge, GA26-27: Wildhorse Creek and its tributaries, GA28-32: Umatilla mainstem from Mission Bridge to Meacham Creek and its tributaries, GA33-37: Meacham Creek and its tributaries, GA40-41: Umatilla from Meacham Creek to the forks and its tributaries, GA42: North Fork Umatilla, GA43-46: South Fork Umatilla and various tributaries. The areas are also shown in Figure 8-2.

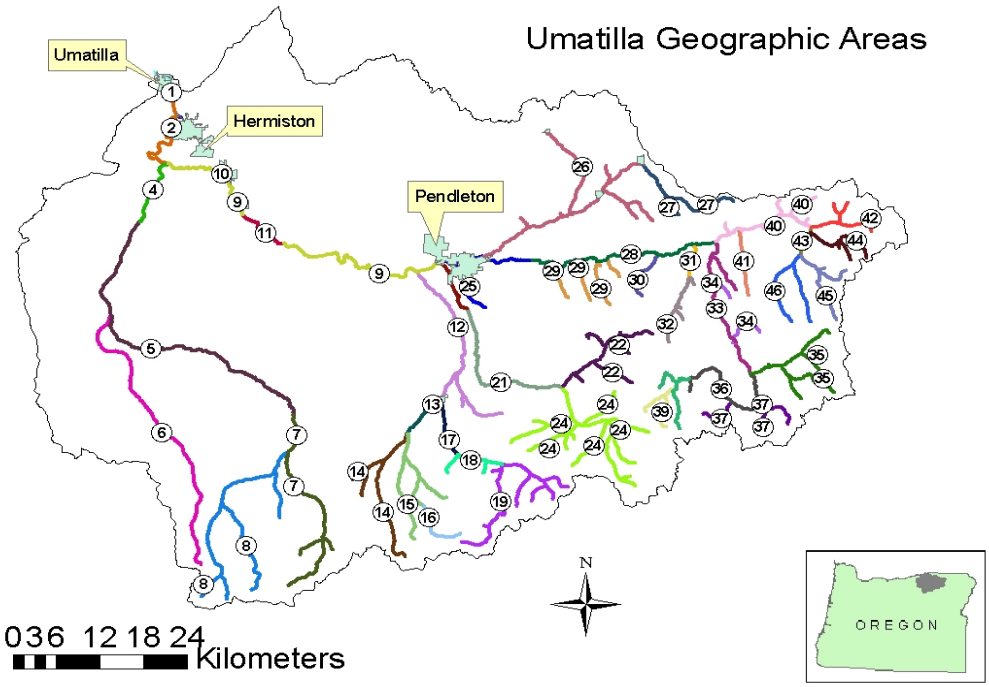


Figure 8-2. Geographic areas used in the EDT analysis for the Umatilla River Subbasin (NPCC 2004c).

Table 8-37. Habitat limiting factors summary for the Umatilla River steelhead population.

Population MaSA and MiSA	Major limiting Factors	Sites Affected*	VSP Characteristics Impacted	Threats	Life Stages Affected
UMATILLA RIVER POPULATION					
Umatilla River Population	Degraded floodplain and channel structure (complexity, diversity, braided channels, sloughs, pools); altered sediment routing; altered hydrology; water quality (temp, pH, ammonia, bacteria); blocked and impaired fish passage; degraded riparian communities, LWD recruitment	MaSAs and MiSAs	Abundance, productivity, spatial structure and diversity	Agricultural cultivation and practices, livestock grazing, water storage and diversion, flood control, forest practices, urban development	All life stages
Butter MaSA	Altered sediment routing; water quality (temp); altered hydrology; degraded floodplain and channel structure; blocked or impaired fish passage	Butter Cr. [BP (flash boards - RM 7.9, irrigation dams- RM 27.2 and 43)]; Johnson Cr. [IP (culvert RM 0.3)];	Abundance, productivity, spatial structure and diversity	Agricultural cultivation and practices, livestock grazing, water storage and diversion, urban development	All life stages
East Birch MaSA	Water quality (temp); altered sediment routing; degraded floodplain and channel structure; impaired fish passage	East Birch Cr. [T (mouth to Pearson C) and F, CS (mouth to headwaters); IP (irrigation dams RM 4.0, 9.0)]	Abundance, productivity, spatial structure and diversity	Agricultural cultivation and practices, livestock grazing, water storage and diversion, forest practices	All life stages
Little Butter MaSA	Altered sediment routing; degraded floodplain and channel structure; altered hydrology		Abundance, productivity, spatial structure and diversity	Agricultural cultivation and practices, livestock grazing, water storage and diversion	All life stages
McKay MaSA	Degraded floodplain and channel structure; altered hydrology; water quality (temp, pathogens); altered sediment routing; impaired fish passage	McKay Cr. [T and B (mouth to reservoir), McKay Dam blocks steelhead access to 108 miles of productive habitat]; NF McKay [T,S, F, CS (mouth to headwaters)]	Abundance, productivity, spatial structure and diversity	Agricultural cultivation and practices, livestock grazing, water storage and diversion, urban development, forest practices	All life stages
Meacham MaSA	Water quality (temp); degraded floodplain and channel structure; impaired fish passage; altered sediment routing; altered hydrology	Meacham Cr. [T and F, CS (mouth to headwaters), S (above EF)] NF Meacham [T and F, CS (mouth to headwaters)]; EF Meacham [T (mouth to headwaters)]	Abundance, productivity, spatial structure and diversity	Agricultural cultivation and practices, livestock grazing, water storage and diversion	All life stages
Middle Umatilla MaSA	Altered sediment routing; water quality (temp); degraded floodplain and channel structure; altered hydrology; degraded riparian communities		Abundance, productivity, spatial structure and diversity	Agricultural cultivation and practices, livestock grazing, water storage and diversion, Union Pacific railroad, roads, forest practices, flood control, urban development	All life stages

Population MaSA and MiSA	Major limiting Factors	Sites Affected*	VSP Characteristics Impacted	Threats	Life Stages Affected
UMATILLA RIVER POPULATION					
Upper Umatilla MaSA	Water quality (temp); degraded floodplain and channel structure (diversity/complexity); altered sediment routing; impaired fish passage		Abundance, productivity, spatial structure and diversity	Agricultural cultivation and practices, livestock grazing, water storage and diversion, Union Pacific railroad, roads, forest practices, flood control	All life stages
West Birch MaSA	Impaired fish passage; altered sediment routing; degraded floodplain and channel structure	West Birch Cr. [T and S (mouth to headwaters); IP (irrigation dams- RM 1, 3.5, 5.5, 8.5; bridge – RM 3.8)] Bridge Cr. [BP (culvert – RM 2)]	Abundance, productivity, spatial structure and diversity	Agricultural cultivation and practices, livestock grazing, water storage and diversion, forest practices	All life stages

* Abbreviations for limiting factors: degraded floodplain connectivity and function (F); Degraded channel structure and complexity (CS); degraded riparian communities (R); altered hydrology (H); degraded water quality (WQ), temperature (T); altered sediment routing (S); man-made block to migration (BP); impaired fish passage (IP).

8.2.11 Walla Walla River Population, Tributary Habitat Limiting Factors

The primary tributary habitat limiting factors identified by the recovery planning team for the Walla Walla River steelhead population are water quality (temperature), altered sediment routing, blocked and impaired fish passage, degraded floodplain and channel structure (key habitat quantity and habitat diversity) and flow.

Degraded floodplain connectivity and function
Land use activities within the Walla Walla Subbasin including flood plains and upslopes have dramatically altered connectivity between the river channel and the floodplain. Dikes, levies, roads and channels exist throughout the subbasin and separate the channel from the floodplain.

Degraded channel structure and complexity
Habitat complexity is generally reduced or absent in the lower reaches of the Walla Walla River, particularly in channelized areas. Habitat complexity in headwater areas of some streams, including the South Fork, North Fork, and Mill Creek is close to or at properly functioning condition. The lower reaches of these tributaries, particularly in areas of agricultural or urban development, have poor habitat complexity due to a lack of pools and LWD.

Altered sediment routing
EDT analyses for streams occupied by this population indicate that elevated fine sediment levels in stream substrates are present, particularly in the lower reaches. Land management activities such as agriculture and road building add fine sediment to streams and reduced high flows can interrupt normal sediment flushing events.

Altered hydrologic processes
The runoff pattern in the Walla Walla River subbasin generally consists of high flows from November through May and low flows from June through October. The spring snowmelt flood period usually extends from about the first of March through the end of May, but peak discharges resulting from snowmelt runoff rarely result in damaging stages. In the past, winter flood peaks in the period of December through February have been responsible for flash-flood damage, caused by intense rainfall occurring on ground with high soil moisture content or by warm temperatures and rainfall on snow and frozen ground. (USACE 1997).

The Walla Walla River valley is extensively and intensively irrigated (NPCC 2004d). Primary water sources include the Touchet and Walla Walla rivers, East-West Canal, Gardena Canal, Lowden Canals, gravel aquifers, and the underlying basalt aquifer system (NPCC 2001, 2004d). Water diversions reduce flows in some reaches of the river and principle tributaries; lower Mill Creek and Walla Walla River near the border of Oregon and Washington have been completely dewatered in the past (NPCC 2004d). An increasing number of shallow individual domestic wells resulting from urban sprawl also pose a very real and significant deterrent to full utilization of the available water resources in the underlying aquifer (NPCC 2001, 2004d).

Degraded water quality
High water quality in the upper Walla Walla drainage generally degrades in lower elevations (NPCC 2001, 2004c). Temperature is a primary concern, with much of the lower Walla Walla remaining above 20°C (68°F) for most of the summer (NPCC 2001, 2004d). In Oregon, the Walla Walla River, North and South Forks of the Walla Walla River, and Mill Creek were all listed as 303(d) water quality limited for temperature in 2002 (ODEQ 2002). Sediment also reduces water quality as rain on frozen snow events in winter and spring often lead to high surface erosion in agricultural lands (NPCC 2001, 2004c).

Blocked or impaired fish passage
There are several total or partial fish passage barriers in the streams occupied by this population. Table 8-38 shows barriers to upstream passage in the subbasin for the Walla Walla steelhead population; however, the accuracy of the list is unknown because there has not been a comprehensive on-the-ground inventory of passage barriers in the subbasin. Obstructions are caused by low streamflow and channel spawning diversion structures and dams. Some culverts also act as fish passage barriers.

Table 8-38. Barriers to Upstream Passage on Streams in the Walla Walla Subbasin within the Area Inhabited by the Walla Walla River steelhead population. This list is based on a combination of archived records and field observation.

Stream	Description	River Mile /1	Priority	Lat.	Long.
Pine Cr.	Bevans Irrigation Dam	6.5	2	45.9903984	-118.57524108
Pine Cr.	Grade Control Structure on County Road 707	7.1	2	45.98669815	-118.56809997
Pine Cr.	Bevans and Young Irrigation Dam	7.5	2	45.98413848	-118.56359863
Pine Cr.	Irrigation Dam	8.1	2		
Pine Cr.	Irrigation Ditch Diversion	10.8	2		
Pine Cr.	Bridge on County Road 708	11.0	2	45.9595	-118.5372
Pine Cr.	Culvert at Johnson Road	23.6	2	45.8337	-118.4354
Pine Cr.	Culvert at Hwy 11	23.9	2	45.83039855	-118.43309783
Pine Cr.	Pine Cr. Rd Culvert	27	2	45.78490066	-118.40599822
Pine Cr.	Spring Reservoir Dam 1	28.7	2	45.77669906	-118.39499664
Pine Cr.	Spring Reservoir Dam 2	30.6	2	45.77603149	-118.36067962
Dry Cr.	Cockburn and Ray Irrigation Dam	1.0	2	45.9645195	-118.51821136
Dry Cr.	Marlatt-Shaw-Kelty Irrigation Dam	3.0	2	45.95537948	-118.48547363
Dry Cr.	Earnest Key Irrigation Dam	5.25	2	45.93603897	-118.45072174
Dry Cr.	Hohn and Phillips Irrigation Dam	5.75	2	45.93013	-118.44455718
Dry Cr.	Unnamed Dam	6.75	2	45.92193984	-118.43679809
Dry Cr.	Unnamed Dam	8.75	2	45.90356063	-118.41124725
Dry Cr.	Unnamed Dam	12.0	2	45.85702896	-118.40177154
Dry Cr.	Upper Dry Creek Rd Culvert	13.3	2	45.84577941	-118.38316345
Little Dry Cr.	Winn Rd Culvert	0.75	2	45.84624862	-118.4035263
Little Dry Cr.	Winn Power Dam	1.5	2	45.8399887	-118.40193176
Dry Cr. (Walla Walla)	Bridge at Lower Waitsburg Rd.	18.4	2		
Dry Cr. (Walla Walla)	Cement box culvert just upstream of Sapolil Rd.	24.1	2		
Mud Cr. (Dry Cr. Trib nr Dixie		1.4	2		
East Little Walla Walla	Locust Rd Culvert		2	45.95819854	-118.39649963
East Little Walla Walla	Appleton Rd Culvert		2	45.96920013	-118.40000152
East Little Walla Walla	Crockett Road Culvert		2	45.97299957	-118.39969635
East Little Walla Walla	Ballou Rd Culvert		2	45.98740005	-118.40440368
East Little Walla Walla	Stateline Rd Culvert		2	46.00040054	-118.4083023
West Little Walla Walla	Winesap Rd Culvert		2	45.96900177	-118.41320037
West Little Walla Walla	Appleton Rd Culvert		2	45.96920013	-118.41390228
West Little Walla Walla	Sunquist Rd Culvert		2	45.99110031	-118.42350006
West Little Walla Walla	Stateline Rd culvert		2	46.00049972	-118.43969726
Middle Branch Mud Cr.	Triangle Rd Culvert		2	45.97399902	-118.4287033
Middle Branch Mud Cr.	County Rd 332 Culvert		2	45.9748001	-118.43389892
Middle Branch Mud Cr.	County Rd 332 Culvert		2	45.97660064	-118.43779754
Mill Cr.	Stiller Ditch Diversion Dam	2.1	1		
Mill Cr.	Gose St. Dam and Concrete Apron	5.4	1		
Mill Cr.	Concrete Channel, velocity and light barriers	5.4 to 9.3	1		
Mill Cr.	Concrete capped weirs and diked channel from Gose St. to Bennington Dam	5.4 to 12.3	1		
Titus Cr.	Culvert at mouth	0	2		
Mill Cr.	Yellowhawk Division Dam and Ladder	11.4			

Stream	Description	River Mile /1	Priority	Lat.	Long.
Mill Cr.	Bennington Dam and ladder	12.3	1		
Mill Cr.	Kooskooskie Dam	23.0	1		
Mill Cr.	City Water Intake – fishway needs upgrading		1	45.99021148	-118.04837036
Garrison Cr.	Larch and Lyon's ponds	3.7	2		
Stone Cr.	Pond Dam	1.1	2		
Big Spring Cr.	Railroad crossing	0.7	2		
Unnamed spring	Railroad crossing	0.3	2		
Russell Cr.	Old irrigation diversion dam	0.9	2		
Russell Cr.	CCC Dam, complete obstruction	5.6	2		
Yellowhawk Cr.	Yellowhawk-Garrision Division Dam	7.8	1		
Doan Cr.	Underground pipe in which creek is confined	2.1	2		
Birch Cr.	Waterfall	0.4	1	45.99863815	-118.36891174
Birch Cr.	Culvert at Powerline Rd.	3.9	1	45.9824	-118.3139
Walla Walla R.	Nursery Bridge Dam – Additional improvements needed	46.8	1		
Couse Cr.	Culvert at gravel pit entrance	1.1	1	45.8967514	-118.36978149
Cup Gulch (NF Walla Walla	NF Walla Walla River Road Culvert		2	45.89690017	-118.25279998

Degraded riparian communities and large wood recruitment

Vegetative conditions in the Walla Walla subbasin reflect land use practices. Historically, extensive riparian zones existed along streams in the Walla Walla subbasin (USACE 1997). Along the Oregon portion of the river, 70% of the existing riparian zone is in poor condition (Water Resources Commission 1988 cited in USACE 1997). Where steppe grassland vegetation communities once existed in the valley, crops and invasive plant species have largely replaced them.

Table 8-39 shows key limiting factors for Mid-C steelhead in different parts of the Walla Walla drainage based on EDT findings. A summary of major limiting factors and threats is presented in Table 8-40.

Table 8-39. Limiting factors and priorities for protection and restoration as defined by EDT for the Walla Walla River steelhead population.

Geographic area priority			Attribute class priority for restoration																
Geographic area	Protection benefit	Restoration benefit	Channel stability	Chemicals	Competition (w/ hatch)	Competition (other sp)	Flow	Food	Habitat diversity	Harassment/poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment load	Temperature	Withdrawals	Key habitat quantity
Lower Walla Walla (mouth to Touche)		◯	●	•	●		●	•	●				●	●	●	●	•	•
Lower Touche (mouth to Coppei)			•		•		•		•					•	●	•	•	●
Walla Walla, Touche to Dry (plus Mud Cr)		○	•				●	•	●				●	•	●	●		●
Pine Cr mainstem (plus Swartz)		○	•				●		●		•		•		●	•		●
Dry Cr [Pine] Drainage		○	•		•		●	•	●	•			•		●	●		●
Lower Dry Cr (mouth to Sapolil)		○	•		•		●		●		●		•		●	●	•	•
Upper Dry Cr (Sapolil to forks)		○	•		•		•		•		●				●	●		•
Dry Cr Tribs (Mud[Dixie], Mud[Dry], NF Dry & SF D		○	●		•		●		●	•	●				●	●		•
Walla Walla, Dry to Mill		○	•		•		●		●	•			•	●	●	●	●	
W Little Walla Walla Drainage (plus Walsh)		○	•				●		●				•		●	●		●
Mill Cr, mouth to start of Corps Project at Gose St		○	•		•		●		●	•			•		●	●	•	●
Lower Mill Cr Tribs (Doan & Cold)		○	●				●		●	•	●				●	●	•	●
Mill Cr, Gose Street to Bennington Dam		◯	•		•		●	•	●	•	●		•		●	●		●
Mill Cr, Bennington Dam to Blue Cr (plusTitus)		○	•		•		●		●		●		•		●	●	•	●
Blue Cr Drainage (including L. Blue)			●				●		●				•		●	●		●
Mill Cr, Blue Cr to Walla Walla water intake	○	○	•				•		•						●	•		●
Middle Mill Cr Tribs (Henry Canyon, Webb &Tiger)			●				•		•									•
Mill Cr, Walla Walla water intake to access limit	○																	•
Upper Mill Tribs (NF, Low, Broken, Paradise)															•			●
Walla Walla, Mill to E L. Walla Walla (plus MacAvo		○	●				●		●	•			•		●	●		•
Garrison Cr Drainage (plus Bryant)		○	•		•		●	•	●	•	●		•		●	●		●
Stone Cr Drainage		○	●		•		●	•	●	●	●		•		●	●		●
E Little Walla Walla Drainage (plus Unnamed Sprin		○	•		•		●	•	●	•	•				●	•		●
Walla Walla, E Little Walla Walla to Tumalum Bridg	○	○	●				●		•	•					●	●		
Yellowhawk mainstem (mouth to source)		○	•		•		•		●	•			•		●	●		
Yellowhawk Tribs (Lassater, Russell, Reser & Cald		○	●				●		●	•	●				●	●		●
Cottonwood Cr Drainage (including NF, SF & MF)		○	●				●		●				•		●	●		●
Birch Creek Drainage			•				●	•	●	•	•		•		●	●		●
Walla Walla, Tumalum Bridge to Nursery Bridge		○	●				●	•	●	●					•	•		●
Walla Walla, Nursery Br to Little Walla Walla Diver		○	●				●	•	●	•					•			●
Walla Walla, Little Walla Walla Diversion to forks	○	○	•				•		●	•					•			●
Couse Creek Drainage			●				●		●	•		●	•		●	●		●
NF Walla Walla, mouth to L. Meadows Canyon Cr		○	●				●		●						●	●		●
NF Walla Walla, L. Meadows to access limit (plus E	○	○	●				•		•						•			
SF Walla Walla, mouth to Elbow Creek	○	◯	•				●		●						●	●		●
Lower SF Walla Walla Tribs (Flume Canyon, Elbow	○		●												●			●
SF Walla Walla, Elbow to access limit	◯	○																
Upper SF Walla Walla tribs (excluding Skiphorton &	○																	
Skiphorton & Reser Creek Drainages	○																	

Key to strategic priority (corresponding Benefit Category letter also shown)

1/ "Channel stability" applies to freshwater areas only.

A ◯/● High B ○/● Medium C ○/• Low D & E Indirect or General

Table 8-40. Habitat limiting factors summary for the Walla Walla River steelhead population.

Population MaSA and MiSA	Major limiting Factors	Sites Affected*	VSP Characteristics Impacted	Threats	Life Stages Affected
WALLA WALLA RIVER POPULATION					
Walla Walla River Population	Degraded floodplain and channel structure (complexity, pools); altered sediment routing; altered hydrology; water quality (temp); blocked or impaired fish passage; degraded riparian communities	MaSAs and MiSAs	Abundance, productivity	Agricultural practices, water diversions for irrigation, wetland draining and conversion, urban development, stream channelization and diking	All life stages
Mill Creek MaSA	Impaired fish passage; altered sediment routing; water quality (temp); degraded floodplain and channel structure (pools, diversity, food, stability); degraded riparian communities	Mill Cr. [F,CS (LWD, pools – lower reach); T and H (lower reach)]	Abundance, productivity	Agriculture, urban development, flood control, water diversions	All life stages
Pine Creek MaSA	Altered sediment routing; degraded floodplain and channel structure (diversity, stability, food); altered hydrology; water quality (temp); impaired fish passage	Pine Cr. [many passage barriers; S (RM 1-5)]	Abundance, productivity		All life stages
Dry Creek MaSA	Altered hydrology; water quality (temp)		Abundance, productivity		Juvenile rearing, spawning
Cottonwood Creek MaSA	No data				
Walla Walla MaSA	Degraded floodplain and channel structure (diversity, quantity); altered hydrology; altered sediment routing; degraded riparian communities; water quality (temp); impaired fish passage	Walla Walla [T (lower)]; North Fork [F,CS, H,T, S and H (lower reach)]; South Fork [T, F,CS, H, S (lower reach)]	Abundance, productivity	Agricultural practices, livestock grazing, stream channelization,	All life stages

* Abbreviations for limiting factors: degraded floodplain connectivity and function (F); degraded channel structure and complexity (CS); degraded riparian communities (R); altered hydrology (H); degraded water quality (WQ), temperature (T); altered sediment routing (S); man-made block to migration (BP); impaired fish passage (IP).

8.3 Mainstem and Tributary Hydrosystems

This section describes direct and delayed effects of mainstem and tributary hydropower projects on Mid-C steelhead originating from the Fifteenmile Creek and the Deschutes, John Day, Umatilla and Walla Walla rivers. It describes how configurations and operations of the Federal Columbia River Power System affect the abundance and productivity of Mid-C steelhead juveniles and adults. This includes a discussion of how current actions under NOAA Fisheries 2004 FCRPS BiOp affect the juvenile and smolt-to-adult return of steelhead populations as well as factors related to species recovery. The section also discusses how tributary hydropower

projects in the Deschutes, Umatilla and Walla Walla rivers subbasins influence steelhead viability.

8.3.1 Mainstem Hydropower Configurations and Operations

The FCRPS consists of 19 sets of dams, powerhouses, and reservoirs, operated as a coordinated system for power production and flood control by the Federal Action Agencies (i.e., USACE, USBR, and BPA) under various Congressional authorities. The principle projects are: Dworshak, Lower Granite, Little Goose, Lower Monumental, and Ice Harbor dams, power plants, and reservoirs in the Snake River basin; Albeni Falls, Hungry Horse, Libby, Grand Coulee and Banks Lake (features of the Columbia Basin Project), and Chief Joseph dams, power plants, and reservoirs in the upper Columbia River basin; and McNary, John Day, The Dalles, and Bonneville dams, power plants, and reservoirs in the lower Columbia River basin.

Development and operation of the mainstem Columbia hydropower system dramatically alters travel conditions in the mainstem Columbia River, resulting in delayed upstream passage (adults), downstream passage (juveniles), and direct and indirect mortality for downstream migrants (juveniles). The hydropower system also changes the hydrograph; depleting historically available nutrients, increasing water temperatures, and degrading rearing and food resources for both presmolts and smolts in the Columbia River. Changes in the hydrograph leave steelhead more vulnerable to bird and pinniped predation in the mainstem and Columbia River estuary. These impacts increase somewhat for each population in direct relation to the number of dams that fish must pass during their migration to and from the Pacific Ocean. Mid-C steelhead populations pass one to four Columbia River dams: the Fifteenmile Creek population passes one dam; Deschutes River populations pass two dams; John Day River and Umatilla River populations pass three dams; and the Walla Walla River population passes four dams).

Legacy and Current Effects of Hydropower System
Hydropower development and operation in the Columbia Basin has reduced productivity, restricted salmonid migrations, altered habitats, and increased predation on and competition between juvenile salmonids. The hydropower system affects the following factors:

> **Loss of population traits and productivity:** Low adult abundance attributable to direct mortality of downstream migrant smolts at a dam, or to direct mortality or delayed passage of upstream migrant adults at a dam. Selective mortality resulting in non-normative changes in genetic and phenotypic characteristics. Reduction and possible elimination of iteroparity due to high mortality of kelts attempting to return to the ocean.
>
> **Impaired habitat access:** Impaired access to spawning and rearing areas upstream from a dam, or restriction of spawning and rearing to sub-optimal areas downstream from a dam.
>
> **Degraded habitat quality and quantity:** Modification of riverine habitat into impoundments results in changes in habitat availability, migration patterns, and feeding ecology. Downstream migration is significantly slower through impoundments. Food webs are different in the impoundments than in natural rivers.

Increased predation: Ecosystem alterations attributable to dams led to increased predation by native and introduced fish species on naturally produced juveniles. Other fishes, including northern pikeminnow, walleye, smallmouth bass, and salmonids, prey on juvenile salmonids. Modification of the Columbia River hydrosystem and estuarine habitat also led to increased predation by pinnipeds and birds on adult and juvenile salmonids.

Degraded water quality: Flow regulation and reservoir construction have increased average water temperatures beyond optimums for salmonids in the lower Columbia River. High water temperatures can cause migrating adult steelhead to stop or delay their migrations. Warm temperatures can also increase the fishes' susceptibility to disease. Flow regulation and reservoir construction also have increased water clarity that can affect salmonids through food availability and susceptibility to disease. Water can become supersaturated with atmospheric gases, primarily nitrogen, when water is spilled over high dams and this has resulted in significant salmonid mortality. Temperature changes influence physiological transition and seawater readiness of migrating smolts.

Altered hydrograph/water quantity: Changes in flow patterns affect steelhead migration and survival directly and indirectly. Juvenile and adult migration behavior and travel rates are related to river flow. Flow fluctuations stimulate or delay juvenile emigration or adult migration, thereby affecting the timing of juvenile arrival in the estuary and ocean, or adult arrival at the spawning grounds. Reduced springtime flows, for example, have delayed upstream migrations. Flow also affects the availability of habitat for mainstem spawning and rearing stocks. Rapid diurnal flow fluctuations can disrupt mainstem spawners, leave redds dewatered, or strand juveniles.

While management of the hydropower system has improved in recent years, the conditions created by current practices continue to exert negative impacts on the viability to Mid-C steelhead and other listed species today.

Current Effects of Federal Columbia River Power System Management

The FCRPS is currently operated consistent with actions identified in *NOAA Fisheries 2004 Federal Columbia River Power System Biological Opinion* (BiOp)(NOAA Fisheries 2004) and the U.S. Army Corps of Engineers *Final Updated Proposed Action for the FCRPS Biological Opinion Remand* (UPA) (USACE et al. 2004). These actions are intended to address the needs for survival and recovery of all ESA-listed salmon and steelhead ESUs and DPSs in the Columbia Basin. Operation of the FCRPS may change as a result of a remand of the NOAA Fisheries 2004 BiOp, as ordered in June 2005 by the Federal District Court. However, pending any court-ordered hydrosystem operational changes during the remand process, the FCRPS Action Agencies intend to implement the actions identified in the 2004 BiOp and UPA through 2014. Many of the actions are continuation of the 'Reasonable and Prudent Alternative' (RPA) actions contained in the 2000 Biological Opinion.

The following hydrosystem actions are currently being implemented under the 2004 BiOp and UPA.

Continue adult fish passage operations. The Action Agencies continue to complete capital construction projects at federal dams to improve adult fish passage. These fish passage improvements have resulted in meeting or exceeding the adult fish survival performance standards set out in the 2000 BiOp, however there is concern that they do not adequately address delayed mortality and reduced spawning success effects from upstream passage (delay/fallback). The effect of reduced operation of adult passage facilities during winter maintenance, which is especially critical for Fifteenmile Creek winter steelhead, is also a concern.

Improve juvenile fish passage. The Action Agencies continue to implement specific capital improvements, giving priority for funding and implementation to dams with the lowest juvenile passage survival rates. They are pursuing the use of removable spillway weirs (RSWs) or similar surface bypass devices, where feasible. RSWs are installed or planned for installation at all Snake River projects and feasibility studies are being conducted for RSWs at McNary and John Day dams and a forebay guidance device at The Dalles. These RSWs/surface bypass systems are currently designed to operate with reduced levels of conventional spill to provide similar or greater spillway passage and survival at a lower overall spill level to reduce operational costs. However, RSWs with greater training spill or multiple RSWs could be installed at projects to provide even higher spillway passage and survival.

Continue and enhance spill for juvenile fish passage. The basic spring and summer spill program from the 2004 BiOp continues to be implemented. Under the 2004 BiOp remand, court-ordered summer spill was provided in 2005 at Snake River collector projects and McNary Dam to improve survival of listed Snake River fall Chinook.

Continue reservoir operations and flow augmentation to benefit migrating fish. The Action Agencies continue to operate federal storage reservoirs to supplement streamflows and provide spill at mainstem dams to benefit juvenile fish migration consistent with current implementation of the 2000 BiOp as modified through implementation plans. The hydrosystem operations include both discretionary and nondiscretionary actions. Under these operations, the Action Agencies operate federal storage projects at or near upper (flood control) rule curve elevations during the spring to pass spring runoff downstream and to help refill the projects by July 1 for summer flow augmentation operations.

Modify fish transportation to improve juvenile survival. Collection and transport of juvenile fish at Lower Granite, Little Goose, Lower Monumental and McNary dams continues. Under the 2004 and previous Biological Opinions, spring migrants including Mid-C steelhead are not transported during the spring April 10-June 30 spill period so transportation effects (only potentially applicable to Yakima and Walla Walla steelhead) are not considered aside the effects of transportation of upriver stocks on straying in Middle Columbia tributaries.

While current actions under NOAA Fisheries 2004 BiOp are improvements over past hydropower system management, the FCRPS continues to affect Mid-C steelhead abundance and productivity by restricting migrations, altering habitats, and increasing predation on and competition between juvenile salmonids. As a result, the ICTRT ranked the Columbia hydropower system as a major limiting factor for all Oregon Mid-C steelhead populations. Effects of the FCRPS are assessed in the following four categories:

1. Smolt-to-adult returns
2. Juvenile migration and survival related to dam operations and river environment
3. Delayed mortality associated with the FCRPS
4. Adult migration and survival related to dam operations and river environment

Because of the lack of specific survival data for Mid-C steelhead, research data from juvenile steelhead marked primarily from Snake and upper Columbia River stocks, and run-at-large juvenile and adult fish were used to generalize effects of the FCRPS on Mid-C steelhead. These data gaps need to be addressed by the TRT.

1. Smolt-to-Adult Returns

Smolt-to-adult return (SAR) rates provide a measure of survival that encompasses smolt migration, estuary/ocean residence, and adult returns. Changes in SAR over a number of years provide an index of temporal variability in stock productivity and viability, and a basis to understand the relative effects of natural limiting factors in freshwater and marine environments, as well as effects of the FCRPS.

SAR data for hatchery and wild steelhead in the Umatilla and Hood rivers indicate that the effects of the FCRPS increase in relation to the number of dams the fish pass while migrating through the Columbia. Data for the Hood River, which is not part of the Mid-Columbia DPS, have been used here to represent fish passage through one mainstem dam, such as is true for Fifteenmile Creek. These data show that, although not directly comparable, survival of hatchery summer and winter steelhead released from the Hood River have about four to five-fold higher SARs (1.94 % summer and 1.65% winter for 1992-97 brood or 1994-99 migration years) than the Umatilla (0.39%). ODFW contends that that is likely due to additional mortality incurred from passage at three mainstem dams (John Day, The Dalles, and Bonneville) for Umatilla steelhead vs only one dam (Bonneville) for Hood River steelhead. Similarly, SARs of combined wild summer and winter steelhead in Hood River were about four-fold higher than SARs of wild summer steelhead in the Umatilla River.

For Umatilla River wild steelhead, SARs for 1995-2002 migration years ranged from 1.418% in 1996 to 5.316% in 1998, and averaged 2.570% for the eight-year period (Table 8-41).

Table 8-41. Smolt-to-adult return of Umatilla River wild summer steelhead at Three Mile Falls Dam for 1995-2002 migration years (White et al. 2007). Data are incomplete for 2001 and 2002 migration years.

Smolt Migration Year	No. of Smolts	No. Returns to TMFD	Smolt-to-Adult Return Rate (%)
1995	54,361	837	1.540
1996	73,361	1,040	1.418
1997	22,221	1,026	4.615
1998	59,182	3,146	5.316
1999	46,530	2,299	4.941
2000	81,759	4,045	4.948
2001	33,844	1,135	3.353
2002	77,016	1,649	2.141
2003	24,773		
2004	35,640		
2005	59,807		
Mean =	**51,681**		**2.570**

For hatchery summer steelhead released in the Umatilla River from 1987-97 broods, SARs have ranged from 0.043% for the 1988 brood to 0.752% for the 1994 brood and averaged 0.38% for the 11 years (Table 8-42).

Table 8-42. Smolt-to-adult return (hatchery release to Three Mile Falls Dam) of Umatilla Hatchery steelhead 1987-97 broods (Rowan 1998; Chess et al. 2005).

Brood Year	Rearing Location	No. CWT'ed	Total Released	Smolt-to-Adult Return Rate (%)	No. Adults Produced	No. Returns to TMFD
1987	Oak Springs Hatchery	58,067	61,306	0.437	374	268
1988	Oak Springs Hatchery	52,726	81,712	0.043	41	35
1989	Oak Springs Hatchery	56,034	89,193	0.704	838	628
1990	Oak Springs Hatchery	57,825	71,935	0.598	612	430
1991	Umatilla Hatchery	103,353	199,404	0.085	221	169
1992	Umatilla Hatchery	92,952	158,388	0.313	587	495
1993	Umatilla Hatchery	57,033	153,098	0.385	826	589
1994	Umatilla Hatchery	57,884	146,463	0.752	1372	1101
1995	Umatilla Hatchery	61,580	146,703	0.333	541	489
1996	Umatilla Hatchery	58,699	137,287	0.283	407	389
1997	Umatilla Hatchery	60,914	137,485	0.248	393	341
Mean =		**65,188**	**125,725**	**0.380**	**565**	**449**

For the Hood River, estimated SARs for combined wild summer and winter steelhead for 1994-2002 migration years ranged from 3.68% for 1997 migration year to 17.84% for 2001 and averaged 9.00% for the nine years (Table 8-43). Hatchery summer steelhead SARs for the same time period ranged from 0.98-4.52% with a mean of 2.51% (Table 8-44). Hatchery winter steelhead SARs for the same time period ranged from 0.64-2.90% with a mean of 1.78% (Table 8-45).

Table 8-43. Combined estimates of wild summer and winter steelhead subbasin smolt production, escapement to the mouth of the Hood River, and smolt-to-adult survival rate. Estimates are by year of migration. Year of migration is bold faced for those years in which estimates of adult escapements back to the mouth of the Hood River subbasin are greater than 97% complete (Olsen 2005).

Year of smolt migration	Smolts	Adult returns		Smolt-adult survival (%)
		Run years[a]	No.[b]	
1994	7,573	1994/95-1999/00	538	7.10
1995	4,656	1995/96-2000/01	438	9.41
1996	6,799	1996/97-2001/02	400	5.88
1997	13,334	1997/97-2001/02	400	3.68
1998	25,485	1998/99-2003/04	491	6.16
1999	18,842	1999/00-2004/05	1,569	8.22
2000	14,882	2000/01-2004/05	1,979	13.30
2001	5,786	2001/02-2004/05	1,032	17.84
2002	8,096	2002/03-2004/05	765	9.45

[a] Summer steelhead escapements in the 2004-2005 run year are preliminary estimates through 31 December, 2004. Winter steelhead returns are complete through the 2003-2004 run year.

[b] Hooking mortality was assumed to average approximately 10% in the sport fishery located from the mouth of the Hood River to Powerdale Dam.

Table 8-44. Estimates of Foster and Hood River stock hatchery summer steelhead subbasin smolt production releases, adult escapements to the mouth of the Hood River, smolt-to-adult survival rate, and percent difference from the wild smolt-to-adult survival rate. Estimates are by year of migration. Year of migration is bold faced for those years in which estimates of adult escapements back to the mouth of the Hood River subbasin are more than 97% complete (Olsen 2005).

	Foster stock hatchery summer steelhead					Hood River stock hatchery summer steelhead				
		Adult Returns		Smolt to adult survival			Adult Returns		Smolt-to-adult survival	
Year of smolt migration	**Smolts[a,b]**	**Run Years[c]**	**No.**	**Percent Survival**	**Difference from wild (%)**	**Smolts[a,b]**	**Run Years[c]**	**No.**	**Percent Survival**	**Difference from wild (%)**
1994	90,042	1995/96-2000/01	2,051	2.28	-67.89	--	--	--	--	--
1995	76,330	1996/97/2001/02	1,010	1.32	-85.97	--	--	--	--	--
1996	68,378	1997/98-2002/03	673	0.98	-83.33	--	--	--	--	--
1997	60,993	1998/99-2003/04	600	0.98	-73.37	--	--	--	--	--
1998	64,910	1999/00-2004/05	1,624	2.5	-59.42	--	--	--	--	--
1999	62,218	2000/01-2004/05	2,208	3.55	-56.81	19,513	2000/01-2003/04	470	2.41	-70.68
2000	49,278	2001/02-2004/05	2,225	4.52	-66.02	33,899	2001/02-2004/05	1,253	3.7	-72.18
2001	62,354	2002/03-2004/05	1,777	2.85	-84.02	37,665	2002/03-2004/05	522	1.39	-92.21
2002	58,711	2003/04-2004/05	2,100	3.58	-62.12	45,658	2003/04-2004/05	1,154	2.53	-73.23

[a] Production releases of Foster stock hatchery summer steelhead smolts were direct released into the West Fork of the Hood River from 1994-1997. Annual production releases were made below Powerdale Dam (RM 4.5) beginning in 1998.

[b] Number represents the estimated hatchery smolt production release. Numbers have not been adjusted for residualism.

[c] Escapements in the 2004-2005 run year are preliminary estimates through 9 March, 2005.

[d] Hood River stock hatchery summer steelhead smolts were first released into the Hood River subbasin in 1999 (1998 brood). The entire production release is acclimated for up to two weeks prior to being volitionally released into the West Fork of the Hood River.

[e] Hood River stock summer steelhead were generally not available for harvest in the sport fishery through the 2003-2004 run year; with the exception of a small number of adipose-left maxillary clipped adults returning from the 2000 brood release (i.e., 29 adults). This was because of their unique hatchery mark combination (i.e., maxillary only clip). The 2002 brood release was the first brood release in which the entire production group was marked with an adipose clip; in combination with another mark (i.e., a maxillary clip). Hooking mortality of maxillary only clipped adults was assumed to average approximately 10% in the sport fishery located from the mouth of the Hood River to Powerdale Dam.

[f] Estimates include counts at Powerdale Dam of adult steelhead with a valid (i.e., for harvest) Hood River stock summer steelhead mark combination that were classified as a Hood River stock (Unknown) winter steelhead.

Table 8-45. Estimates of Hood River stock hatchery winter steelhead subbasin smolt production releases, adult escapements to the mouth of the Hood River, smolt-to-adult survival rate, and percent difference from the wild smolt-to-adult survival rate. Estimates are by year of migration. Year of migration is bold faced for those years in which estimates of adult escapements back to the mouth of the Hood River subbasin are more than 97% complete (Olsen 2005).

		Adult returns		Smolt-adult survival	
Release strategy, year of smolt migration	Smolts[a,b]	Run years	No.[c]	Percent Survival	Diff. from wild (%)
Direct release,					
1994	38,034	1994/95-1998/99	682	1.79	-74.79
1995	4,656	1995/96-2000/01	1,023	2.39	-74.60
Acclimated,					
1996	6,799	1996/97-2001/02	580	1.14	-80.61
1997	13,334	1997/97-2001/02	385	0.64	-82.61
1998	25,485	1998/99-2003/04	651	1.05	-82.95
1999	18,842	1999/00-2004/05	1,355	2.90	-64.72
2000	14,882	2000/01-2004/05	1,724	2.73	-79.47
2001	5,786	2001/02-2004/05	720	1.42	-92.04
2002	8,096	2002/03-2004/05	1,220	1.94	-79.47

[a] Hood River stock hatchery winter steelhead smolts were first released into the Hood River subbasin in 1993 (1992 brood). The entire production release was first acclimated in 1996 (1995 brood). Hatchery smolts are acclimated for up to two weeks prior to being volitionally released into both the East and Middle forks of the Hood River.
[b] Number represents estimated smolt release. Numbers have not been adjusted for residualism.
[c] Number includes counts at Powerdale Dam of adult steelhead with a valid Hood River stock winter steelhead mark combination that were classified as a Hood River (Unknown) stock summer steelhead.

2. Juvenile Migration and Survival Related to Dam Operations and River Environment

Juvenile steelhead migration and survival are affected by dam operations (primarily spill), environmental parameters (primarily flow and temperature), and predation. Impacts on juvenile survival and migration timing are discussed below.

Juvenile survival

Currently, there are inadequate data to estimate juvenile survival of Mid-C steelhead because very few of these fish have been PIT-tagged, and only steelhead from the Umatilla and John Day rivers have been tagged. Consequently, data from PIT-tagged steelhead from the Snake River have been used to gain a better understanding of Mid-C steelhead survival through Mid-Columbia dams (McNary to Bonneville). While these findings cannot be directly extrapolated to Mid-C steelhead, they provide a basis for understanding probable environmental and dam operational conditions that might be influencing survival and viability of Mid-C steelhead. Additional tagging of specific Mid-C stocks is needed to corroborate results.

Data collected by the Fish Passage Center (FPC 2005) from 1999 to 2005 show statistically significant relationships between survival of PIT tagged steelhead from McNary to Bonneville dams and spill (Figure 8-3), water transit time (related to flow) (Figure 8-4), and temperature (Figure 8-5). Pearson's correlation matrix for these analyses is provided in Table 8-46. Although these relationships were highly influenced by a single low flow year (2001), they still suggest that survival of steelhead is influenced by the amount of spill, flow, and temperature at Mid-Columbia dams, with higher survival at higher spill and flow and lower water temperatures. These results are similar to those found for yearling Chinook between McNary to Bonneville (FPC 2005), and for yearling Chinook and steelhead between Lower Granite to McNary dams.

(FPC 2005) where greater sample sizes and observations over a wider range of dam operations and environmental conditions allow greater statistical rigor and strength of relationships.

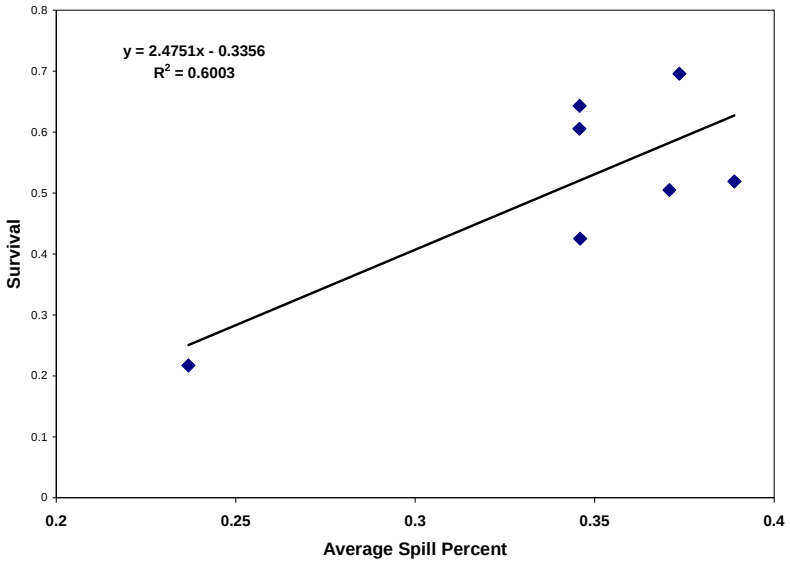


Figure 8-3. Reach survival from McNary Dam to Bonneville Dam for PIT-tagged steelhead detected at McNary Dam between May 11 and June 8 for years 1999 to 2005 plotted with average spill percent at John Day, The Dalles and Bonneville dams.

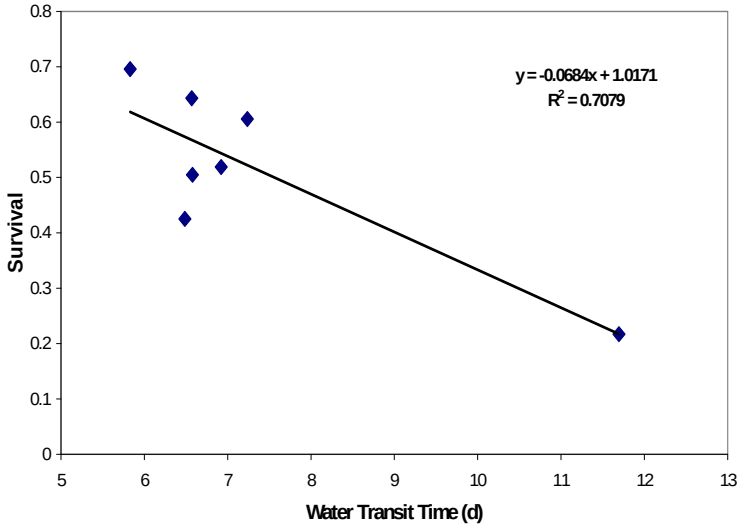


Figure 8-4. Reach survival from McNary Dam to Bonneville Dam for PIT-tagged steelhead detected at McNary Dam between May 11 and June 8 for years 1999 to 2005 plotted with average water transit time for the reach McNary Dam to Bonneville Dam.

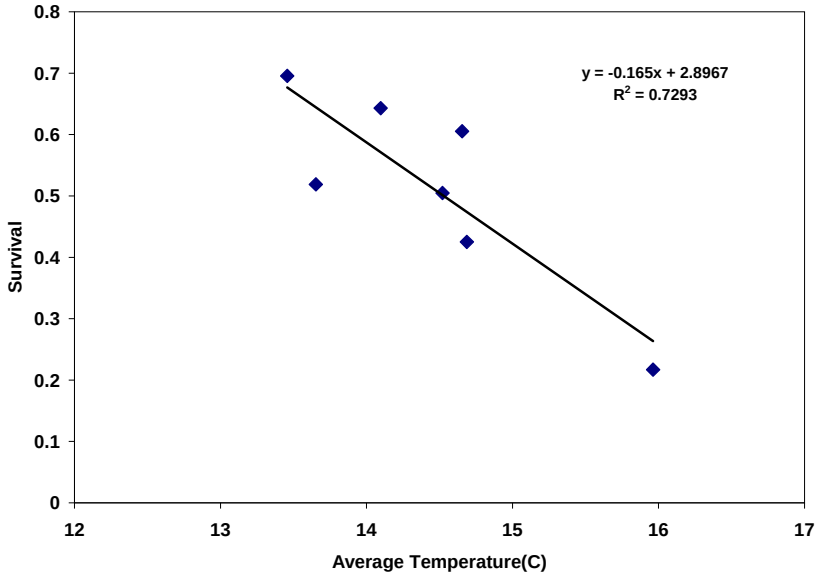


Figure 8-5. Reach survival from McNary Dam to Bonneville Dam for PIT-tagged steelhead detected at McNary Dam between May 11 and June 8 for years 1999 to 2005 plotted with average water temperature(C) measured at tailwater TDGS monitors for the reach McNary Dam to Bonneville Dam.

Table 8-46. Pearson correlation matrix for Snake River steelhead survival relationships.

	SURVIVAL	TRAVTIME	WTT	AVGSPILL	AVTEMP
SURVIVAL	1.00000				
TRAVTIME	-0.76894	1.00000			
WTT	-0.84138	0.96015	1.00000		
AVGSPILL	0.77482	-0.92923	-0.93281	1.00000	
AVTEMP	-0.85401	0.87935	0.85638	-0.90103	1.00000

Data from PIT-tagged steelhead from the Snake River have been used to estimate survival through Mid-Columbia dams. These data were not sufficient to estimate juvenile steelhead survival from McNary to Bonneville until 1997, and then only for pooled wild and hatchery steelhead (Table 8-47). Annual estimates ranged from 0.250 in 2001 to 0.770 in 1998, and averaged 0.540 for the seven years. These survival estimates include only direct effects of passage through the Mid-Columbia dams and reservoirs; delayed, or latent, mortality from hydrosystem passage for these fish is discussed later in this section.

Data from 1997 to 2003 indicate that steelhead survival from McNary Dam to Bonneville Dam is influenced by dam operations (spill); as well as migration rate (as influenced by flow), temperature, and predation. Survival in 2001 was only about one-third of 1998, due to extremely

low flows, high temperatures, and limited spill at each dam because of a declared power emergency by BPA (Williams et al. 2005).

Table 8-47. Estimated survival from McNary Dam tailrace to Bonneville Dam tailrace for hatchery and wild steelhead (pooled) PIT tagged from the Snake River (from Williams et al. 2005).

Year	Survival	Standard Error
1997	0.651	0.082
1998	0.770	0.081
1999	0.640	0.024
2000	0.580	0.047
2001	0.250	0.016
2002	0.488	0.090
2003	0.510	0.015
Average	0.540	0.071

Survival data from 1999 to 2005 for wild summer steelhead from release in the Umatilla River to John Day Dam echo these findings. Results from these data — which examine effects in the Umatilla River and also passage through John Day Reservoir — show that survival probabilities were lowest in 2001 and 2004, two below normal flow years in both the Umatilla and Columbia rivers (Table 8-48).

Table 8-48. SURPH generated survival and capture probabilities for natural summer steelhead tagged and released into the Umatilla River, 1999 – 2005 (White et al. 2007). S*P = Survival Probability.

	Survival probabilities			Capture probabilities		Final S*P		
Year	TMFD	TMFD to JDD	JDD	TMFD	JDD	TMFD	JDD	Number tagged
				All fish tagged and released in Upper Basin[a]				
1999	0.26	0.75	0.19	0.32	0.42	0.40	0.19	2010
2000	0.34	0.52	0.18	0.34	0.34	0.25	0.22	1652
2001	0.39	0.38	0.15	0.15	0.53	0.27	0.36	2622
				Fish tagged and released from January - June in Upper Basin[ab]				
2000	0.37	0.57	0.21	0.36	0.29	0.24	0.18	1281
2001	0.40	0.37	0.15	0.15	0.53	0.26	0.36	2480
				Fish tagged at TMFD for Trap Efficiency tests[c]				
1999	0.97	0.69	0.67	0.21	0.37		0.20	1845
2000	--	--	--	--	--	--	--	24
2001	0.75	0.53	0.40	0.35	0.25		0.21	281
2002	1.04	0.61	0.64	0.17	0.30		0.14	468
2003	0.80	0.64	0.51	0.18	0.40		0.32	498
2004	0.84	0.44	0.37	0.43	0.39		0.13	309
2005	0.91	0.54	0.49	0.29	0.41		0.10	704

[a] These fish were tagged at various times and released at various upriver sites (RM 48 – RM 80) but were grouped for species survival. Natural fish were only tagged from 1999 to 2001.

[b] Fish tagged from January to June were assumed to be actively migrating smolts. These fish were separated because of the potential for overwintering mortality associated with fish tagged from July to December.

[c] These fish were released about 1.5 miles upstream of TMFD at various times.

Predation by Piscivorous Fish. Survival rates also reflect predation that has increased due to dam development and operations. Slower river flows and warmer water temperatures in the lower Columbia River caused by hydropower development and operations create hospitable environments for northern pikeminnow, walleye, smallmouth bass and other fishes that prey on outmigrating juvenile steelhead. The dams can stress and disorient migrating smolts, making them vulnerable to predators. Dams may also delay migration, thereby increasing travel time and exposure to predators. Northern pikeminnow are considered the major piscivore responsible for predation on juvenile salmonids, with mortality potentially similar to that caused by dam passage (Rieman et al. 1991). Predation impacts are further discussed in Sections 8.7.

Juvenile migration timing

Data on the migration timing for wild Mid-C steelhead in the mainstem Columbia River, as determined by detection of PIT tagged fish, are limited to wild and hatchery steelhead PIT tagged in the Umatilla River, where adequate numbers have been PIT tagged since 2001. PIT tagging of wild steelhead has also been initiated in the John Day, Wind and Hood rivers, but inadequate numbers have been detected at mainstem dams to determine migration timing.

Summarized migration timing data for Umatilla River wild and hatchery PIT tagged steelhead from 2001 to 2005 show that Umatilla steelhead generally passed John Day Dam during April and May, typical of migration timing of steelhead PIT tagged in the Snake and upper Columbia rivers (Figures 8-6--8-10). However, in 2001, Umatilla steelhead migrations extended into August because of drought and power emergency (limited spill) conditions (Figure 8-6).

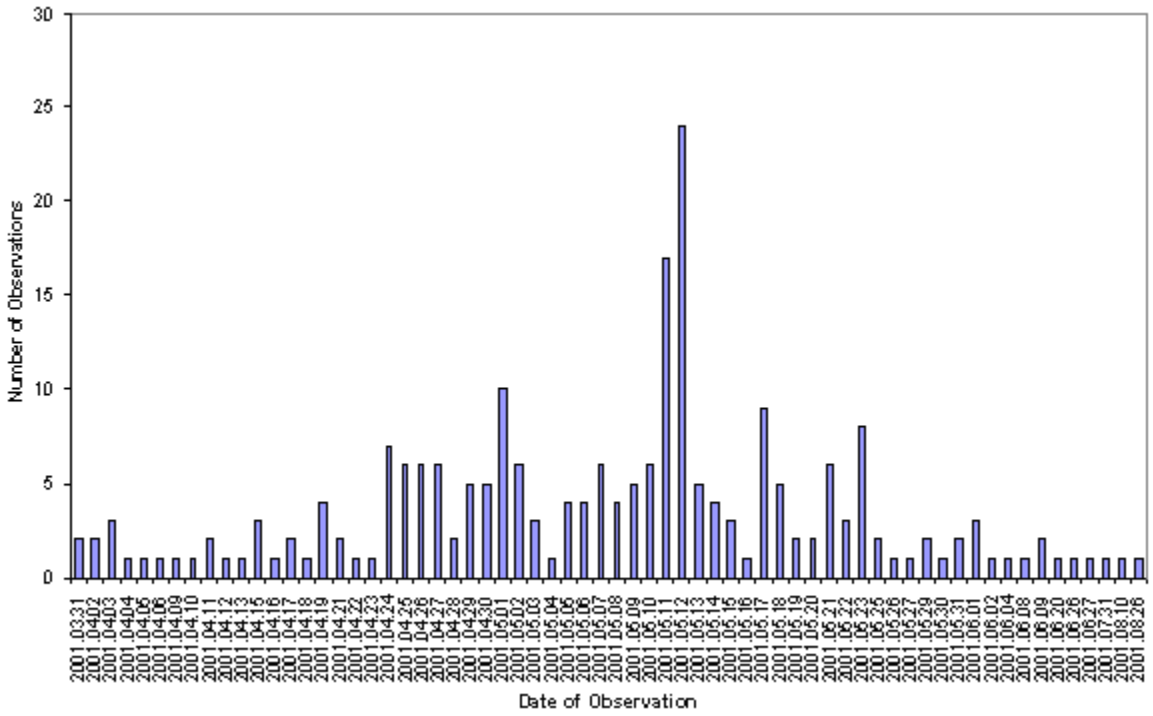


Figure 8-6. Migration timing of wild PIT-tagged Umatilla River steelhead at John Day Dam in 2001.

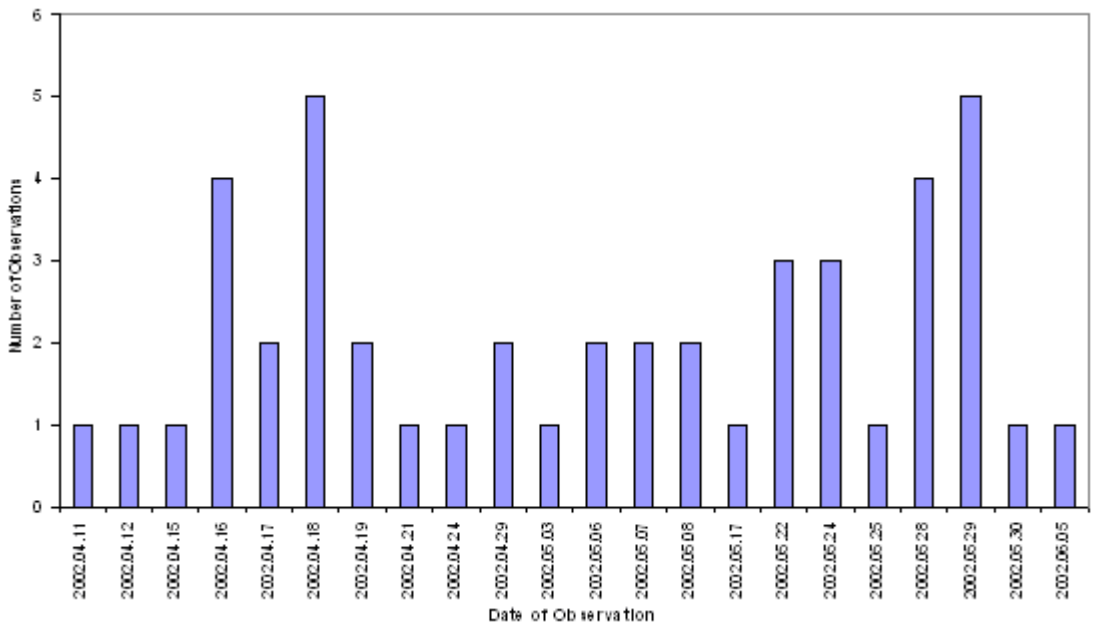


Figure 8-7. Migration timing of wild PIT-tagged Umatilla River steelhead at John Day Dam in 2002.

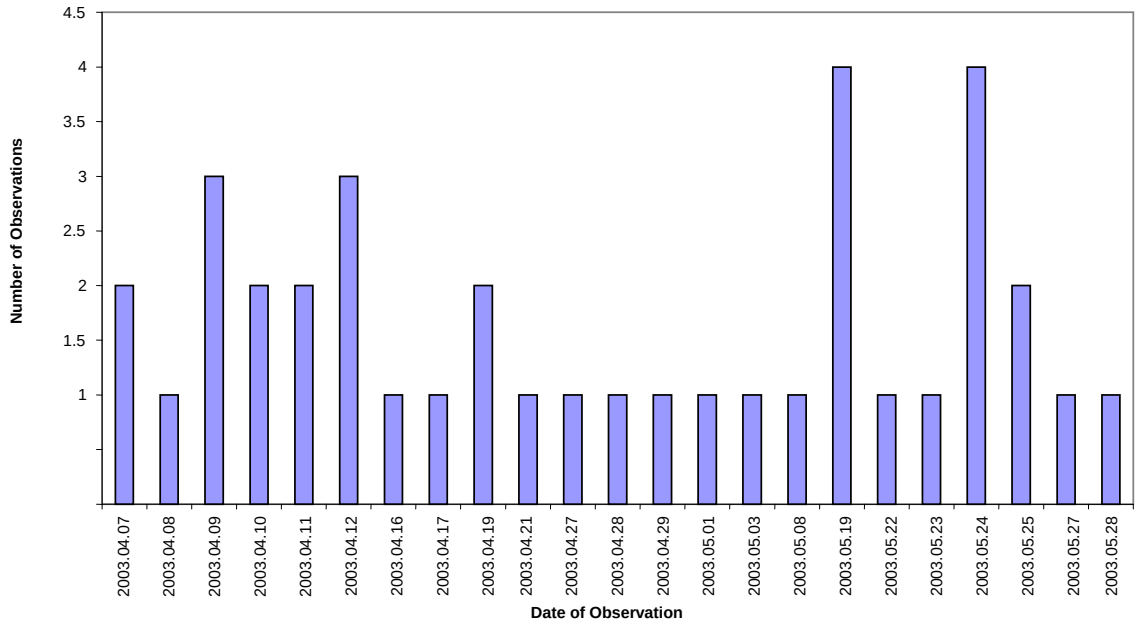


Figure 8-8. Migration timing of wild PIT-tagged Umatilla River steelhead at John Day Dam in 2003.

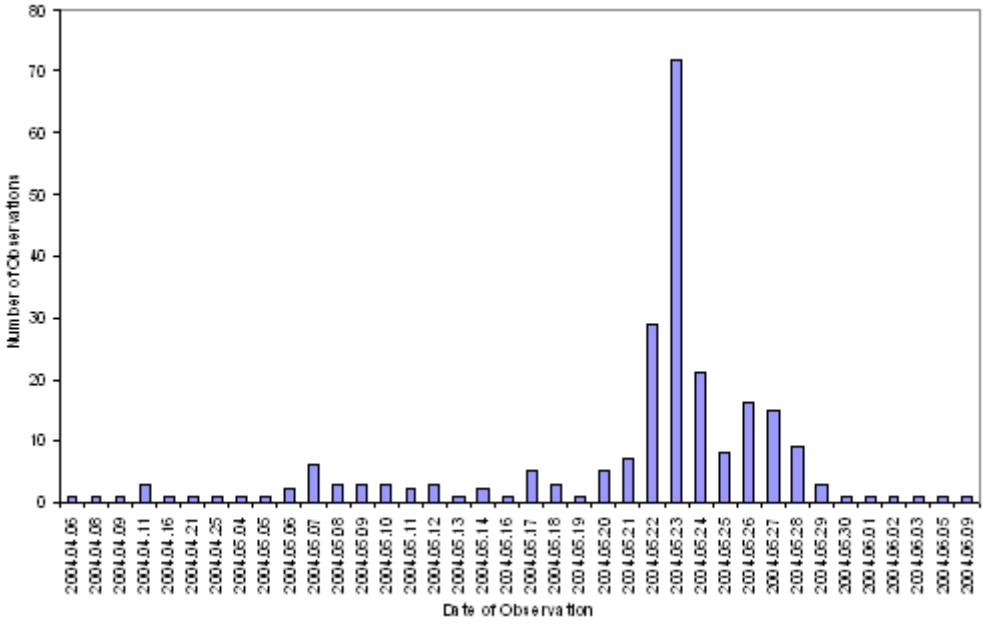


Figure 8-9. Migration timing of wild PIT-tagged Umatilla River steelhead at John Day Dam in 2004.

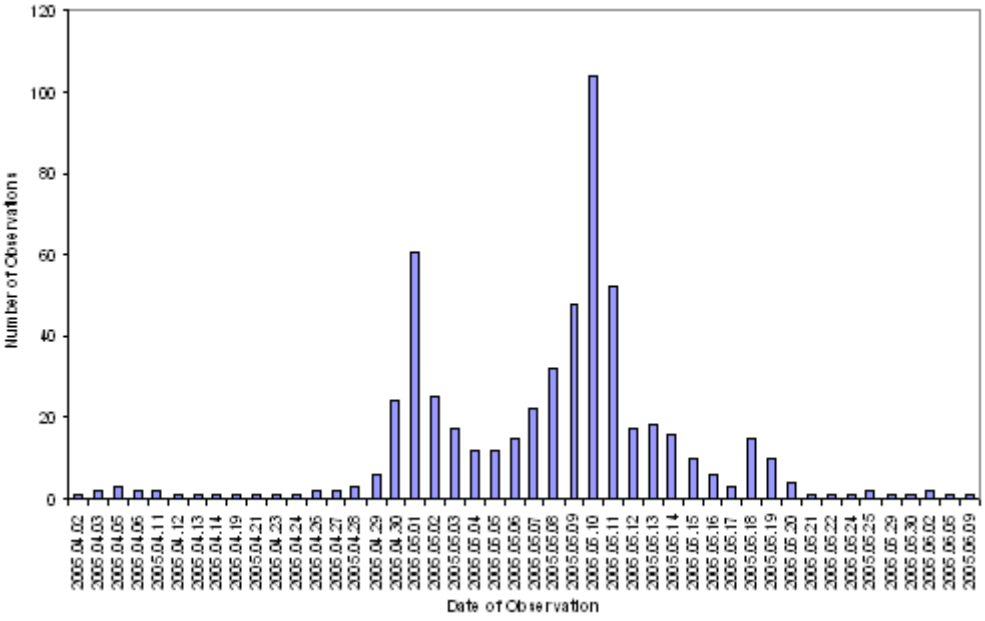


Figure 8-10. Migration timing of wild PIT-tagged Umatilla River steelhead at John Day Dam in 2005.

3. Delayed Mortality Associated with the FCRPS

While there currently is not enough data to determine what level of latent mortality for Mid-C steelhead can be attributed to passage through the hydropower system, studies and analyses conducted on Snake River spring/summer Chinook and steelhead indicate that latent mortality can be high. Comparisons of SARs for Snake River spring/summer Chinook and steelhead with survival estimates through the FCRPS (both juvenile downstream and adult upstream direct survival estimates) indicate that most mortality of both in-river and transported fish occurs outside the hydrosystem, manifested as "delayed" mortality (Marmorek et al. 2004). Studies and analyses have been conducted over the last 10 years to identify causative mechanisms including changes in migration timing (from delay of in-river smolts and acceleration of transported smolts), disease transmission or stress resulting from concentration of fish in bypass/transportation facilities, depletion of energy reserves due to prolonged migrations, altered estuary/plume characteristics, and disruption of homing instincts.

The Comparative Survival Study (CSS) Workshop (Marmorek et al. 2004) found that results from updated modeling (Delta model used by Deriso et al. 2001) indicate that delayed mortality for Snake River spring/summer Chinook has remained high in recent years (long-term average=0.81) despite improvements in ocean conditions. The CSS Workshop evaluated evidence of several mechanisms of delayed mortality, including several that are directly applicable to Mid-C steelhead:

The hydrosystem indirectly affects SARs by delaying in-river arrival of smolts in the estuary- Snake River steelhead arrive in the estuary 2-3 weeks later than historically (travel times greatly extended due to reduced water particle time from dam construction) that influence availability of prey that might be key in estuary/early ocean survival. Although delay of Mid-C steelhead may not be as great as Snake River stocks, any delay may affect survival.

The hydrosystem indirectly affects SARs by delaying the smolt development process through altered entry timing and stress- Similar to Snake River stocks, Mid-C steelhead may be stressed from hydrosystem passage and reverse in smolt development decreasing overall survival.

The hydrosystem indirectly affects SARs through size selectivity and annual variation in bypass survival- Although thought to be a key hypothesis (Williams et al. 2005), a re-analysis of data by Marmorek et al. (2004) for Snake River wild Chinook showed a weak trend in size selectivity and only at Little Goose Dam. Bypass passage for Mid-C steelhead is probably less of a factor than for upriver stocks due to less bypass systems encountered (most stocks are affected by only two dams, John Day and Bonneville, as there is no bypass at The Dalles).

Smolt passage through the hydrosystem increases stress, reduces growth rate and fish condition that increases vulnerability to mortality factors including predation and horizontal transmission of pathogens- This hypothesis is likely but uncertain as evidence is mainly from laboratory studies and lack of empirical data confirming results.

4. Adult Migration and Survival Related to Dam Operations and River Environment

Research by the University of Idaho and NMFS since 1996 (provided by Dr. Chris Peery, University of Idaho) indicates that adult steelhead migration and survival is also affected by the FCRPS. The research focused primarily on passage of adult Snake River salmon and steelhead, but the findings are also applicable, though to a lesser degree, to Mid-C steelhead.

From 1996 to 2003, more than 18,000 adult Snake River salmon and steelhead, were radio-tagged and monitored, and the fates of individual fish were assessed. Monitored groups included spring, summer, and fall Chinook salmon, steelhead, and sockeye salmon. Samples from later years included adults that were PIT-tagged as juveniles at known locations, allowing researchers to assess behavior and survival for individuals with known homing destinations. The tagging program has included several ESA-listed stocks including limited Mid-C steelhead (primarily Umatilla and John Day steelhead). Additional information related to research results described here can be found at, http://www.cnr.uidaho.edu/uiferl/.

Survival and pre-spawn mortality

Survival. Survival through the Columbia River hydrosystem (Bonneville Dam to Lower Granite or Priest Rapids dams) averaged 73% for spring–summer Chinook salmon, 61% for fall Chinook salmon, and 63% for steelhead; survival varied significantly among years (Figure 8-11). Fish that did not reach spawning areas were presumed lost to harvest and other causes. Survival of Mid-C steelhead is likely to be higher due to less dams encountered.

Non-Harvest Mortality. After accounting for fishing mortality, an average of 12–17% of Columbia River and Snake River salmon and steelhead adults had unknown fates before reaching spawning tributaries or exiting the monitored hydrosystem. Causes for these mortalities are unknown, but likely include extended migrations, stress from elevated water temperatures, energetic exhaustion, disease, unreported harvest, delayed mortality due to injuries sustained during fallback or from encounters with fisheries, or other factors. An important finding applicable to Mid-C steelhead is that survival for all runs has tended to be lowest in the lower Columbia River (Bonneville to McNary) and higher through lower Snake River reaches.

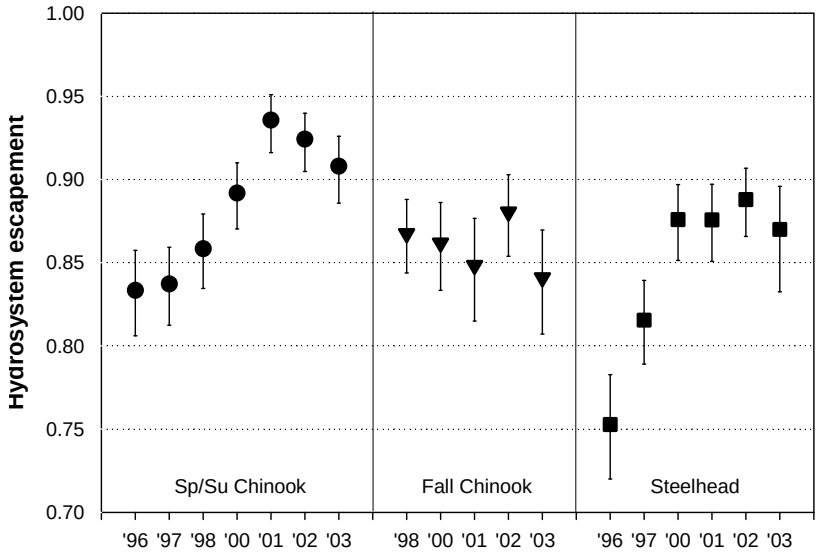


Figure 8-11. Average escapement for adult spring/summer Chinook salmon, fall Chinook salmon, and steelhead through the Federal Columbia River Power System, adjusted for known commercial and sport harvests. Error bars are 95% CIs.

Pinniped Predation. Predation by Pacific harbor seals, Steller sea lions and California sea lions on salmon and steelhead in the lower Columbia River has increased in recent years. More and more seal lions have been traveling as far as Bonneville Dam to prey on adult salmon and steelhead that congregate below the dam before attempting to climb the fish ladders. They also consume large numbers of salmon and steelhead in the 145 miles of the Columbia River below the dam. Section 8.7 discusses the effects of pinniped predation on Mid-C steelhead.

Pre-Spawn Mortality. Additional mortality occurs upstream from the hydrosystem and before spawning, but quantitative summaries of these components of adult survival are limited. Intensive surveys of spawning areas in the South Fork Salmon River, Idaho, reveal 25 to 60% of successful Chinook salmon migrants die before spawning each year compared to numbers observed at Lower Granite. A study is underway to determine how migration history, water temperatures in and upstream from the hydrosystem, and fish energetics are related to pre-spawn mortality for this population. Similar studies are needed for Mid-C steelhead.

Straying. Permanent inter-basin straying is a challenging component of assessing adult survival because they could be considered either successful migrants (they reached a spawning area) or unsuccessful migrants (they did not home to their natal site). On average, 2–4% of known-origin spring–summer and fall Chinook salmon and 7% of steelhead in the radiotelemetry study strayed into non-natal basins where they may have spawned with native stocks. Hatchery fish and fish transported (barged) from the Snake River as juveniles were more likely than other groups to stray. Many stray steelhead from the Snake River entered the Deschutes and John Day rivers and possibly spawn with native populations.

Wandering. In warm years and during warm periods within years, large proportions of summer and fall Chinook salmon and steelhead runs encounter temperatures considered stressful for salmonids. In response, many fish seek cool thermal refuges—and particularly cool non-natal tributary streams particularly the Deschutes River. During the warmest times, majorities of the fall Chinook and steelhead runs concentrate in these refugia, where they may be highly vulnerable to harvest. While the behavior likely has immediate energetic benefits, delays and elevated harvest risks during warm water periods may lead to overall decreases in system productivity. There is some evidence that survival consequences of high temperature exposure may be greater for obligatory migrants like Chinook salmon than for steelhead which migrate many months in advance of spawning.

Effects of dams and operations

Passage Rates. Most adult salmon and steelhead pass individual dams in 1 to 2 days, and pass quickly through reservoirs. However, a proportion of each run (typically between 2–12%) takes several days to weeks to pass individual dams. Research found that fish that took a relatively long time to pass individual dams were less likely to migrate successfully to spawning tributaries. Similarly, relatively slow passage through the lower Columbia hydrosystem (multiple dams and reservoirs) from McNary to Bonneville was associated with unsuccessful migration. Though the cause is unknown, the association described above may have resulted from inadequate dam passage facilities 'delaying' some individuals, the expenditure of large amounts of energetic stores, and resulting in premature death. Alternatively, individuals in poor condition at river-entry may have been both slow and less likely to reach spawning grounds, regardless of passage conditions at dams. Studies are on-going to determine the relative roles of these two mechanisms. Improving passage efficiency has been a management goal, and incremental improvements to fishways (transition pools, count windows, entrance and exit conditions) and operations (spill, fishway temperatures) are being studied and implemented.

Fallback. Some fish from all runs pass dams and then fall back downstream. Approximately 22% of spring/summer Chinook salmon, 15% of fall Chinook salmon, and 21% of steelhead fell back at one or more dams during migration. Fallback is associated with both direct and delayed mortality, slowed migration rates, and increased likelihood of straying. Fallback rates have been highest in years with high river flow and high spill at dams, at least in part because most fish fall back via dam spillways. Fish also appear to fall back as a result of orientation errors, including failure to locate natal tributaries and imprinting problems associated with juvenile barging. Providing benign downstream passage routes for these individuals could lessen the survival costs of fallback. Operational changes may help reduce fallback and therefore increase overall survival, but it is unclear how large a reduction is possible given the management constraints.

Juvenile Barging. Currently, about 70% of juvenile migrating seaward in the Snake River are collected and transported by barge below Bonneville Dam. Returning adults that had been barged as juveniles were ~10% less likely to migrate to spawning grounds, exhibited less direct migrations, and strayed to non-natal tributaries (ex: Deschutes River) at rates that were approximately twice that of adults that had migrated in the river as juveniles. Barging probably interrupts the 'sequential imprinting' process whereby adults use olfactory memories from the juvenile seaward migration during homing. It should be noted that fish used in this study are captured at the Washington shore fish trap which may have influenced results.

Spill. Results three years when spill levels were manipulated at Bonneville Dam suggest that high spill volumes (>100 to kcfs at Bonneville) increase adult passage times slightly compared to moderate spill volumes of ~75 kcfs. Higher spill was also associated with higher fallback rates in spring Chinook salmon and in steelhead. As already noted, longer passage times and fallback events have been associated with lower survival for individual fish.

Summer Spill. Preliminary results from the adult radiotelemetry project suggest that moderate spill during summer would likely have only a limited impact on adult passage. Summer Chinook salmon also exhibited slight increases in passage time and fallback rate at high spill levels at Bonneville dam. However, these effects should be weighted against the potential benefits of limited spill for those adults that volitionally fallback (i.e., those that overshot natal tributaries) because fallback via spillways is more benign than through turbines.

Fishway Temperatures. Elevated water temperatures and large temperature differentials (between the top and bottom of ladders) in dam fishways can deter passage. Mean passage times for spring-summer Chinook at Lower Granite Dam increased from 6.6 hours when temperatures at the ladder exit were similar to those at the base of the ladder, to 19.1 hours when exit temperatures were ≥ 2˚C warmer than at the base. Similarly, the proportion of fish requiring more than one day to pass the dam increased from 32.7% with no temperature barrier to 71.4% when temperatures differed by ≥ 2˚C. Greater numbers of fish reject fishways at John Day Dam when water temperatures exceed 18ºC. Temporary temperature barriers contribute to adult passage delay that may result in permanent straying to downstream sites or migration failure.

Dissolved Gas. High spill at dams can create supersaturated dissolved gas condition in tailraces and downstream areas, and there is concern that fish that encounter these conditions may develop gas bubble disease. Results from an archival tag study that monitored fish swimming depths suggest that adults do not avoid plumes of high dissolved gas and frequently experience high dissolved gas conditions. However, most adults remained at depths that provided adequate "hydrostatic compensation" and consequently prevented expression of gas bubble disease. Little is known about the effects of the observed frequent, but short, exposures to supersaturated conditions. Addition of flow deflectors and increased use of surface flow weirs at spillways should moderate dissolved gas conditions in the system. Additional study of this issue may be warranted given the incidence of gas bubble disease symptoms in adults in some years.

River and ocean environment

Flow and Survival. Adult Chinook salmon appear to have lower hydrosystem survival in years with high flow (discharge). This pattern is probably the result of higher fallback and slower migration rates in high-flow years, two energetically demanding aspects of migration. Survival for runs that migrate during typical low-flow times (most fall Chinook salmon and steelhead) has not been correlated with river flow.

Temperature and Survival. Water temperatures in the Columbia and Snake Rivers have been increasing since dam construction began due to development and management of the hydrosystem as well as from regional climate and water use patterns, resulting in longer summers and higher summer temperatures. Adults returning in the late spring, during summer, and in the early fall frequently choose the coolest water available to them to migrate in, but still

frequently encounter stressful temperatures. Higher temperatures were associated with altered migration behavior and lower migration success. Predictions for continued warming will probably adversely affect migrating adults because migration through stressful temperature conditions requires more energy and may contribute to higher rates of prespawn mortality. A study is underway to evaluate effects of temperature exposure on gamete quality and spawning success.

8.3.2 Tributary Hydropower Configurations and Operations

Several hydroelectric dams on Columbia River tributaries pose significant threats to the viability of specific Mid-C steelhead populations, including the Deschutes Westside, Crooked, Umatilla, and Walla Walla populations.

Deschutes River Populations
The Pelton-Round Butte Complex on the Deschutes River at RM 100 significantly impacts abundance, productivity, and spatial structure of the Deschutes Westside steelhead population and to a lesser extent the Deschutes Eastside Population. The complex blocks passage to historical upstream habitats in the Deschutes watershed, including the Crooked River, Metolius River, the Deschutes River upstream to Big Falls, and Whychus Creek. On the Deschutes River, Big Falls (RM 132) is considered to have been the upstream limit of anadromous fish migration (Nehlsen 1995). Summer steelhead were historically present throughout much of the Crooked River subbasin, with the exception of the North Fork Crooked River above Upper and Lower Falls.

Construction of the complex, a system of three dams and reservoirs, began in the late 1950s and was completed in 1964. The complex spans 20 miles on the Deschutes River and also extends into two tributaries, the lower seven miles of the Crooked River and the lower 13 miles of the Metolius River. The complex was constructed with upstream and downstream fish passage facilities, however, by 1966 it appeared that downstream passage through Lake Billy Chinook, the reservoir behind Round Butte Dam, could not be maintained due to poor guidance of out-migrating smolts. The last fish were passed in 1968, and production shifted to state hatchery facilities. In 1974 Round Butte Hatchery was completed at Round Butte Dam, and production shifted to this facility.

With the new federal license issued in June 2005, the joint owners of the project (PGE and CTWSRO) have developed plans to reinitiate fish passage through the complex and reintroduce Chinook and steelhead above the complex. A comprehensive fish passage plan includes development of effective downstream collection and passage for parr and smolt life history stages. The facility is scheduled for completion in 2009.

Potential to Introduce Disease
The reintroduction of steelhead to historical habitats upstream of Round Butte Dam in the Deschutes River subbasin may expose existing resident populations to diseases. Resident trout upstream of the dam have been isolated from the rest of the Columbia Basin for over 30 years. As such, they have not been subject to newly introduced or more virulent disease found downstream. Primary diseases of concern that may affect upstream fish populations include

Infectious Hematopoietic Necrosis Virus (IHNV) and *Myxobolus cerebralis* the parasite that causes whirling disease.

Umatilla River Population

The Boyd Hydro Project has been in operation since the early 1980's and is located at approximately RM 9-10 on the Umatilla River. Water is diverted from the Umatilla River at approximately RM 10 into a mile long canal that routes water to the generating facility where the water is returned to the river. The hydraulic capacity of the facility is 500 cubic feet per second with an average head of 30 feet. Flows for operation of the facility are generally only available during the winter and spring months. The Oregon Water Resources Department and Federal Energy Regulatory Commission have established minimum flows for the Bypass reach of 150 cfs from September through November and 100 cfs from December through August. These flows are well below the instream water right for this reach with priority date of November 3, 1983. The instream water right flows are 300 cfs October through November 15, 250 cfs November 15 – June, 120 cfs in July, 85 cfs August – September 15, and 250 cfs September 15 to October 1.

A low head dam exists at the point of diversion and fish screens are installed across the intake canals. Malfunction of the fish screens led to entrainment of fish and an associated fish kill in 1993. Problems with the screens were corrected and no further problems with the screens have been identified. A fishway exists at the dam structure, but this facility does not meet current fish passage standards for anadromous adult salmonids.

Walla Walla River Population

The Twin Reservoirs Hydro Project, owned and operated by the city of Walla Walla, is located on Mill Creek along a six-mile reach that dips into Oregon (most of this creek is within the state of Washington). The City diverts water from Mill Creek for municipal uses and to generate electricity that is sold on the power market to offset costs of the City's water supply system. Water for both uses is diverted at the same point of diversion and routed to Walla Walla through a pipeline. The current hydraulic capacity of the facility is 38 cfs when the hydro plant is in operation. The City's original 1866 municipal water right has no instream flow requirements. However, when the city operates its hydropower project the following bypass flows are required:

Immediately below project intake:	
Aug-Nov	13 cfs
December	15 cfs
January	20 cfs
February	25 cfs
Mar- Apr	30 cfs
May	25 cfs
June	15 cfs
July	14 cfs

At Kooskooskie	
October	32 cfs
November	35 cfs
December	37 cfs
January	44 cfs
February	53 cfs
March	63 cfs
April	86 cfs
May	64 cfs
June	39 cfs
July	32 cfs
Aug-Sept	31 cfs

The City's hydroelectric license is conditioned to require gauging equipment as necessary to provide full-time, continuous records of project diversions and of streamflow below the project intake. A dam with fishway exists at the point of diversion and fish screens are installed on the intake. The current fish screens were installed in 1999 to replace old screens that were found to result in fish mortality. The screens meet current ODFW and NMFS standards. Recovery team members are unsure of the fishway's compliance with current passage standards.

8.4 Estuarine and Plume Habitat

Changes in estuarine and plume habitat at the mouth of the Columbia River impact Mid-C steelhead juveniles and adults as they undergo the vast physiological changes needed to transition to and from saltwater production. This section summarizes relevant information presented in the Columbia River Estuary Recovery Plan Module (LCREP 2006). The module provides detailed descriptions of limiting factors and proposes recovery actions to improve salmon and steelhead habitat conditions in the estuary.

The Columbia River estuary and plume are considerably degraded compared to only 200 years ago. In terms of absolute size, the estuary tidal prism is about 20% smaller than it was when Lewis and Clark camped along the Columbia's shore (NPCC 2004). This reduction in estuary size is due mostly to dike and filling practices used to convert the floodplain to agricultural, industrial, commercial, and residential uses. Instream flows entering the estuary also have changed dramatically—there has been a 44% decrease in spring freshets or floods, and the annual timing, magnitude, and duration of flows no longer resemble those of the historical hydrograph in the Columbia River (Jay and Kukulka 2002). Changes to the hydrograph are attributed to flow regulation by the hydrosystem, water withdrawal for irrigation and water supplies, and climate fluctuations.

While much remains to be learned about how Mid-C steelhead and other stream-type juveniles use estuarine and plume habitats, scientists generally believe that stream-type salmonids are particularly affected by changes in plume habitat conditions and by predation in the estuary and plume (LCREP 2006). Changes in estuarine habitats affect ocean-type juveniles more because they reside in the estuary longer than stream-type juveniles and tend to use shallow-water

habitats, thus they are more affected by flow alterations that structure habitat and/or restrict access to wetland or floodplain areas than are stream-type juveniles. Mid-C steelhead and other stream-type juveniles have relatively short estuary residence times and use the plume much more extensively than ocean types do. Thus they are more affected by plume habitat conditions. They are also threatened by predation in the estuary and plume (LCREP 2006).

8.4.1 Changes in Plume Habitat

Mid-C steelhead and other stream-type salmonids are affected by the size, shape, behavior, and composition of the plume. The plume is believed to function as habitat, as a transitional saltwater area, and as refugia for juvenile salmonids as they prepare for ocean life (LCREP 2006; Fresh et al. 2005).

Evidence suggests that the plume supports ocean productivity by increasing primary plant production during the spring freshet period, distributing juvenile salmonids in the coastal environment, concentrating food sources such as zooplankton, and providing refugia from predators in the more turbid, low-salinity plume waters (Fresh et al. 2005). Changes in the Columbia River hydrograph alter both the size and structure of the plume during the spring and summer months (NPCC 2000). Changes in the hydrograph also affect plume habitat by reducing fine-sediment inputs leaving the estuary.

8.4.2 Predation

Predation is a primary concern for juvenile and adult Mid-C steelhead during their stay in the Columbia River estuary and plume. Effects of predation are discussed below and in Section 8.7.

Estuary habitat modifications have increased the number and/or predation effectiveness of Caspian terns, double-crested cormorants, and a variety of gull species (Fresh et al. 2005). Stream-type juvenile salmonids, including Mid-C steelhead, are most vulnerable to avian predation by Caspian terns because they use deep-water habitat channels that have relatively low turbidity and are close to island tern habitats.

Native pinnipeds, including harbor seal, Stellar sea lions and California sea lions, also prey on steelhead in the estuary (NPCC 2004). Native pinniped abundance has steadily increased since passage of the Marine Mammal Protection Act in 1972. Diet studies indicate that pinnipeds consume both juvenile and adult salmonids. Mortality of adult salmonids at Bonneville Dam because of sea lions was estimated at 4.1% in 2007 (USACE 2005), however the estimate does not reflect pinniped mortality occurring in the 145 river miles downstream of the dam. There are also no official estimates of downstream mortality on adult spring Chinook and winter steelhead (both of which are stream-type salmonids); however, unsubstantiated estimates are as high as 10%, which would equate to about 29,000 adult fish (LCREP 2006).

The northern pikeminnow and other native piscivorous fish likely pose a lesser concern for Mid-C steelhead in the estuary. The fish prey on ocean-type juveniles more than stream-type juveniles because of their longer estuary residency times and use of shallow-water habitats;

however, it is believed that stream-type juveniles leave faster, deeper water to forage for food in the shallows and also experience mortality from pikeminnow predation.

8.5 Harvest

This section explains the different types of harvest impacts, the types of fisheries and areas that Mid-C steelhead fisheries occur, and the multitude of jurisdictions and processes that influence harvest. The section also provides perspective on historical and current harvest impacts.

Harvest may affect population viability by affecting abundance, productivity, spatial structure and/or diversity. Harvest decreases survival rates relative to an un-harvested population by direct and incidental mortality. Steelhead may be removed at several life stages, ranging from pre-smolts taken in trout fisheries to adults taken after they have returned to natal tributaries to spawn. Harvest, therefore, directly decreases adult abundance (viewed either as the number of spawners or as the number of adult recruits) and productivity, measured as the number of adult recruits per spawner returning to the spawning ground. The extent of this decrease in abundance is usually reported as a harvest rate. Harvest also may be selective and influence diversity and spatial structure viability criteria. Harvest may selectively remove fish based on size, age, distribution or run timing, depending on the gear, timing and location of the fishery. Selectivity impacts have rarely been measured or reported.

The ICTRT identified harvest-related adverse effects as a secondary level limiting factor and the Mid-C Expert Panel did not identify harvest as a primary or secondary threat (Mid-C Expert Panel 2006). Given the current management regulations for mainstem and tributary fisheries we consider harvest to be a threat that does limit viability; however, the combined affect of all fisheries only raises the threat to a secondary level.

8.5.1 Fisheries Management — Historically to Present

Steelhead may be caught in ocean, mainstem Columbia River, or tributary fisheries depending on their distribution, run timing relative to fishery openings and vulnerability to gear. Because of their exposure to fisheries across large geographic regions of the West Coast, Pacific salmon and steelhead management is governed by a number of regional organizations. Fisheries of the Columbia River are established within the guidelines and constraints of the Pacific Salmon Treaty, the Columbia River Fish Management Plan, the Endangered Species Act administered by NOAA Fisheries, The Pacific Fishery Management Council, the states of Oregon and Washington, the Columbia River Compact, and management agreements negotiated between the parties to US v. Oregon.

Fisheries management through these various organizations has resulted in the decline of total exploitation rates for Columbia River salmon and steelhead, especially since the 1970s. Because of these changes, the ICTRT and Expert Panel currently consider harvest a secondary limiting factor for Oregon Mid-C steelhead populations. There has been no direct freshwater non-tribal harvest on wild steelhead from the Mid-Columbia DPS since 1992 when the last wild fish catch-and release regulations on these populations became effective. It is also assumed that steelhead are rarely caught in ocean fisheries. Therefore, all current non-tribal harvest impacts on Mid-

Columbia DPS steelhead are due to incidental by-catch in commercial or recreational fisheries that target hatchery steelhead or other species. Tribal fishers in Zone 6 of the Columbia mainstem (between Bonneville Dam and McNary Dam) continue to retain wild steelhead for commercial sale or for personal use. The impact of these various fisheries is discussed below.

Ocean Fisheries

Columbia River steelhead have been captured in high-seas sampling in the far North Pacific and along the coast of SE Alaska and British Columbia (Burgner et al. 1992). According to Rich (1942), Columbia River steelhead were historically taken along with Chinook and coho in ocean fisheries off the mouth of the Columbia River, but accounted for less than 0.1% of the catch and numbered only in the few hundreds of fish. More recent ocean commercial fisheries have not been monitored for incidental steelhead by-catch, and it is assumed that by-catch is very low. Recreational fisheries in the ocean catch small numbers of steelhead.

Mainstem Commercial Fisheries

Steelhead catch in Columbia River mainstem commercial fisheries was reported starting in 1889, although it is thought that some steelhead were processed along with Chinook (and counted as Chinook) in previous years. The available information is mostly about summer steelhead catch since early reporting focused on the fall fishery, but earlier spring fisheries probably caught some winter steelhead. The maximum annual catch reported was about 492,000 fish (Figure 8-12) (Craig and Hacker 1940). Annual catches were averaging about 189,000 fish by the 1930s. Escapements were not estimated before the late 1930s so the harvest rates due to these early fisheries were not known. All early catch was of wild steelhead.

The Bonneville Dam fish ladder opened in 1938 and allowed escapement estimates to be made on populations that passed above that location. Rich (1942) estimated that the 1938 harvest rate on up-river steelhead was 67%, with 80% of the catch occurring below Bonneville Dam. Subsequent harvest records indicate that commercial harvest rates on up-river steelhead were about 66% between 1938 and 1950 (Figure 8-15) (WDFW and ODFW 2002). Most of the harvest was probably of summer steelhead. Winter steelhead were not identified as a separate race until 1953. From 1939 through 1950, about 8% of the steelhead passing the dam were probably winter steelhead based on run timing.

Total mainstem commercial harvest rates on steelhead (tribal and non-tribal combined) began to decline in the 1950s, and also began to include a mix of hatchery and wild fish. Mainstem harvest rates on up-river summer steelhead declined from about 50% to about 20% from the early 1950s to the early 1970s, while winter steelhead harvest rates declined from about 30% to about 5% over the same period. Non-tribal mainstem commercial fisheries on steelhead were discontinued in 1975. Subsequent impacts in the non-tribal commercial fishery were due to by-catch during fisheries on other species. All steelhead were released in these fisheries, although some release mortality occurred. Tribal commercial harvests in Zone 6 since 1975 ranged from about 30% to less than 10% (Figure 8-13).

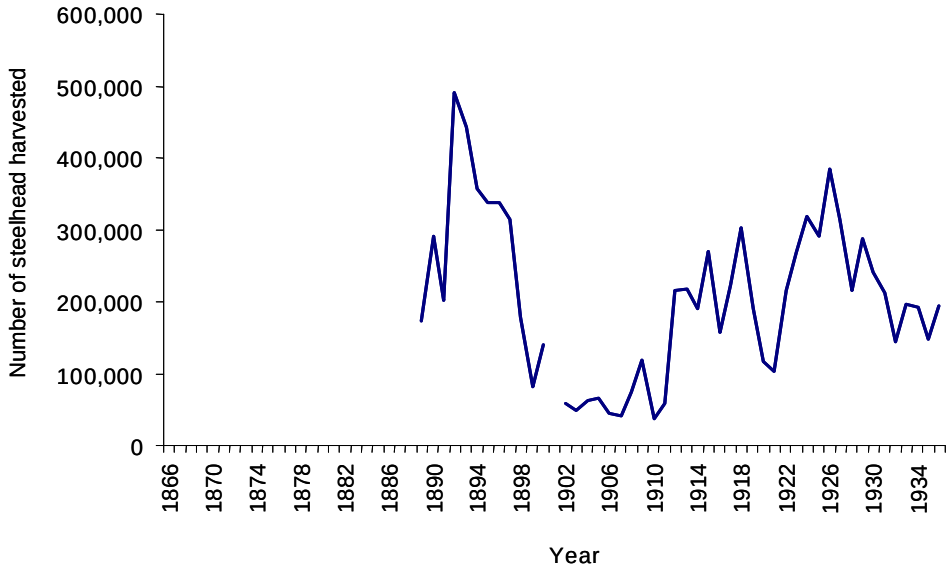


Figure 8-12. Number of steelhead harvested each year in mainstem Columbia River fisheries (1866-1936) (Craig and Hacker 1940).

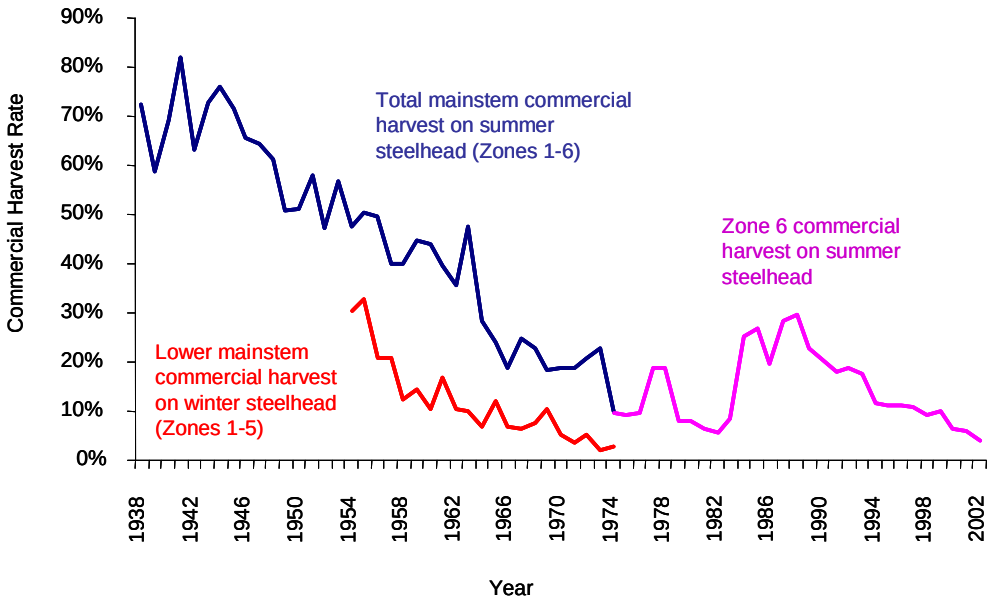


Figure 8-13. Commercial harvest rates on steelhead, 1938 – 2002 (WDFW and ODFW 2002). Non-tribal commercial harvest was discontinued in 1975.

Mainstem Recreational Fisheries

Mainstem recreational fisheries below Bonneville Dam have been monitored by creels since 1964. The harvest rate on summer steelhead ranged from over 16% to less than 1% until 1992

when all fisheries became catch-and-release for wild fish (Figure 8-14). The harvest rate on winter steelhead over the same period ranged from 2% to less than 1%. Current recreational harvest impacts for both life histories are estimated to be less than 1% and are due entirely to hooking mortality.

Recreational fisheries in the mainstem above Bonneville Dam are not monitored, except by punch card estimates. Bubble fisheries at the mouths of some tributaries can be seasonally intense, but the impact rates are unknown except for a bubble fishery at the mouth of the Deschutes. These fisheries have also been catch-and-release since 1992 and impacts to wild fish are thought to be less than 1%.

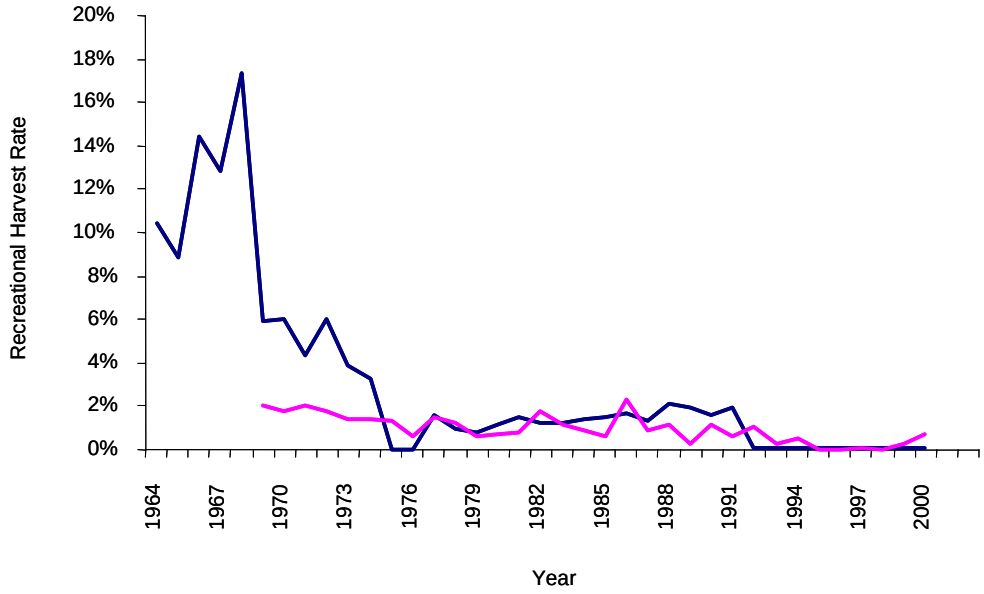


Figure 8-14. Recreational harvest rates on steelhead in the mainstem below Bonneville Dam, 1964 – 2002 (WDFW and ODFW 2002). Blue is summer steelhead while pink is winter steelhead. All mainstem fisheries became catch-and-release in 1992 and the impacts since that year were calculated by the encounter rate and an estimated release mortality.

8.5.2 Allowed Harvest Impacts under NOAA Biological Opinions

Harvest of ESA-listed fish, including the Mid-C steelhead DPS, is controlled by NOAA Fisheries to protect weak stocks. The Oregon Fish and Wildlife Commission also sets limits on certain fisheries to protect the listed stocks. Impacts from harvest regulations to protect Mid-C steelhead are discussed below.

Mid-C Winter Steelhead
The NOAA Biological Opinion for 2008 set a mainstem Columbia River non-tribal impact limit on winter steelhead of 2% (including both sport and commercial impacts), and an average tribal impact of 2.3%. Oregon has FMEPs in place that set tributary impact limits between 0% and 2.5%.

Mid-C Summer Steelhead
The NOAA Biological Opinion for 2008 set a mainstem Columbia River non-tribal impact limit on summer steelhead of 4%, including both sport and commercial impacts. This limit is split across two seasons, with 2% applied to spring and summer fisheries and 2% applied to fall fisheries. An average annual tribal impact of 9.3% (1.9% summer season and 7.4% fall season) is set for Zone 6. Oregon has FMEPs in place or proposed that set tributary impact limits between 0% and 5%.

8.5.3 Actual Recent Harvest Impacts

Monitoring of harvest impacts on Mid-C steelhead is complex because there is no direct non-tribal harvest on wild steelhead from the DPS and all catch is indirect. Indirect effects include incidental mortality of fish that are caught and released, encounter fishing gear but are not landed, or are harvested incidentally to the target species or stock. Monitored and unmonitored fisheries, and impacts due to fishing gear and environmental conditions are discussed below.

Monitored Fisheries
Actual harvest impacts on Mid-C DPS steelhead over the last several years have been incompletely monitored. Monitoring of incidental harvest impacts is complex for two reasons. First, since all caught fish are released, encounter rates and characteristics of encountered fish are difficult for monitors to observe. Second, released fish experience a mortality rate, possibly delayed and difficult to measure, that is highly variable and depends upon what gear is used, how the fish is caught by the gear, how the fish are handled during capture and release, and on environmental conditions.

Ocean commercial and recreational harvest of salmon has generally declined in recent years because of international treaties, fisheries conservation acts, regional conservation goals, the Endangered Species Act, and state and tribal management agreements. Creels on recreational ocean fisheries recorded less than 100 steelhead caught each year in 2003 – 2005. Of these, less than 10 were estimated to be released wild fish mortalities.

The only effort to regularly monitor steelhead by-catch in non-tribal commercial fisheries occurs in the spring Chinook commercial fishery, which impacts primarily winter steelhead, in the mainstem Columbia below Bonneville Dam. This monitoring effort, which began in 2003, employs observers on board fishing boats to measure steelhead encounter rates and uses information from recent literature to set a release mortality rate from gill nets according to mesh size. The estimated impact rate on wild winter steelhead from 2003 to 2005 ranged from 0.5% to 1%. The measurements have an unknown error around these numbers due to the use of point estimates for encounter rates, mortality rates and escapements, all of which actually contain some variance and/or measurement error.

Recreational creel surveys in the lower Columbia mainstem below Bonneville Dam and in the lower Deschutes and Umatilla include questions about wild steelhead releases to estimate encounter rates, and use recent literature to set a hooking mortality rate. Estimated recent impact rates in these recreational fisheries ranged from 0.1% to 1.5% in each fishery. The fish in any particular population may be exposed to several of the fisheries as they move through the

mainstem and into tributaries, but the total recreational impact is probably less than 2.5% in most cases. Again, there is an unknown error around these numbers.

Catch of steelhead in the Zone 6 tribal fishery is easier to monitor since steelhead sold to commercial buyers are counted and measured. However, some tribal steelhead catch, and possibly much of it, may not be reported if they are sold over the bank by individuals or if they are retained for personal use. Tribal biologists make some effort to account for unreported catch, especially in fall fisheries. Reported steelhead catch in Zone 6 winter and spring fisheries for 2003 to 2005 ranged from 0.7% to 7.9% of the winter steelhead run over Bonneville Dam (Table 8-49). Reported steelhead catch in Zone 6 summer and fall fisheries in 2003 and 2004 was 2.6% and 2.7% of the summer steelhead run over Bonneville Dam (Table 8-50). In 2004, the estimated non-reported catch increased the impact to 4.8% of the run at Bonneville. Again, there is an unknown error around these numbers.

Potential impacts due to harvest selectivity are only taken into account in the Zone 6 tribal fishery that is thought to select for larger steelhead because of the use of gill nets with unrestricted mesh sizes. Mesh size in these fisheries is generally selected to optimize the catch of Chinook, the target species. Smaller and younger steelhead are able to escape many nets. The Zone 6 fishery monitors the catch of large steelhead as a separate stock. The 2004 estimated impact on large verses small fish is presented in Table 8-51. Each of the four "stocks" also has a distinct run timing which may account for hatchery/wild differences within size category.

Table 8-49. Estimated impacts (percent of run) on winter steelhead in winter and spring mainstem fisheries (2003–2005).

	Non-tribal Commercial		Tribal	
Year	Number of wild steelhead	Impact rate (of Columbia River mouth escapement)	Total number of steelhead (wild + hatchery)	Impact rate (of Bonneville Dam escapement)
2003	229	1.0%	807	7.9%
2004	238	0.8%	81	0.7%
2005	69	0.5%	208	3.6%

Table 8-50. Estimated impacts (percent of run) on summer steelhead in summer and fall Zone 6 fisheries. Fish numbers include hatchery and wild steelhead, and impact rates are calculated based on the Bonneville Dam escapement.

				Fall							
		Summer		Bonneville Pool		The Dalles Pool		John Day Pool		Total summer/fall	
Year		Fish	Impact rate	Fish	Impact rate	Fish	Impact rate	Fish	Impact rate	Fish	Impact rate
2003	Ticketed	96	<0.1%	4,484	1.3%	2,478	0.7%	2,251	0.6%	9,309	2.6%
2004	Ticketed	714	0.2%	4,611	1.5%	1,792	0.6%	1,219	0.4%	8,336	2.7%
	Est. Total Landed in 2004 (Ticketed, non-ticketed, and C&S)									14,757	4.8%

Table 8-51. Estimated size selectivity of the 2004 Zone 6 fishery. The size breakout is that "Small" fish are less than 78 cm, while "Large" fish are equal to or greater than 78 cm. Estimated impact rates are based on the abundance of each group at Bonneville Dam.

Characteristic	Number of Fish	Estimated Impact Rate
Small hatchery	6,791	3.2%
Small wild	1,963	3.4%
Large hatchery	4,963	17.2%
Large wild	1,040	10.6%

Unmonitored Fisheries

All other fisheries that could encounter steelhead have been unmonitored or irregularly monitored in the past few years. All of these other fisheries must release caught steelhead, but mortality can still occur. The Mid-Columbia steelhead DPS is a diverse DPS that includes winter and summer-run steelhead. Winter steelhead move through the Columbia River between November and May; summer steelhead move through the Columbia River primarily between April and October, although some may be present at other times. Therefore, steelhead from the DPS are present in the mainstem Columbia River nearly year-round, making them potentially vulnerable to a variety of lower mainstem fisheries (Figure 8-15). Some information about potential impacts caused by these fisheries can be inferred by the season and gear, which determine steelhead vulnerability to the fisheries.

The primary fisheries targeting steelhead occur in the Columbia River mainstem and tributaries. These fisheries harvest primarily hatchery fish, and wild fish mortality is incidental. Unmonitored recreational fisheries currently occur in the mainstem Columbia above Bonneville Dam, Fifteenmile Creek (winter steelhead), Deschutes River above Sherars Falls, and in the John Day and Walla Walla rivers.

Unmonitored mainstem non-tribal commercial fisheries target sturgeon, summer and fall Chinook, sockeye, shad and coho. These fisheries all use gill nets of various sizes and occur

between the mouth of the Columbia River and Bonneville Dam, although particular fisheries may target specific zones (Table 8-52). All steelhead taken in commercial nets must be released, but are subjected to encounter rates and release mortalities that vary by gear and season.

Ocean fisheries generally target Chinook and coho salmon, and interception of steelhead is believed to be rare. Currently, however, all ocean commercial fisheries are unmonitored for steelhead by-catch.

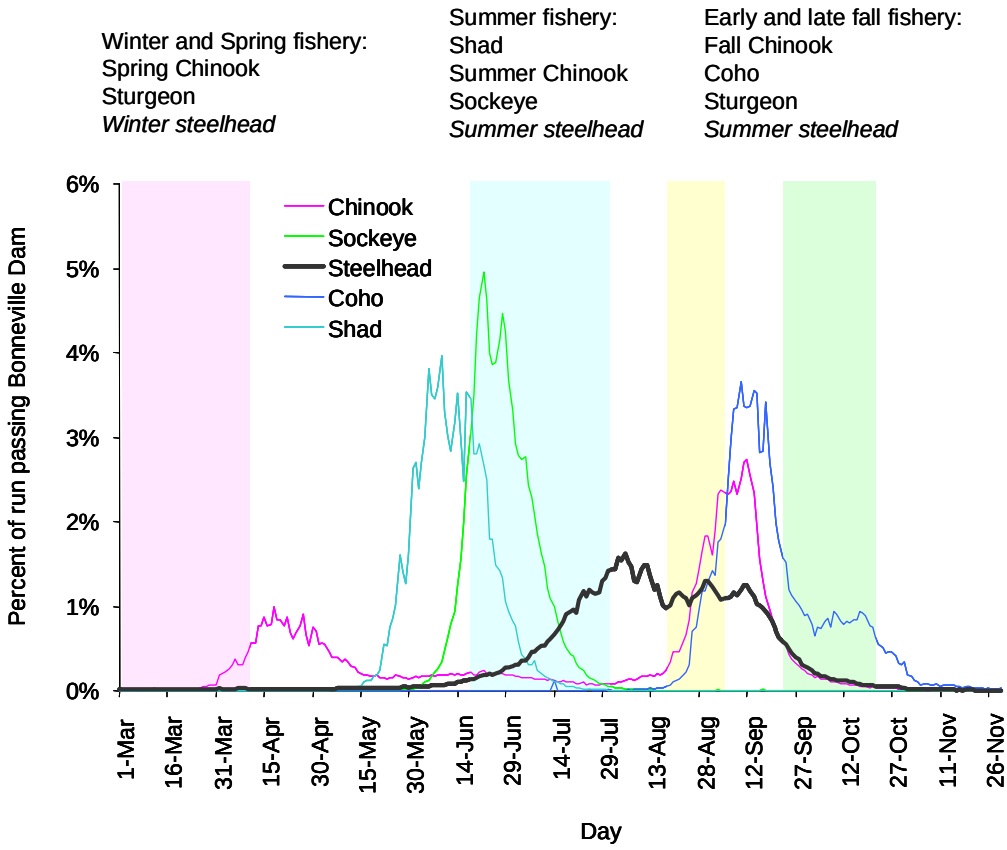


Figure 8-15. Run timing at Bonneville Dam of steelhead and other species that are targeted in mainstem commercial fisheries.

Table 8-52. Characteristics of commercial fisheries in the Columbia River below Bonneville Dam.

Fishery	Non-tribal Season	Non-tribal Gear	Tribal Season	Tribal Gear	Water temperature	Steelhead life history present
Sturgeon	Variable	9 inch min.	Variable		variable	Winter and summer
Spring Chinook	Late Feb. to early April	9 inch min. or 4 ¼ inch max.	February through April	Dip nets, set lines and gill nets with no	low	winter steelhead
Shad	May and June	5 $^{3}/_{8}$ to 6 ¼ inch 10 lb break	no specific fishery	mesh size restrictions	high	Summer steelhead
Sockeye	June and July	4 ¼ inch max.	June and July		high	Summer steelhead
Summer Chinook	June and July	8 inch min.	June and July		high	Summer steelhead
Fall Chinook	August, late Sept.	8 inch min. or 9 inch min.	August through October		high	Summer steelhead
Coho	Late Sept. and October	No min. 5 - 6 inch nets used	September and October		high	Summer steelhead

Encounter Rates and Mesh Size

Encounter rates for Mid-C steelhead increase with smaller mesh nets. Figure 8-16 shows the number of steelhead caught and released per Chinook landed, by mesh size, as observed in the spring Chinook fishery, 2003 to 2005 (test fisheries, research, and observer data combined).

Generally, few steelhead are caught in nets that are 9-inch mesh or larger because most fish are able to swim through them, although steelhead catch has been observed to be as high as one steelhead per four Chinook landed, and the steelhead that are caught are the large fish. Some fisheries use 8-inch minimum mesh size, which has a slightly higher encounter of steelhead, and is also selective for large fish. Mid-size mesh nets (5 to 6 inches) gill or body-wedge steelhead, and have high encounter rates and a high mortality rates. Small mesh "tangle" nets (4¼-inch) tangle most steelhead, causing high encounter rates but lower mortality rates compared to nets that gill fish. Some fisheries that are designed to catch small species (like shad) use nets with low break poundage that allow larger salmonids to break loose from the nets.

Release Mortality Rates, Mesh Size and Environmental Conditions

Release mortality rates in mainstem commercial fisheries vary by mesh size. The highest mortality rates occur when fish are gilled or body-wedged by the nets. In spring fisheries, when the river is relatively cool, release mortalities from nets that gill fish are 40% or higher. Steelhead are gilled or wedged in nets that are 5.5 inches are larger, until the mesh is large enough for the fish to swim through them. Nets that tangle fish, (4¼-inch for steelhead) have mortalities near 20% during the cool spring fisheries. Some fishing practices, particularly long soak times, increase mortality rates. Mortality rates increase dramatically during warm water conditions that occur in the summer and fall.

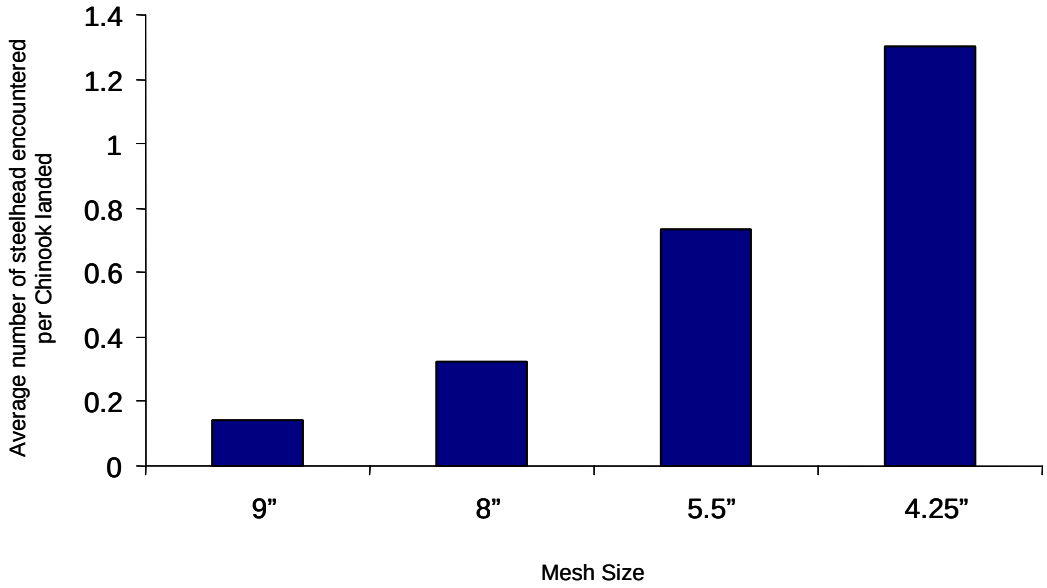


Figure 8-16. Number of steelhead released per number of Chinook landed by mesh size, as observed during monitoring and test fishing in 2003 – 2005 spring Chinook fisheries.

8.5.4 Tributary Fishery Impacts

Fishery Management and Evaluation Plans (FMEPs) have been developed for Oregon Mid-C steelhead populations to address the take of listed fish in recreational fisheries. The primary goal of a FMEP is to devise biologically based fishery management strategies that are consistent with the conservation and recovery of listed populations. FMEPs focus primarily on limiting impacts to abundance and productivity, the two key viability parameters most directly affected by sport fisheries.

Overview

Harvest regulations for Fifteenmile Creek and the Deschutes, John Day, Umatilla rivers and the Oregon portion of the Walla Walla River all reflect strategies that provide protection for natural-origin fish while allowing maximum levels of harvest on hatchery fish. We did not identify tributary harvest as a threat to viability of any of the Mid-C populations. In the review of past and present tributary fisheries, the Mid-C Expert Panel (2006) found that while legacy harvest practices had affected population traits of Mid-C steelhead the impacts of contemporary harvest management on populations in the DPS were much less significant than threats from current land use practices, hatchery programs, and hydropower projects.

Steelhead Sport Harvest Management

In part, ODFW bases steelhead sport fishery harvest rates on the results of model runs that examine the extinction probability risks at different fisheries mortality rates. Chilcote (2001) estimated extinction probabilities for 27 Oregon steelhead populations with respect to a variety of fishery mortality rates. These model runs were then used to assess the impact of fisheries mortality on the status and recovery of steelhead in Oregon (Chilcote 2001). The model looked

at a range of fisheries mortalities from 0% to 75%. The results were stated in terms of the probability of population extinction in 50 years at each mortality rate. For most populations, the modeling suggested that the probability of extinction was essentially zero as long as fisheries mortality rates remained less than 30%. However there was significant variation between populations. The probability of extinction increased dramatically as mortality rates became greater than 40%. Furthermore, once the probability of extinction increased beyond 0.05, the transition to an extinction probability of 1.00 was very rapid. In other words, once mortality rates increase sufficiently to cause the probability of extinction to exceed 0.05, any additional mortality would cause a rapid increase in the likelihood of extinction. Because the transition from low to high risk happens rapidly, there is little room for error (in the model or the measurements of mortality rates). To address this concern, ODFW generally manages steelhead fisheries not to exceed a maximum fisheries mortality rate of to 20%, but it is more conservative when warranted.

Trout Harvest Management

Fisheries managers reduce juvenile steelhead mortality during trout fisheries by requiring catch and release fisheries and by prohibiting the use of natural and synthetic baits. They also restrict fisheries to areas, times and size limits that protect steelhead. Such steps are necessary because steelhead occupy many waters that are also occupied by resident trout species, and it is not possible to visually separate juvenile steelhead from similarly sized stream-resident rainbow trout.

Juvenile steelhead and resident rainbow trout are the same species, are similar in size, and have the same food habits and habitat preferences; so, assumably, catch-and-release mortality studies on stream-resident trout would also apply to juvenile steelhead. Many studies have shown trout mortality to be higher when using bait than when angling with artificial lures and flies (Mongillo 1984; Taylor and White 1992; Schisler and Bergersen 1996; Schill and Scarpella 1997; Wydoski 1997). As a result, the prohibition of natural and artificial bait is believed to reduce juvenile steelhead mortality more than any other angling regulatory change. Hook-and-release mortality of juvenile steelhead is expected to be less than 10% and approaches 0% when anglers are restricted to use of artificial flies and lures with barbless hooks.

Studies show that catch and release mortalities tend to increase for juvenile steelhead as water temperatures increase, with over 80% of the observed mortalities in one study occurring above 21° C (Taylor and Barnhart 1997). Consequently, fisheries are restricted in some areas during times of the year when stream temperatures are high.

Fifteenmile Creek

Under current fisheries regulations, adult steelhead cannot be legally retained in any of the minor Columbia River tributaries (Fifteenmile, Mill or Chenoweth creeks). Steelhead are rare in Mosier, Rock and Threemile creeks; though they have been observed in each of the streams. Conservative trout angling regulations are currently in effect on Rock, Mosier, Chenoweth, Mill, Threemile and Fifteenmile creeks and provide a high level of protection for steelhead juveniles.

Chenoweth, Mill, Rock, Mosier, Threemile and Fifteenmile creeks open to trout angling the fourth Saturday in May and remain open through October. It is believed that most steelhead

smolts emigrate for their natal streams before the opening date. Further, Chenoweth, Mill, and Fifteenmile Creeks are restricted to catch and release angling with artificial lures only.

Rock, Mosier and Threemile creeks have very limited areas that are accessible to steelhead. Rock Creek has a porous alluvial fan at its mouth and fish passage across this fan is possible only at high winter and spring flows, and natural barriers that are not passable to steelhead are present a short distance upstream. Anadromous fish are blocked from accessing all but the lower 400 meters of Mosier Creek by an impassable falls. Steelhead access in Threemile Creek is severely restricted by improperly functioning culverts under Interstate 84, and culverts under Highway 197 block access approximately 300 meters above that point. Trout fishing in these streams does not open until the fourth Saturday in May, but is not restricted to catch and release or artificial lures. Five trout can be harvested per day with an 8-inch minimum length limit. Managers are not aware of any trout angling effort in the portions of these streams that are accessible to steelhead.

In Fifteenmile Creek, juvenile steelhead receive significant protection from angling mortality. As noted above, anglers are restricted to artificial flies and lures for all angling. The incidental mortality associated with these fisheries is due to impacts from the catch and release of juvenile steelhead. ODFW has estimated that the mortality rate from the trout fisheries is less than 1% of the juvenile steelhead in Fifteenmile Creek, based on the low effort observed, and the low catch and release mortality. ODFW (2005) has submitted to NMFS a FMEP for fisheries affecting Mid-C steelhead in Fifteenmile Creek and the other mainstem Columbia River tributaries downstream of the Deschutes River (as part of the Deschutes River Basin FMEP), for review and concurrence under Limit 5 of the 4(d) rule for Mid-C steelhead (71 FR 834).

Deschutes River

The Deschutes River FMEP (ODFW 2005c) submitted to NMFS, specifies that the management objective is to provide consumptive recreational fisheries on adult hatchery summer steelhead, non-listed salmon, and resident redband trout in the Deschutes River while allowing for the recovery of ESA listed steelhead. Only adipose fin-clipped adult steelhead may be retained in the fisheries. The source of mortality in these selective fisheries is from the hook-and-release of listed fish.

Steelhead Sport Harvest Management

Specific exploitation rate goals for hatchery summer steelhead in the Deschutes River have not been identified, but fisheries managers recognize that maximizing removal of hatchery origin summer steelhead through angling is important to maintain the genetic health of the wild population. Removing hatchery steelhead utilizing harvest reduces the number of hatchery fish available to spawn in the wild. Continuing sport angler removal of hatchery steelhead from the Deschutes River is an important tool to meet management objectives.

The importance of sport angler removal of hatchery steelhead in the Deschutes River is underscored by extinction probabilities estimated by Chilcote (2001). The current long-term average percentage of hatchery steelhead in the Westside population is estimated to be 18% and 34.4 % for the Eastside population. Chilcote (2001) concluded that hatchery-origin fish spawning naturally in the Deschutes River subbasin posed significant risk to persistence of

natural populations. Reduction in the proportion of natural spawners that are hatchery origin would significantly reduce the risk of extinction. It is crucial that subbasin fish managers continue to use sport anglers as a tool to maintain and even increase removal of hatchery fish from the spawning population.

The best available information suggests that the fishing mortality rate for summer steelhead in the Deschutes River is expected to be 1% (section 1.4.1 of the FMEP; ODFW 2005c). This estimate was derived using a 10% encounter rate and a 10% catch-and-release mortality rate (Hooton 1987). Also, as discussed earlier, catch and release mortalities tend to increase as water temperatures increase, with over 80% of the observed mortalities in one study occurring above 21° C (Taylor and Barnhart 1997); and water temperatures in the Deschutes can approach 21° C during parts of the summer. As a result, a 10% hooking mortality was used to estimate fishing impacts on natural summer steelhead. The average recreational catch rate of Round Butte Hatchery origin steelhead from the mouth to RM 43 has been estimated to be 9.3% for the last 5 years. Assuming that natural steelhead are also caught at this rate and that they suffer a 10% hook-and-release mortality, fishery impacts of less than 1% are expected for natural-origin steelhead.

The steelhead fishery will continue as proposed as long as the average natural spawning summer steelhead escapement is above 1,479 at Sherars Falls. The trend in natural steelhead escapement will be monitored annually. If there is a downward trend or if escapement is expected to fall below 1,479 in the foreseeable future, fishery restrictions will be imposed.

The current harvest rate on steelhead is believed to be well below that seen in the past. Cramer et al. (1997) reviewed harvest rates of adult steelhead in sport fisheries in Oregon and Washington before wild (unmarked) steelhead release regulations and concluded that harvest rates on natural summer steelhead were in the neighborhood of 50%. While past harvest impacts to adult steelhead in the Deschutes River before the start of mandatory unmarked fish release regulations in 1979 are unknown, harvest rates in the Deschutes River could have been of this magnitude during some years. It is estimated that the annual harvest impacts for fisheries covered in this FMEP will remain at less than 1.5%, which is well below the 50% observed in the past.

ODFW sport harvest regulations for the Deschutes are also designed to protect holding and spawning steelhead. ODFW believes that the vast majority of mainstem steelhead spawning occurs in that portion of the Deschutes River bordering the Warm Springs Reservation (RM 71 to 100). This river reach is closed to all angling from January 1 to the fourth Saturday in April each year. This closure minimizes disturbance to holding and spawning steelhead and outmigrating smolts.

Steelhead Tribal Harvest

The Warm Springs Tribal steelhead fisheries typically occur from September through December. The majority of fish are harvested at Sherars Falls and creel surveys are conducted to estimate harvest. Typically steelhead are not the target species but are caught incidentally during the Fall Chinook salmon fishery. Tribal members fish from scaffolds and with hook and line. Scaffold fishing is the more common method. Targeted hook and line steelhead fisheries occur on the Reservation lands but are minimal in scope and impact. In response to the listing of Mid-C

steelhead, the Warm Springs Tribal Council has annually approved Tribal Resolutions requiring the release of wild steelhead. Compliance with the resolution is generally good; however a few wild fish are retained. Table 8-53 shows harvest of wild and hatchery fish from 1980-2005. Prior to 1999 natural-origin fish were retained; after 1999 the majority of the natural-origin fish were released back into the Deschutes River. Since 1992, the estimated harvest of natural-origin fish has been well below previous years and has generally been low.

Table 8-53. Deschutes River expanded summer steelhead tribal harvest estimates for Sherars Falls, by run year (June 16 – October 31). Harvest estimates are for the dip net and hook and line fisheries combined (ODFW/CTWSRO Creel Data).

Year	Anglers/ Fishers	Hours	Tribal*	
			Wild	Hatchery
1980	944	7,357	981	1,309
1981	605	5,025	688	772
1982	516	4,628	549	1,066
1983	954	5,131	903	3,286
1984	576	5,553	1,600	2,730
1985	710	6,126	1,463	2,728
1986	523	5,848	1,225	3,729
1987	724	4,736	972	1,800
1988	744	5,978	339	939
1989	973	6,347	529	1,294
1990	602	4,232	301	1,300
1991	175	930	75	565
1992	36	332	10	65
1993	64	246	15	79
1994	82	400	12	130
1995	114	417	1	85
1996	80	355	1	155
1997	238	1,001	27	428
1998	304	1,123	135	760
1999*	275	1,451	0	419
2000	303	1,225	42	616
2001	261	1,106	65	700
2002	345	1,984	17	585
2003	411	1,809	22	287
2004	478	1,919	69	546
2005	671	3,031	23	505

Every year, the Tribal Council sanctions a sport fishery that occurs in select areas on and bordering the Warm Springs Reservation. These fisheries are for non-tribal anglers and require the purchase and possession of a permit. The regulations that are adopted by the Tribal Council are very similar to the ODFW regulations, where the fishing areas overlap. In 1999 the fishing area in the Warm Springs River near the Kah-Nee-Tah Resort was closed to reduce the impact of hook and line angling on steelhead. Also, the area along the Deschutes River from Dry Creek to Trout Creek is closed from November 1st until the third Saturday in April. Camping, fishing, or landing on all islands west of the middle of the main channel (Reservation Islands) is prohibited, and critical spawning areas for steelhead and fall Chinook are posted and the regulations require that no fishing is to occur within 100 feet of the signs. These regulations greatly reduce the amount of fishing pressure and harassment on the west bank of Deschutes River along the Reservation boundary during the steelhead run. Given the low exploitation and restrictive current regulations, no additional Tribal management regulations are proposed.

Salmon Harvest Management

Spring Chinook are reared at the Round Butte Hatchery and at the Warm Springs National Fish Hatchery. Spring Chinook are harvested principally from April 15 through June 15, and virtually all sport and tribal spring Chinook harvest takes place in the one-mile reach immediately downstream from Sherars Falls. This reach is characterized by very deep, high velocity areas where the river is constrained between bedrock cliffs; conditions that restrict use by significant numbers of juvenile steelhead. In addition, while natural bait is legal in the three-mile stretch of river downstream from Sherars Falls, anglers tend to use large hooks and bait when angling for Chinook salmon. Very few adult steelhead are caught in this fishery because very few steelhead are in this area at this time of year. The mortality on steelhead (adults and juveniles) caught and released in the fishery is estimated to be very low.

Fall Chinook salmon return to the Deschutes River starting in late June and early July. The sport harvest scenario for fall Chinook is very similar to that for spring Chinook, with the majority of the sport harvest taking place in the one-mile stretch immediately downstream of Sherars Falls. Greater numbers of natural summer steelhead are caught and released during this fishery, given the greater number of natural steelhead present at the time of this fishery. The increased hooking mortality to natural summer steelhead due to the use of bait is unknown, but is likely small given the spatial and temporal constraints on the fishery.

For all of the tributary fisheries described in the FMEP, the impacts are estimated to be less than 1.5% of the natural-origin summer steelhead.

Trout Harvest Management

Trout fisheries for native redband trout are ongoing in the Deschutes River. Trout angling is closed from the northern boundary of Warm Springs Reservation upstream to Pelton Regulating Dam from November 1 through the fourth Saturday in April. This closure minimizes disturbance to rearing juvenile steelhead before spring migration. Redband trout are very abundant in the lower Deschutes River, where estimated population densities of more than 2,000 trout (greater than or equal to eight inches) per mile have been observed. The total abundance of redband trout in the lower 100 miles of the Deschutes River likely exceeds 100,000 individuals,

and the magnitude of that population provides an effective buffer against juvenile steelhead mortality in the redband trout fishery.

Juvenile steelhead are protected through the current fisheries regulations. There is a two fish bag limit for redband trout, and only fish between 10 and 13 inches in length can be retained. Other trout must be released unharmed. Most natural steelhead smolts are less than eight inches in length. Effort and harvest information collected from redband trout anglers in the lower Deschutes River for many years shows that the current trout slot length limit and bait ban combine to nearly eliminate consumptive trout angling. Data from harvest samples in the lower 43 miles of the Deschutes consistently show that anglers harvest approximately 3% of their total redband trout catch. This harvest rate translates into an actual harvest of less than 1% of the redband trout population in the river each year. This very low harvest rate also protects juvenile steelhead caught incidentally by redband trout anglers. Further protection was provided in 1978 with the end of stocking of legal-sized rainbow trout, which limited impacts to natural juvenile steelhead that are harvested incidentally to the catchable trout fishery. Protection is also provided by restricting anglers to artificial flies and lures for all angling on 97 of the 100 miles open to fishing in the lower Deschutes River.

John Day River

Fishery impacts on adult and juvenile steelhead in the John Day River have been minimized under the fishing regulations established in the FMEP, with impacts from all tributary fisheries estimated to be less than 2% of the natural-origin fish. The John Day River FMEP (ODFW 2005a) submitted to NMFS, specifies that the management objective for the plan is to conduct consumptive fisheries for marked adult hatchery steelhead, resident rainbow trout, and warmwater species. Fisheries for spring Chinook salmon have not been open in the John Day River subbasin since 1976.

While specific exploitation rate goals for hatchery summer steelhead in the John Day River have not been identified, managers stress that maximizing removal of hatchery origin summer steelhead through angling is important to maintain the genetic health of natural populations. Removing hatchery steelhead utilizing harvest reduces the number of hatchery fish available to spawn in nature. Continuing sport angler removal of hatchery steelhead from the John Day River is an important tool to meet management objectives. To help increase harvest of hatchery steelhead from the John Day River, managers have adopted a 3 fish per day, no annual limit regulation for adipose fin-clipped steelhead.

Steelhead Sport Harvest Management

Adult steelhead fishery impacts are minimized by season and areas closures. Listed below are the areas and times that are open to adult steelhead fisheries.

- Mouth of the John Day to Cottonwood Bridge RM 38: Year round.
- RM 38 Cottonwood Bridge to RM 185 at Kimberly: Year round.
- RM 185 at Kimberly to RM 257, the mouth of Indian Creek: Sept.1 to April 15.
- Mouth of the North Fork to RM 60 at Hwy 395 Bridge: Sept.1 to April 15.
- Mouth of the Middle Fork to RM 24.2 at Hwy 395 Bridge: Sept.1 to April 15.
- South Fork: Closed to adult steelhead angling.

- All other tributaries and portions of the Middle Fork, North Fork and Mainstem not listed: Closed to adult steelhead angling.

In addition, ODFW has implemented restrictive regulations permitting only the retention of marked adult hatchery steelhead and requiring the release of natural-origin adult steelhead in the John Day subbasin. Punchcard estimates during years when retention of wild steelhead was permitted indicate that wild fish harvest rates in the John Day River subbasin averaged approximately 12% of the annual return (ODFW 2005a). This estimate includes years when bag limits allowed retention of 2 fish per day and up to 20 fish per year, and also includes a significant component of hatchery fish in some years. For 1996 (the only year in which statistical creel data are available), the proportion of hatchery fish in the harvest below Cottonwood Bridge (where most fish are caught) was approximately 48% (ODFW 2005a); so the estimated 12% harvest rate on natural-origin fish is likely higher than actual. Based on these data, ODFW estimates the potential encounter rate of natural-origin steelhead in the John Day River fishery to be in the range of 6 to 12% of wild steelhead present in the subbasin. A fishery requiring release of wild fish has been in effect since 1995, so in-subbasin fishery related mortality rates (likely less than 1% [12% encounter rate x 5% hooking mortality rate = 0.6%]) and angler effort have dropped substantially since the hatchery only harvest regulation was implemented.

The 5% catch and release mortality rate is conservative for steelhead based on the mortality estimate for steelhead of 3.4% developed by Hooton (1987). Studies show that catch and release mortalities tend to increase as water temperatures increase, with more than 80% of the observed mortalities in one study occurring above 21° C (Taylor and Barnhart 1997). While the adult steelhead fisheries in the John Day River do not begin until September when the water temperatures are slightly elevated, steelhead returns and fishing effort do not increase until mid-October when flows increase and water temperatures drop below 21° C.

ODFW estimates that the annual harvest impacts on natural-origin fish under the FMEP will remain at less than 1.5% annually. Harvest impacts on adult steelhead in the John Day River before the start of mandatory unmarked fish release regulations in 1996 are unknown, but were clearly greater than the current level

Trout Harvest Management

While the John Day River is not highly regarded by most anglers for its trout angling opportunities, redband trout occur throughout the subbasin and westslope cutthroat trout occur in the upper John Day River system and a few North Fork tributaries. Presently, angling effort for trout is targeted to standing water bodies where ODFW routinely stocks hatchery fingerling or legal sized rainbow trout. Past harvest impacts on juvenile steelhead during trout fisheries in the John Day River are unknown.

Historically, most trout angling effort in streams was associated with areas where legal or fingerling rainbow were released. An evaluation of ODFW's fingerling rainbow stocking program in the South and Middle forks was completed in 1995. The evaluation concluded that the stocked fingerling were not being caught by the few anglers interviewed, and that there were

adequate numbers of wild, legal-sized rainbow trout in both streams to support the modest fishery.

Since 1998, there have been no releases of hatchery rainbow trout into any streams within the subbasin. The trout-angling season for streams does not open until the fourth Saturday in May and the minimum legal size is 8 inches. Monitoring of smolt migration at irrigation diversion bypass traps and out-migrant traps (screw traps located on the South Fork John Day River, Middle Fork John Day River and mainstem John Day River) indicates that most steelhead smolts emigrate before the second week in May. Juvenile *O. mykiss* length frequency data from selected steelhead spawning and rearing streams indicate that 98% of them are less than six inches long. The combination of a late opener and the eight-inch minimum size limit provides significant protection for juvenile steelhead and smolts. In addition, the following streams are closed to all angling: the Granite Creek system (North Fork John Day tributary), and the Middle Fork John Day River from Highway 7 to Summit Creek.

It is difficult to quantify the impacts to juvenile steelhead from sportfishing because of the lack of information specific to the John Day River. However, given the current regulations that are in place to protect juvenile steelhead, the dispersed nature of the fishery and cessation of trout stocking after 1997, it is estimated that <1% of rearing juvenile steelhead in the John Day River subbasin are caught and released in the trout fishery.

Warmwater Fisheries Harvest Management

Warmwater fisheries in the subbasin are believed to have little, if any impact on the steelhead population because they occur primarily at a time and location where juvenile and adult steelhead are not present. These fisheries are open only during trout, salmon, or steelhead seasons, and the angling is largely dependent upon water temperatures and water clarity. Significant angler effort does not begin until mid- to late-May in most years. The bulk of the warmwater fishery takes place in the lower mainstem from RM 40 to RM 185 where steelhead do not rear. There is virtually no warmwater fishery in the John Day River above Kimberly or above Wall Creek on the North Fork John Day River because the abundance of smallmouth bass is relatively low. The probability of encountering juvenile steelhead increases as one progresses upstream due to improved rearing conditions. Additionally, most warmwater anglers use terminal angling gear that reduces the probability of catching steelhead, and if hooked, it facilitates easy release.

Umatilla River

The Umatilla River system supports steelhead sport and tribal harvests. Steelhead are also captured in fisheries targeting resident trout, warmwater fish and Chinook salmon.

Steelhead Sport Harvest Management

The Umatilla River steelhead sport fishery is directed at the harvest of hatchery steelhead produced by the Umatilla Hatchery and stray hatchery fish. Current angling regulations require the release of natural-origin (unmarked) steelhead in the Umatilla River. The general steelhead season for the Umatilla River (September 1 – April 15) and open area (mouth to west reservation boundary) seek to maximize harvest opportunity of hatchery steelhead while minimizing impacts to wild fish. The open season encompasses the period of adult migration into and through the

Umatilla River. The open area includes approximately 56 miles of the mainstem Umatilla River and does not include spawning areas of natural-origin summer steelhead. The bag limit of 3 hatchery steelhead per day with no annual limits seeks to balance maximization of harvest and equally distribute the harvest among the angling constituents. When necessary, the Oregon Commission can adopt and implement emergency regulations that further restrict fisheries for conservation purposes.

The abundance threshold for triggering harvest management regulation changes is the 6-year average natural-origin adult steelhead escapement of at least 650 unmarked steelhead; approximately two times the critical fishery conservation threshold recommended by Chilcote (2001).

The draft FMEP for the Umatilla (ODFW 2005b) focuses primarily on the potential impacts of harvest on abundance and productivity, the two key viability parameters most directly affected by harvest. Although fisheries with high harvest rates and fisheries that are selective on phenotypic traits can influence spatial structure and diversity, the tributary fisheries in the Umatilla River are not selective and have little or no influence on spatial structure and diversity.

Chilcote (2001) estimated extinction probabilities with respect to a variety of fishery mortality rates and demonstrated that for the Umatilla population there is substantial increase in risk of extinction for harvest greater than 10% (Table 8-54). Within the Umatilla, it is estimated that fisheries will result in a mortality rate of approximately 1.5% on the natural-origin fish. This estimate is based on an assumed post-catch and release mortality rate of 5% and a maximum fishery interception rate of 30% for the natural-origin fish. The interception rate for wild fish in the most recent years has been less than 25% and averaged 17%. The net mortality impact on natural-origin fish is between 1-2%. This is considerably less than the within subbasin maximum mortality objective of 5% (ODFW 2005b) natural-origin fish.

Table 8-54. Results of Population Viability Analysis (PVA) simulations of estimated probability of extinction in 50 years for Umatilla steelhead under 16 different adult mortality rates.

	Percent Adult Mortality Rate															
Population	**0**	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**
Umatilla	.01	.08	.21	.57	.85	.98	1.0	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**

CTUIR Tribal Steelhead Harvest

Tribal fisheries are conducted within the Umatilla subbasin and both natural- and hatchery-origin fish are allowed to be harvested. CTUIR estimated that 50-100 fish are harvested annually, of which about 33% are natural-origin fish (Gary James, personal communication, 2006). Tribal harvest is not considered a significant threat.

Trout Harvest Management

Significant protection for juvenile steelhead is provided under current trout fisheries regulations. Redband trout fisheries in the Umatilla subbasin have been adapted to protect wild *O. mykiss* in natural production areas. The upper Umatilla and tributaries upstream from the eastern boundary of the Umatilla Indian Reservation have been catch and release only, and flies and lures only for

redband trout since 1995. Streams within the boundaries of the Umatilla Indian Reservation are under jurisdiction of the CTUIR. Other steelhead production streams, including Meacham Creek and Birch Creek, have a bag limit of five trout per day with an eight-inch minimum length. Both of these streams have limited public access. The lower 20+ miles of Meacham Creek are only accessible via the Union Pacific Railroad right-of-way that is managed to exclude public entry. Upper parts of the Meacham drainage are lands under private ownership. The lands adjacent to Birch Creek are all private with limited public access available. Mortality due to harvest on these streams, while not quantified, is estimated to be low.

The redband trout fishery is open from the fourth Saturday in May to October 31, with an eight-inch minimum length to minimize angling impacts on adult steelhead spawners and outmigrating smolts. Thus, the fishery through the summer and fall likely focuses on resident trout (eight-inch minimum length) rather than younger fish, which could be either resident or anadromous juveniles.

All stocking of hatchery rainbow trout was ceased in 1999 in streams within the Umatilla subbasin to protect wild stocks of *O. mykiss*. Legal-sized rainbow trout have been historically stocked in many streams throughout the Umatilla subbasin. However, stocking over the past decade has only occurred in the Umatilla River (downstream of steelhead production areas) and lower McKay Creek. From 1990 through 1993, approximately 8,000 legal sized Cape Cod stock rainbow trout were stocked in the forks area of the upper Umatilla River. In 1994, stocking of legal sized rainbow trout was moved downstream to the Pendleton area to reduce interaction with wild O. *mykiss* in the upper Umatilla River.

Fishing effort is currently much lower than in previous years because of the elimination of hatchery catchable trout stocking in the Umatilla River and the conservative, selective fishing regulations currently in place. It is difficult to quantify the impacts to juvenile steelhead from sportfishing because of the lack of information specific to the Umatilla River. However, given the current regulations that are in place for juvenile steelhead, the dispersed nature of the fishery and cessation of trout stocking, it is estimated that <1% of rearing juvenile steelhead in the Umatilla River subbasin are caught and released in the trout fishery.

Warmwater Fishery Harvest Management

The warmwater game fish fishery is focused in the lower Umatilla River downstream from Echo; isolating the fishery from areas where anglers would likely encounter significant numbers of steelhead parr. Smolts and adults are the only life history forms that would be expected in the lower Umatilla River. Adult wild steelhead are required to be released unharmed. The warmwater gamefish fishery is closed from April 16 through the third Saturday in May, the peak of the steelhead smolt out-migration. During creel census of the fall and spring salmon fisheries and the steelhead fishery, personnel also census warmwater anglers to gather baseline data on this fishery. Data from 1998 through 2000 show that warmwater anglers catch very few smolts. The potential impact is not of concern.

Spring Chinook Harvest Management

Mortality on steelhead (adults and smolts) caught and released by spring Chinook salmon anglers is low and does not warrant further restrictions. The Umatilla River spring Chinook fishery

occurs in two sections of the Umatilla River: section 1 from Hwy 730 Bridge upstream to Threemile Dam during April 16 – May 21 and section 2 from Threemile Dam upstream to the western boundary of the Umatilla Indian Reservation (RM 55) from April 16 through June 30. The fishery begins after most steelhead adults have migrated above the fishery area to spawning areas. Although this fishery occurs through the peak of the steelhead smolt out-migration, the fishing tackle is not conducive to catching of smolts (large hook sizes and large lures).

Walla Walla River

Steelhead in the Walla Walla River system are captured in the tributary steelhead fishery and in resident trout fisheries.

Steelhead Harvest Management

The Walla Walla River steelhead fishery is directed at catch and release of natural-origin fish and harvest of stray hatchery steelhead. The season occurs from December 1 through April 15 and the area open to angling is from the Oregon-Washington state line upstream to the confluence of the North and South forks. The entire upper subbasin has been set aside as an adult steelhead sanctuary area and will remain closed to steelhead angling. The daily bag limit (three fish/day) is restricted to adipose fin-clipped steelhead only. Natural-origin steelhead are required to be released unharmed. Harvest of natural-origin steelhead or further restrictions on this fishery are not anticipated in the foreseeable future.

This fishery is managed based on the six-year rolling average of returns to Nursery Bridge Dam. As long as the rolling average natural-origin spawner escapement is above the critical fishery conservation threshold of 220 adults, the current fishery regime will be maintained (draft FMEP, revised September 2005). However, the abundance of natural-origin steelhead is monitored and evaluated annually. If there is a downward trend of wild adult steelhead below the objective of 220, the fishery will be modified to reduce impacts. Possible adjustments could be gear restrictions, restriction of the open area and/or season length.

There is also a process to make in-year adjustments to fisheries when returns approach the critical fishery conservation threshold. To make reasonable predictions for steelhead returns to the Walla Walla River, ODFW has developed a regression of Bonneville wild Group A summer steelhead counts and wild steelhead counts at Nursery Bridge Dam (Figure 8-17). This regression is used to develop a steelhead return estimate for the Walla Walla Annual Operation Plan to provide managers with a forecast model. As discussed above, the fishery will be managed based on a rolling six-year average. However, the Bonneville predictive tool will also be used to adjust fishery management within-year if escapements are expected to approach and/or go below the critical fishery conservation threshold.

As seen in Figure 8-17, the data show two time series trends that are quite distinct; the years 1993 through 1995 plot higher and result in a steeper trend line than do data from 1996 to 2000. While the apparent shift in population productivity in relation to the total wild Group A summer steelhead run is not fully understood, it is distinct enough for use in developing run predictions. The data and trend line from 1996 to 2000 are used to develop in-year run forecasts based on wild Group A returns to Bonneville. This conservative run estimate seems a prudent approach since this is the most current trend.

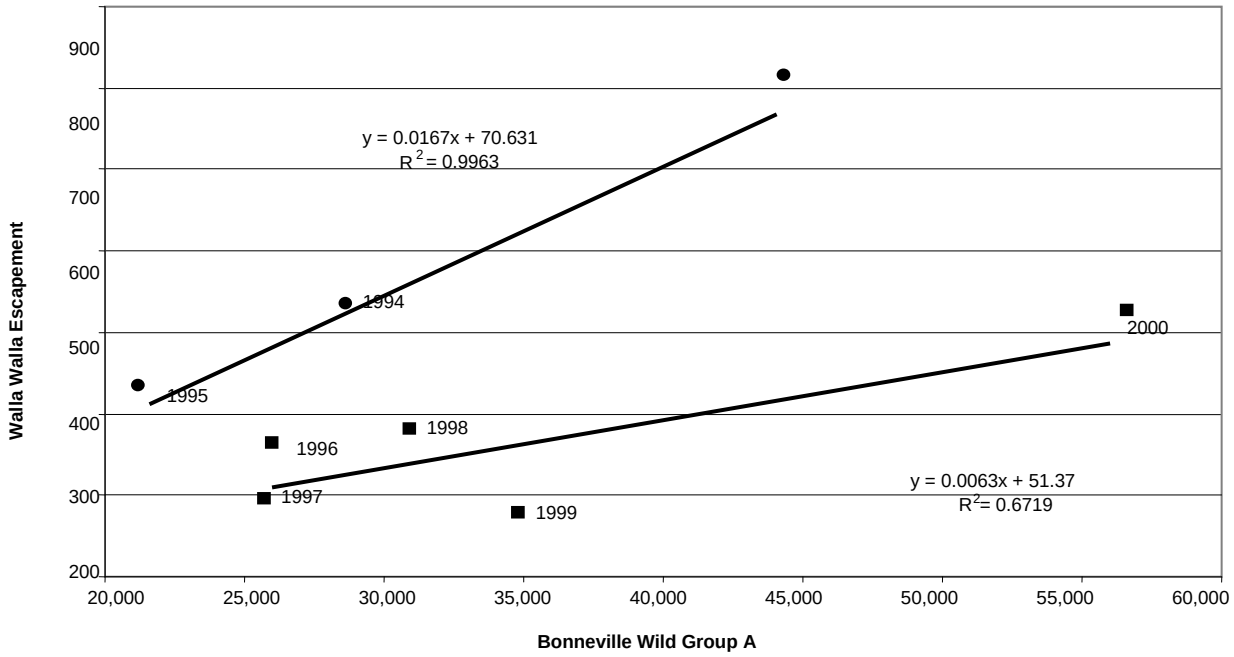


Figure 8-17. Relationship of Bonneville Dam wild Group A steelhead counts to estimated escapement above Nursery Bridge Dam, Oregon for run years 1993-1994 through 1996-2000.

Based upon Population Viability Analysis simulations of estimated extinction probability for 27 steelhead populations in Oregon, Chilcote (2001) recommended a maximum fishery mortality rate for most wild steelhead populations of 20%. The fisheries that currently occur do not exceed this exploitation rate.

Within the Walla Walla, it is estimated the current and proposed future fisheries will result in a mortality rate of approximately 1.5% on the natural-origin fish. This estimate is based on an assumed post-catch and release mortality rate of 5% (from Hooton 1987) and a maximum fishery interception rate for natural-origin fish of 30%.

Creel surveys conducted by the WDFW from 1997 to 2000 indicate that approximately 27% of the steelhead caught during the Washington Walla Walla subbasin recreational steelhead fisheries are natural origin. Because there are currently no estimates of total wild steelhead escapement to the entire Walla Walla subbasin, these creel data cannot be used to determine the catch rate of natural-origin fish in the Walla Walla population. However it does indicate that significant numbers of wild fish are caught. The WDFW (2001) estimates that an average of 438 natural-origin adults are caught and released in their steelhead fishery, resulting in an estimated mortality of 22 natural-origin adults. Natural-origin adults from both the Touchet and Walla Walla populations are caught and released in the fishery. This level of mortality results in 1-2% annual impact given the recent 10-year geomean abundance of 1,000 adults in the Walla Walla population.

Trout Harvest Management

To minimize angling impacts on adult steelhead spawners and outmigrating smolts, redband trout angling in the Walla Walla subbasin where anadromous fish are present is open from the fourth Saturday in May through October 31, with an eight-inch minimum length. The fishery through the summer and fall is focused on resident trout (eight-inch minimum length) rather than younger fish, which could be either resident or anadromous juveniles. All waterways in the subbasin are open to fishing for redband trout during the appropriate season. There are no closed areas.

Significant protection for juvenile steelhead and bull trout is also being provided under the current fisheries regulations. Fisheries for redband trout in the Walla Walla subbasin have been adapted to protect wild *O. mykiss* in natural production areas. Anglers have been restricted to the use of flies and lures in the South Fork since 1996 and in Walla Walla River and tributaries since 1999. The daily bag limit is five fish over eight inches in length.

Legal-sized hatchery rainbow trout have been historically stocked in many streams throughout the Walla Walla subbasin in Oregon. In 1994, all stocking of hatchery rainbow trout was discontinued in streams within the Oregon portion of the Walla Walla subbasin to protect wild stocks of *O. mykiss* and bull trout.

Fishing effort is currently much lower than in previous years because of the elimination of hatchery catchable trout stocking in the Walla Walla River and the conservative, selective fishing regulations currently in place. It is difficult to quantify the impacts to juvenile steelhead from sportfishing because of the lack of information specific to the Walla Walla River. However, given the current regulations that are in place for juvenile steelhead, the dispersed nature of the fishery and cessation of trout stocking, it is estimated that <1% or rearing juvenile steelhead in the Walla Walla River subbasin are caught and released in the trout fishery.

8.6 Hatchery Practices and Releases

This section describes potential hatchery-related limiting factors for Mid-C steelhead populations in the Fifteenmile, Deschutes, John Day, Umatilla and Walla Walla rivers systems.

8.6.1 Overview

Two hatchery programs are operated within the Mid-C DPS in Oregon, the Round Butte Hatchery program in the Deschutes River and the Umatilla Hatchery program in the Umatilla River. In addition WDFW releases hatchery smolts into the Walla Walla population as part of the Lower Snake River Compensation Plan program. The Mid-C Expert Panel expressed particular concern regarding the continuing detrimental impact of stray out-of-DPS hatchery fish in natural spawning areas on the genetic traits and productivity of naturally produced Mid-C steelhead. They also concluded that the spawning of hatchery produced adult steelhead from programs in the Umatilla and Walla Walla subbasins with naturally produced fish in these and other drainages adversely affects the population traits (productivity, genetic traits, and adult abundance) of the steelhead populations. Round Butte Hatchery in the Deschutes subbasin also

produces steelhead; however, the risks from this hatchery program to naturally spawning populations are considerably less than those from the other programs.

8.6.2 Fifteenmile Creek Steelhead

ODFW stocked rainbow trout in Fifteenmile Creek at the Taylorville Bridge until 1974 and at the downtown Dufur Bridge until 1991; and in Mosier Creek from 1952-1963 and 1968-1971. Today, hatchery fish are only stocked in Hanel Lake that has been stocked annually since 1994 with approximately 500 catchable coastal rainbow trout from a private hatchery/trout farm near Sandy, Oregon or Oak Springs Fish Hatchery. A screen in the Wolf Run Ditch prevents the stocked fish from migrating out of the reservoir.

Interbreeding between hatchery rainbow trout and steelhead in Fifteenmile Creek is believed to have been minimal. The particular stock of rainbows used for these introductions is not believed to have survived the summer due to susceptibility to a naturally occurring disease (*Ceratomyosis*), to which native rainbow are resistant.

Currently, there are no plans to use artificial propagation to augment fisheries or enhance natural production in the Fifteenmile Creek subbasin any time in the future. Consequently, the main hatchery-related threat to the Fifteenmile steelhead population is from out-of-subbasin strays. There have been very few stray hatchery steelhead observed in Fifteenmile Creek and there are few likely sources of winter steelhead strays in the Mid-Columbia DPS. Stray hatchery fish were not identified as a risk in the viability assessment.

8.6.3. Deschutes River Steelhead

Round Butte Hatchery
Round Butte Hatchery (RBH) currently produces and releases steelhead in the Deschutes as mitigation for loss of habitat and harvest opportunities due to the construction of the Round Butte Complex of hydroelectric dams. The goal of the program is to produce 1,800 adults returning to the project. The RBH summer steelhead program is limited to known RBH stock to prevent the propagation of out-of-subbasin fish and associated disease concerns. Natural-origin fish were incorporated into the broodstock during the 1990–1998 brood years, but the practice was discontinued due to concerns about introducing or propagating diseases borne by unmarked fish of unknown origin from outside the subbasin. All RBH steelhead not used for broodstock and all out-of-subbasin hatchery fish are removed from the river at Pelton Trap and Warm Springs National Fish Hatchery (WSNFH).

The RBH program minimizes impacts to naturally produced summer steelhead by releasing juveniles as age 1+ smolts, and at sizes and times that support rapid migration from the subbasin. This limits the potential for competitive interactions. RBH steelhead are acclimated at the hatchery before release to improve homing back to the hatchery. As a result, competitive interactions with wild juvenile steelhead in overwintering or rearing habitat are believed to be low. Resident *O. mykiss* naturally exist at multiple ages and at relatively great densities in parts of the Deschutes River and co-exist with other native salmonids including natural steelhead. This acclimation and homing of the RBH steelhead has been effective; in recent years less than 1% of

the steelhead observed at the WSNFH have been of RBH origin. RBH summer steelhead are uniquely marked to allow for their harvest and removal in selective recreational fisheries and to allow for identification during broodstock collection activities.

Out-of-Subbasin Strays

The large number of out-of-subbasin hatchery steelhead straying into the Deschutes River each year presents a major risk to the population. In recent years, out-of-subbasin hatchery steelhead collected and removed at WSNFH and the Pelton Trap averaged over 30% of the returns. The Mid-C Expert Panel considered strays a primary threat to Deschutes steelhead populations.

The number of out-of-subbasin hatchery-origin steelhead observed in the Deschutes River began to increase as mitigation programs developed in other Columbia Basin watersheds (Figure 8-18 and Table 8-55). A majority of these fish were produced in the Snake River Basin under the Lower Snake River Compensation Program, with a relatively large proportion of the out-of-subbasin stray steelhead originating from the Wallowa Hatchery program (Carmichael and Hoffnagle 2006; Olson and Spateholz, no date). At WSNFH, where all steelhead known to be artificially produced are removed from the natural-origin population that is allowed to pass upstream, RBH steelhead make up a small proportion of the fish collected at the trap (Table 8-56).

Hatchery-origin steelhead have been observed spawning with unmarked steelhead in Deschutes River tributaries, and both live and dead hatchery-origin steelhead have been observed during spawning ground surveys in Bakeoven and Buck Hollow creeks (Table 8-57). However, the fish are not handled and stock composition of hatchery-origin steelhead is unknown. Stock composition of hatchery-origin fish that ascend Sherars Falls (the trapping facility nearest Bakeoven and Buck Hollow creeks) is monitored in terms of the proportion of Round Butte Hatchery steelhead relative to hatchery fish that originate from outside the subbasin, but the rate at which out-of-subbasin fish that ascend the falls remain within the Deschutes and spawn among the native populations is not well known. The trend in abundance of hatchery-origin fish within Bakeoven and Buck Hollow creeks has appeared to follow that at Sherars Falls, but at an overall lower rate. Most hatchery fish observed on the spawning grounds are out-of-subbasin strays.

Out-of-DPS hatchery strays comprised an average of 29% of the Westside population and 15.2% of the Eastside population over the past three generations. This high fraction resulted in high risk ratings for spawner composition for both populations as described in the viability assessment.

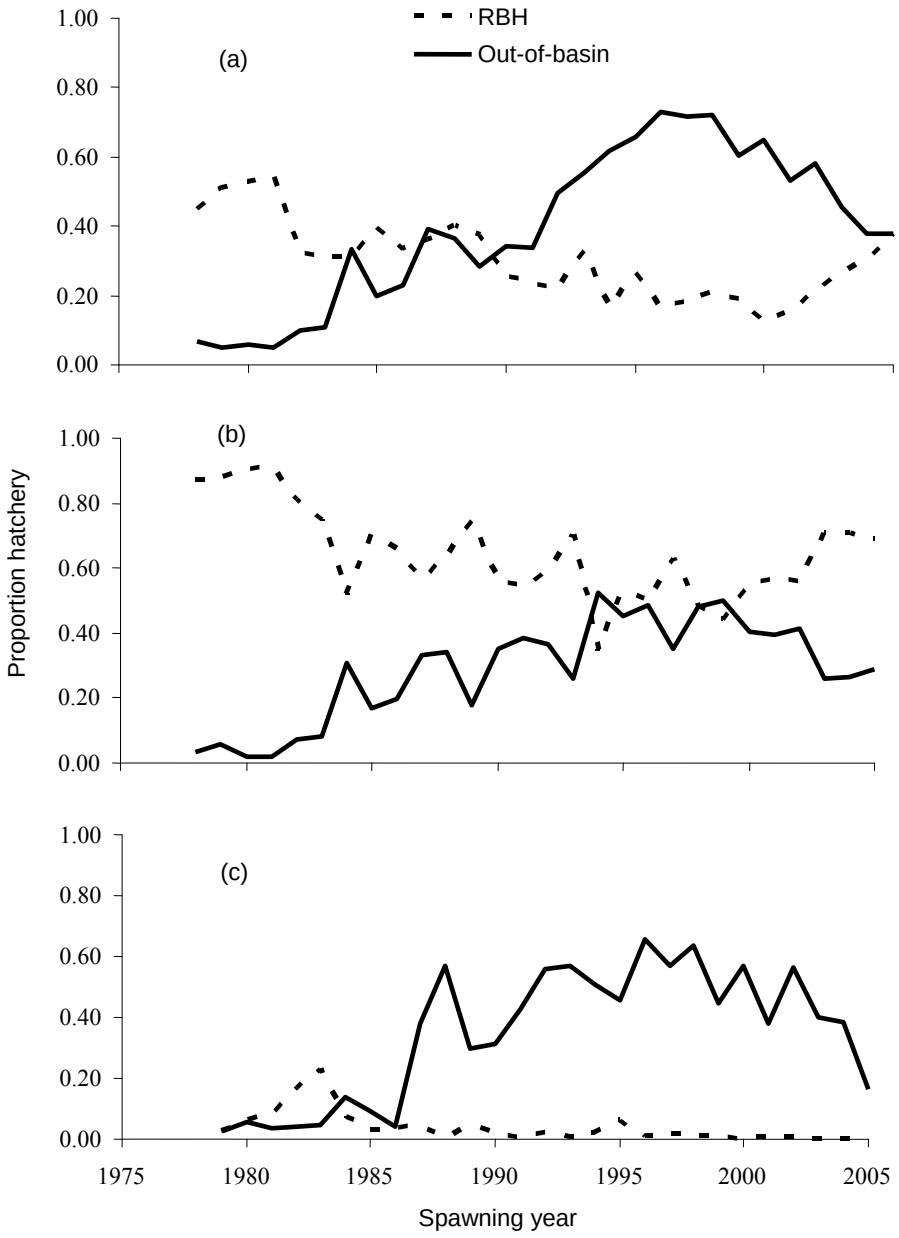


Figure 8-18. Proportion of steelhead that are Round Butte Hatchery and out-of-subbasin hatchery origin by trapping facility: (a) Sherars Falls, (b) Pelton Trap, (c) WSNFH.

Table 8-55. Number of steelhead by origin in the Deschutes River by year and trapping facility, 1977 - 2004.

		Estimated Escapement of Steelhead at Sherars Falls				*Steelhead at Pelton Trap*				*Steelhead at Warm Springs NFH*			
Return year	Brood year	Wild	Round Butte Hatchery	Out-of-subbasin hatchery	Total	Wild	Round Butte Hatchery	Out-of-subbasin hatchery	Total	Wild	Round Butte Hatchery	Out-of-subbasin hatchery	Total
1977	1978	6,556	6,121	900	13,577	233	2,120	80	2,433	336			336
1978	1979	2,759	3,184	300	6,243	136	1,732	110	1,978	290	8	8	306
1979	1980	4,204	5,400	600	10,204	223	2,612	54	2,889	311	22	20	353
1980	1981	4,100	5,500	500	10,100	169	2,195	47	2,411	397	36	15	448
1981	1982	6,900	3,800	1,200	11,900	245	1,760	156	2,161	569	122	31	722
1982	1983	6,567	3,524	1,249	11,340	344	1,547	167	2,058	255	82	16	353
1983	1984	8,228	7,250	7,684	23,162	814	2,439	1,452	4,705	431	40	75	546
1984	1985	7,721	7,563	3,824	19,108	603	3,278	795	4,676	577	22	62	661
1985	1986	9,624	7,382	5,056	22,062	686	3,153	943	4,782	373	15	16	404
1986	1987	6,207	9,064	9,803	25,074	467	2,640	1,538	4,645	822	60	545	1,427
1987	1988	5,367	9,209	8,367	22,943	46	1,484	796	2,326	522	4	695	1,221
1988	1989	3,546	3,849	2,909	10,304	123	1,247	300	1,670	385	28	177	590
1989	1990	4,278	2,758	3,659	10,695	136	829	524	1,489	339	10	157	506
1990	1991	3,653	1,990	2,852	8,495	82	606	428	1,116	165	2	123	290
1991	1992	4,826	3,778	8,409	17,013	101	1,365	849	2,315	280	14	374	668
1992	1993	904	2,539	4,261	7,704	59	1,157	427	1,643	82	1	109	192
1993	1994	1,487	1,159	4,293	6,939	74	190	288	552	135	6	146	287
1994	1995	482	1,781	4,391	6,654	27	753	642	1,422	93	12	88	193
1995	1996	1,662	2,708	11,855	16,225	32	1,000	976	2,008	87	3	171	261
1996	1997	3,458	5,932	23,618	33,008	126	3,605	2,001	5,732	239	8	327	574
1997	1998	1,820	5,042	17,703	24,565	194	2,440	2,459	5,093	218	6	388	612
1998	1999	3,800	3,527	11,110	18,437	155	1,135	1,284	2,574	97	2	79	178
1999	2000	4,790	2,628	13,785	21,203	83	1,050	768	1,901	322	0	422	744
2000	2001	8,985	4,380	15,072	28,437	114	1,593	1,103	2,810	513	3	316	832
2001	2002	8,749	9,373	25,263	43,385	282	4,942	3,674	8,898	733	12	971	1,716
2002	2003	9,363	8,880	15,203	33,446	207	4,841	1,787	6,835	877	0	582	1,459
2003	2004	5,524	5,265	6,542	17,331	104	2,605	967	3,676	286	0	178	464
2004	2005	3,161	4,942	4,949	13,052	79	2,143	903	3,125	327	1	64	392

Table 8-56. Proportions of steelhead by origin in the Deschutes River by year and trapping facility, 1977 - 2004.

		Estimated Escapement at Sherars			*Pelton Trap*			*Warm Springs NFH*		
Return year	Spawning year	Wild	RBH	Out-of-subbasin	Wild	RBH	Out-of-subbasin	Wild	RBH	Out-of-subbasin
1977	1978	0.48	0.45	0.07	0.10	0.87	0.03			
1978	1979	0.44	0.51	0.05	0.07	0.88	0.06	0.95	0.03	0.03
1979	1980	0.41	0.53	0.06	0.08	0.90	0.02	0.88	0.06	0.06
1980	1981	0.41	0.54	0.05	0.07	0.91	0.02	0.89	0.08	0.03
1981	1982	0.58	0.32	0.10	0.11	0.81	0.07	0.79	0.17	0.04
1982	1983	0.58	0.31	0.11	0.17	0.75	0.08	0.72	0.23	0.05
1983	1984	0.36	0.31	0.33	0.17	0.52	0.31	0.79	0.07	0.14
1984	1985	0.40	0.40	0.20	0.13	0.70	0.17	0.87	0.03	0.09
1985	1986	0.44	0.33	0.23	0.14	0.66	0.20	0.92	0.04	0.04
1986	1987	0.25	0.36	0.39	0.10	0.57	0.33	0.58	0.04	0.38
1987	1988	0.23	0.40	0.36	0.02	0.64	0.34	0.43	0.00	0.57
1988	1989	0.34	0.37	0.28	0.07	0.75	0.18	0.65	0.05	0.30
1989	1990	0.40	0.26	0.34	0.09	0.56	0.35	0.67	0.02	0.31
1990	1991	0.43	0.23	0.34	0.07	0.54	0.38	0.57	0.01	0.42
1991	1992	0.28	0.22	0.49	0.04	0.59	0.37	0.42	0.02	0.56
1992	1993	0.12	0.33	0.55	0.04	0.70	0.26	0.43	0.01	0.57
1993	1994	0.21	0.17	0.62	0.13	0.34	0.52	0.47	0.02	0.51
1994	1995	0.07	0.27	0.66	0.02	0.53	0.45	0.48	0.06	0.46
1995	1996	0.10	0.17	0.73	0.02	0.50	0.49	0.33	0.01	0.66
1996	1997	0.10	0.18	0.72	0.02	0.63	0.35	0.42	0.01	0.57
1997	1998	0.07	0.21	0.72	0.04	0.48	0.48	0.36	0.01	0.63
1998	1999	0.21	0.19	0.60	0.06	0.44	0.50	0.54	0.01	0.44
1999	2000	0.23	0.12	0.65	0.04	0.55	0.40	0.43	0.00	0.57
2000	2001	0.32	0.15	0.53	0.04	0.57	0.39	0.62	0.00	0.38
2001	2002	0.20	0.22	0.58	0.03	0.56	0.41	0.43	0.01	0.57
2002	2003	0.28	0.27	0.45	0.03	0.71	0.26	0.60	0.00	0.40
2003	2004	0.32	0.30	0.38	0.03	0.71	0.26	0.62	0.00	0.38
2004	2005	0.24	0.38	0.38	0.03	0.69	0.29	0.83	0.00	0.16
	Minimum	0.07	0.12	0.05	0.02	0.34	0.02	0.33	0.00	0.03
	Maximum	0.58	0.54	0.73	0.17	0.91	0.52	0.95	0.23	0.66
	Average	0.30	0.30	0.39	0.07	0.64	0.29	0.62	0.04	0.34

Table 8-57. Proportion of hatchery-origin fish by location in the lower Deschutes Subbasin (for N > 9).

		Buck Hollow			Bakeoven			Trout Creek		
Return year	Spawning year	Marked	Unmarked	Hatchery fraction	Marked	Unmarked	Hatchery fraction	Marked	Unmarked	Hatchery fraction
1989	1990	2	14	0.125	1	2	N/A	--	--	--
1990	1991	2	4	N/A	0	5	N/A	--	--	--
1991	1992	1	9	0.100	0	0	N/A	--	--	--
1992	1993	2	1	N/A	3	2	N/A	--	--	--
1993	1994	1	1	N/A	0	0	N/A	--	--	--
1994	1995	11	11	0.500	3	1	N/A	--	--	--
1995	1996	11	7	0.611	8	2	0.800	--	--	--
1996	1997	23	9	0.719	9	4	0.692	--	--	--
1997	1998	26	1	0.963	2	3	N/A			0.250
1998	1999	14	15	0.483	6	13	0.316			0.390
1999	2000	8	8	0.500	17	14	0.548			0.500
2000	2001	23	108	0.176	29	167	0.148	--	--	--
2001	2002	20	42	0.323	10	55	0.154	--	--	--
2002	2003	17	43	0.283	4	19	0.174	9	48	0.158
2003	2004	33	30	0.524	5	8	0.385	0	8	0.000
2004	2005	2	12	0.143	0	4	N/A	1	85	0.012
	Average			0.419			0.402			0.218

Potential Inter-Specific Hatchery Interactions

Two spring Chinook salmon hatchery programs exist in the Deschutes River subbasin, one at Warm Springs NFH and one at Round Butte Hatchery, to mitigate for lost habitat and harvest opportunities due to construction and operation of the Pelton-Round Butte Complex. Spring Chinook salmon occur naturally in the Warm Springs River and Shitike Creek. Spring Chinook salmon are reared as juveniles to age 1+ smolts. Smolts actively migrate downstream after release, thus the duration of time that negative interactions could occur with native steelhead juveniles is relatively short. Interactions in overwintering and other rearing habitat are thought to be minimal. Bacterial Kidney Disease occurs within the Round Butte Hatchery broodstock. The influence of the Chinook hatchery programs is minimal and of little concern.

8.6.4 John Day River Steelhead

The John Day River steelhead populations are currently managed entirely as wild populations. No hatchery production or supplementation occurs within the John Day River subbasin. Hatchery releases of summer and winter run steelhead occurred historically in the John Day River subbasin between 1925 and 1969 (Table 8-58). Hatchery steelhead were last released into the John Day River subbasin in 1969. Hatchery steelhead released between 1966 and 1969 were for experimental use only and were not meant for production purposes (ODFW 1990, Olsen et al. 1994).

Table 8-58. Year, run (W-winter, S-summer, U-unknown), number, tributary, and subbasin of release for all known hatchery steelhead released into the John Day River subbasin from 1925 - 1969.

Year	Run	Number	Tributary	Subbasin
1925	U	16,080	Canyon Creek	Upper Mainstem
1941	U	8,760	Canyon Creek	Upper Mainstem
1947	U	7,600	Rock Creek	Lower Mainstem
1947	U	7,520	Thirtymile Creek	Lower Mainstem
1962	W	200,000	Camas Creek	North Fork
1962	W	375,000	Granite Creek	North Fork
1963	U	10,667	Mainstem	Mainstem
1964	W	10,198	Upper Mainstem	Upper Mainstem
1965	W	27,860	South Fork	South Fork
1966	S	55,518	Middle Fork	Middle Fork
1967	S	98,090	Upper Mainstem	Upper Mainstem
1967	S	71,500	Camas Creek	North Fork
1969	S	22,375	Bridge Creek	Middle Fork

Rainbow trout make up the majority of all hatchery fish species released into the John Day River subbasin (Table 8-59). The mean annual stocking rate of hatchery *O. mykiss* in the John Day River subbasin between 1925 and 1997 was 71,402 fish and ranged between 5,000 and 612,668 fish. Concern over competition for resources with wild fish and potential hybridization with natural-origin fish resulted in termination of all hatchery stocking of *O. mykiss* in the John Day River subbasin in 1997.

Table 8-59. Summary of all known stocking records for hatchery salmonids released into the John Day River subbasin from 1925-1997. Species include rainbow trout (RbT), steelhead of unknown run (Sthd), winter steelhead (StW), summer steelhead (StS), brook trout (BkT), and west slope cutthroat trout (WcT).

Summary of Stocking Records for Hatchery Salmonids Released in John Day River Subbasin, 1925-1997.

Year	RbT	Sthd	StW	StS	Coho	BkT	WcT	Total releases
1925	77,000	16,080			25,000			118,080
1926	25,680				45,000	42,745		113,425
1927	6,000							6,000
1928	43,000				27,530			70,530
1929	293,000							293,000
1930					50,000			50,000
1931	5,000				10,000			15,000
1932								0
1933	70,000				8,050			78,050
1934	31,000							31,000
1935								0
1936								0
1937								0
1938								0
1939								0
1940	92,206				50,268			142,474
1941	66,930	8,760						75,690
1942	36,632							36,632
1943	16,763							16,763
1944	31,050							31,050
1945	16,080							16,080
1946	36,960							36,960
1947	254,025	15,120						269,145
1948	66,025							66,025
1949	10,290							10,290
1950	52,343							52,343
1951	14,560							14,560
1952	21,808							21,808
1953	24,376							24,376
1954	36,946							36,946
1955	58,783							58,783
1956	57,297							57,297
1957	43,206							43,206
1958	71,272							71,272
1959	41,727							41,727
1960	41,498							41,498
1961	29,980							29,980
1962	37,668		575,000					612,668
1963	38,931	10,667						49,598
1964	17,508		10,200					27,708
1965	72,598		27,860				199	100,657
1966	174,305			55,518		325,793	59,425	615,041
1967	141,210			170,500				311,710
1968	24,493							24,493
1969	325,185			22,375				347,560
1970	184,227							184,227

Summary of Stocking Records for Hatchery Salmonids Released in John Day River Subbasin, 1925-1997.

Year	RbT	Sthd	StW	StS	Coho	BkT	WcT	Total releases
1971	31,547							31,547
1972	60,093							60,093
1973	141,758							141,758
1974	84,809							84,809
1975	87,850							87,850
1976	84,121							84,121
1977	85,173							85,173
1978	110,521							110,521
1979	148,294							148,294
1980	95,565							95,565
1981	87,480							87,480
1982	106,053							106,053
1983	111,964							111,964
1984	46,567							46,567
1985	57,715							57,715
1986	64,226							64,226
1987	8,997							8,997
1988	43,572							43,572
1989	29,369							29,369
1990	32,987							32,987
1991	21,036							21,036
1992	21,043							21,043
1993	8,004							8,004
1994	22,525							22,525
1995	7,993							7,993
1996	6,988							6,988
1997	6,479							6,479

Out-of-Subbasin Strays

Out-of-subbasin hatchery steelhead strays pose a significant and primary threat to John Day steelhead populations. The Mid-C Expert Panel identified out-of-DPS hatchery strays as a threat to population traits for the Lower Mainstem population. Most hatchery stray recoveries occur in the Lower Mainstem below the North Fork (Table 8-60); however, strays have been observed in all populations. Carmichael et al. (2006) reports that the proportion of hatchery spawners in the Lower Mainstem population ranged from 0.01 in the early 1990's to 0.18 in 2004, with a mean of 0.07. The ICTRT considers this to be a high risk for the metric of spawner composition because of the increasing trend since the 1990's, fraction of strays and origin of the strays (Carmichael et al. 2006). Carmichael et al. (2006) concluded that all five of the John Day steelhead populations were at high risk for the John Day spawner composition viability metric. Data from coded-wire tagged hatchery steelhead recovered between 1986 and 2003 indicate that a large portion of the hatchery fish were from Wallowa stock releases into the Grande Ronde Rivers; however, most hatchery fish from upper Columbia River tributaries are not coded-wire tagged.

Hatchery steelhead coded-wire tag (CWT) recoveries in the John Day subbasin from 1986 to 2003 (378 recoveries) identify 18 separate hatcheries as the sources of strays. The majority of CWT recoveries were located downstream of Tumwater Falls in the John Day Arm (316

recoveries) and may not accurately represent fish that stayed and spawned within the John Day subbasin. The recoveries indicate that Dworshak National Hatchery is the predominate source of hatchery steelhead strays in the lower portion of the subbasin (97 CWT recoveries; 31%). Between Tumwater Falls and Cottonwood Bridge (RM 40) 55 hatchery CWT recoveries have been reported with many recoveries (26 CWT recoveries; 47%) in this area identifying Irrigon Hatchery (fish primarily released in the Grande Ronde Subbasin) as the source of strays (Table 8-61). Limited information is available upstream of Cottonwood Bridge with only seven hatchery CWT recoveries reported. Irrigon Hatchery was the source of two hatchery steelhead strays in this area. It should be noted that the probability of observation of strays in the John Day River from any particular hatchery stock is dependent on the survival, stray rate of that stock, and the number of individuals tagged from the stock. There is substantial difference in numbers of fish tagged between stocks, and in some cases no hatchery fish are marked with CWTs.

Table 8-60. Hatchery source, stock, number recovered, recovery period, and release agency for hatchery steelhead with coded wire tags in the John Day River arm. (Tumwater Falls upstream to Cottonwood Bridge) from 1996-2003. Data were compiled from the Pacific States Marine Fishery Commission Regional Mark Information System.

Hatchery Source	Stock	Number Recovered	Recovery Period	Release Agency
Irrigon	Wallowa R., Imnaha R. & tributaries	25	10/10 - 05/07	ODFW
Cottonwood Creek Pond	Wallowa R.	10	10/11 - 05/23	WDFW
Magic Valley	Pahsimeroi R. 'A' run, Dworshak 'B' run, East Fork Salmon R. 'B' run	5	10/27 - 01/31	IDFG
Niagara Springs	Pahsimeroi R. 'A' run, Hells Canyon 'A' run	5	10/20 - 01/24	IDFG
Clearwater	Dworshak 'B' run	2	01/09 - 02/10	IDFG
Dworshak National	Dworshak 'B' run	2	10/17 - 02/09	FWS
Umatilla	Umatilla R.	2	10/09 - 11/11	ODFW

Table 8-61. Hatchery source, release location, recovery location, number recovered, and recovery year for hatchery steelhead with coded wire tags in the John Day River above Cottonwood Bridge (RM 40) from 1988-2003. Data were compiled from archives in the John Day Field Office and Wilson et al. (2004).

Hatchery Source	Release Location	Recovery Location	Number Recovered	Recovery Year
Big Canyon	Unknown	Lower North Fork	1	1994
Irrigon	Spring Creek of Wallowa R., OR	Kahler Creek, Lower Mainstem	1	2003
Irrigon	Big Canyon Creek of Wallowa R., OR	Service Creek, Lower Mainstem	1	2003
Cottonwood Creek Pond	Grande Ronde R., OR	Service Creek, Lower Mainstem	1	2003
Unknown Washington Hatchery	Unknown	Service Creek, Lower Mainstem	1	2003
Upper Columbia	Unknown	Cottonwood Bridge to Little Ferry Canyon	1	1988
Wallowa	Unknown	Lower North Fork	1	1992

Distribution of Hatchery and Natural Adults
Most observations of hatchery adults in the John Day have occurred in the Lower Mainstem, below the confluence with the North Fork (Wiley et al. 2004). However, several reports have noted observations of fin-clipped fish in the North Fork and South Fork drainages. These observations come from both spawning ground surveys and creel programs.

Claire and Gray (1992a) reported 17 (23%) adipose fin clipped steelhead of 75 caught upstream of Kimberly (RM 185) during the 1992 steelhead fishery. Within the 1992 Zone 3 summer steelhead fishery (Kimberly to Indian Creek), 16% (6 of 37) of the fish reported by anglers were of hatchery origin (Claire and Gray 1992a). Within the 1992 lower North Fork summer steelhead fishery, 29% (11 of 37 reported) of steelhead reported by anglers were of hatchery origin. Claire and Gray (1992a) did not provide an explanation for the high stray rates observed during the 1992 fishery. Wilson et al. (2001) reported observing thirteen adipose fin-clipped adult summer steelhead (46%, both live and as carcasses) of twenty-eight steelhead observed while seining for smolts in the Mainstem John Day River between Kimberly (RM 185) and Spray (RM 170).

Wiley et al. (2004) observed 50, live adult steelhead and sampled five carcasses on spawner surveys conducted during 2004. Of the ten sites where live fish were observed they were able to identify 34 fish as hatchery or wild at six of those sites based upon the presence (hatchery) or absence (wild) of an adipose fin clip (fin mark). Hatchery steelhead (13 fish) comprised 38% of live fish observations and were found at two of the six sites where identifications could be made. The majority of live hatchery steelhead observed (12 fish; 92%) and hatchery carcasses sampled (3 fish; 100%) during spawner surveys came from one stream (Service Creek) located in the Lower Mainstem at RM 157. An additional live hatchery steelhead was also observed in the Lower Mainstem in Rock Creek. They estimated 3,726 wild and 2,284 hatchery steelhead were present during the spawning season based upon the wild:hatchery ratio of live fish observed during spawner surveys.

Wiley et al. (2004) observed fin-clipped adults paired with wild adults on redds during 2004. Others have also observed hatchery origin fish paired with wild fish during spawning (Wilson et al. 2004). Observations of pairings between hatchery and wild fish on the spawning grounds indicate introgression. No evidence is available for any negative impacts resulting from interactions between hatchery and natural steelhead in the John Day River subbasin.

8.6.5 Umatilla River Steelhead

The Umatilla River summer steelhead program was designed to enhance the natural production through supplementation and to provide sustainable harvest in the Umatilla River subbasin. The annual production goal is for a release of 150,000 smolts. Smolts are adipose fin-clipped to allow for selective fisheries and to monitor returns to TMFD. The program is funded by BPA through the NPCC Fish and Wildlife Program.

Several ongoing management actions were implemented to limit potential negative impacts on wild steelhead from the hatchery program. These actions all have positive benefits, and include 1) marking hatchery produced steelhead to limit fishing mortality on wild steelhead, 2) reading

coded-wire tags before spawning broodstock to prevent using out-of-subbasin strays, and 3) acclimating and releasing a portion of hatchery smolts near areas targeted for supplementation and a portion lower in the subbasin to increase fishing opportunities in the lower river. Releasing a portion of the adults in the lower river also has the potential to limit spawning interactions between hatchery and wild adults. Nevertheless, the existing hatchery programs for steelhead and coho in the subbasin continue to pose potential risks to the wild steelhead population. However, the Mid-C Expert Panel did not identify hatchery fish as a primary threat to the population.

Hatchery Program History

The first attempt to supplement the natural population of summer steelhead in the Umatilla River and tributaries was in 1967 when hatchery-produced, non-endemic steelhead from Skamania and Idaho (Oxbow) stocks were released in the Umatilla River (ODFW 1987). From 1968 through 1970, only non-endemic Skamania stock steelhead were released into the Umatilla River. No hatchery-produced steelhead were released in the Umatilla River from 1971 through 1974. The early release numbers and size-at-release varied considerably (Table 8-62). The first release of smolts from endemic Umatilla stock occurred in 1975. There were no releases of hatchery-produced steelhead from 1976 through 1980. Annual releases of smolts from endemic Umatilla stock ensued from 1981 to the present.

Broodstock are currently collected from returns to the Three Mile Falls Dam (TMFD) trap on the Umatilla River (RM 3.7). The broodstock goal is 120 adults, including 10 pairs of coded-wire tagged program fish. Steelhead are transferred to the Minthorn acclimation site for holding and spawning. The coded-wire tags are read prior to spawning to insure out-of-subbasin hatchery fish are not used for broodstock. Spawning is performed using a 3x3 matrix, selecting for natural x natural crosses whenever possible, and no hatchery x hatchery crosses are used. Hatchery fish are used when there are not enough natural-origin fish to meet egg-take objectives.

Run Composition

Steelhead returns to TMFD have averaged 956 hatchery, and 1,668 natural fish from the 1992-93 through 2003-04 run years (Table 8-63). Over the same time period, Umatilla hatchery steelhead comprised 23.9-52.0% of the run (mean 32.0%), while out-of-subbasin hatchery steelhead comprised 2.1-10.1% of the run (mean 3.1%; Table 8-63). Some steelhead are removed at TMFD for broodstock while others are harvested upstream in tribal and non-tribal recreational fisheries. Umatilla hatchery steelhead have comprised 19.0-57.1% of steelhead available to spawn in nature (mean 29.4%), and out-of-subbasin hatchery steelhead have comprised 1.8-9.7% of potential spawners (mean 4.8%; Table 8-64). Carmichael (2000) concluded that the Umatilla River population was at high risk for the spawner composition viability metric. This high risk rating was the result of a moderate risk rating for proportion of out-of-DPS strays and a moderate risk rating for within-population hatchery spawners.

Table 8-62. Releases of summer steelhead in the Umatilla River subbasin prior to the current program at Umatilla Fish Hatchery (Chess et al. 2003a).

Release Year	Hatchery	No. Released	Fish/lb.	Strategy	Stock	Acclimation Facility	Direct-release
1967	Gnat Creek	109,805	75	Subyearling	Skamania		
1967	Oak Springs	238,020	117	Subyearling	Oxbow		
1967	Wallowa	142,240	240	Subyearling	Oxbow		
1968	Gnat Creek	23,100	66	Subyearling	Skamania		
1968	Gnat Creek	150,000	Eggs	eggs	Skamania		
1969	Oak Springs	174,341	145	Subyearling	Skamania		
1970	Carson	39,489	8.0-9.0	Yearling	Skamania		
1975	Wizard Falls	11,094	9	Yearling	Umatilla		
1981	Oak Springs	17,558	6.0-9.0	Yearling	Umatilla		Upper Umat. R.
1981	Oak Springs	9,400	145	Subyearling	Umatilla		Upper Umat. R.
1982	Oak Springs	59,494	7.0-8.0	Yearling	Umatilla		Upper Umat. R.
1982	Oak Springs	67,940	124	Subyearling	Umatilla		Upper Umat. R.
1983	Oak Springs	60,500	11	Yearling	Umatilla		Upper Umat. R.
1983	Oak Springs	52,700	62	Subyearling	Umatilla		Upper Umat. R.
1984	Oak Springs	57,939	6.5	Yearling	Umatilla		Upper Umat. R.
1984	Oak Springs	22,000	135	Subyearling	Umatilla		Upper Umat. R.
1985	Oak Springs	53,850	7	Yearling	Umatilla		Upper Umat. R.
1985	Oak Springs	39,134	150	Subyearling	Umatilla		Upper Umat. R.
1986	Oak Springs	54,137	8.4	Yearling	Umatilla	Bonifer Spr.	
1987	Oak Springs	1,485	5.5	Yearling	Umatilla		
1988	Oak Springs	30,549	7.4	Yearling	Umatilla	Minthorn Spr.	
1988	Oak Springs	30,757	6.5	Yearling	Umatilla		Umat. R. Minthorn
1988	Oak Springs	33,984	10.3	Yearling	Umatilla		Umat. R. Stanfield
1988	Oak Springs	10,033	57.5	Subyearling	Umatilla		Umat. R. Corporation
1988	Irrigon	24,618	3,200	unfed fry	Umatilla		S. Fk. Umatilla R.
1989	Oak Springs	29,852	6.6	Yearling	Umatilla	Minthorn Spr.	
1989	Oak Springs	29,586	5.6	Yearling	Umatilla		Umat. R. at Minthorn
1990	Oak Springs	30,225	5.9	Yearling	Umatilla	Bonifer Spr.	
1990	Oak Springs	29,446	5.5	Yearling	Umatilla		Meacham Cr. (mouth)
1991	Oak Springs	30,221	6.2	Yearling	Umatilla	Bonifer Spr.	
1991	Oak Springs	29,325	8.7	Yearling	Umatilla		Meacham Cr. (mouth)
1992	Umatilla	67,435	5.8	Yearling	Umatilla	Bonifer/Minthorn	
1992	Umatilla	64,550	5	Yearling	Umatilla		Meacham Cr. (mouth)
1992	Umatilla	67,419	5.5	Yearling	Umatilla		Meacham Cr. (mouth)

Table 8-63. Percent of Umatilla and non-endemic hatchery returns to Three Mile Falls Dam.

Run Year	Umatilla Hatchery Return to TMFD	% Umatilla Hatchery Return to TMFD	Non-Endemic Hatchery Return to TMFD	Prop Non-Umatilla Hatch. Return to TMFD	Total Hatchery Return To TMFD	Natural Return to TMFD	Total Hat+Nat Return to TMFD
92-93	490	25.6%	126	6.6%	616	1298	1914
93-94	309	24.0%	36	2.8%	345	945	1290
94-95	535	34.9%	122	8.0%	657	874	1531
95-96	664	31.9%	121	5.8%	785	1296	2081
96-97	1288	52.0%	175	7.1%	1463	1014	2477
97-98	725	41.1%	178	10.1%	903	862	1765
98-99	701	37.2%	49	2.6%	750	1135	1885
99-00	690	23.9%	61	2.1%	751	2141	2892
00-01	939	25.6%	164	4.5%	1103	2559	3662
01-02	1585	28.7%	276	5.0%	1861	3658	5519
02-03	816	26.5%	142	4.6%	958	2121	3079
03-04	1088	32.1%	190	5.6%	1278	2111	3389
Mean	819	32.0%	137	5.4%	956	1668	2624

Table 8-64. Percent of Umatilla and non-endemic hatchery returns available to spawn in nature.

Brood Year	Umatilla Hatchery Potential Spawners	Umatilla Hatchery Percent of Total Pot. Spawners	Non-Endemic Hatchery Potential Spawners	Non-endemic Hatchery Percent of Total Pot. Spawners	Total Hatchery Potential Spawners	Natural Potential Spawners	Total Potential Spawners
93	345	21.9%	62	3.9%	407	1165	1572
94	204	19.0%	23	2.1%	227	847	1074
95	420	32.4%	95	7.3%	515	783	1298
96	522	28.8%	95	5.2%	617	1194	1811
97	1146	51.7%	155	7.0%	1301	914	2215
98	609	39.8%	149	9.7%	758	771	1529
99	538	33.7%	37	2.3%	575	1020	1595
00	543	20.7%	48	1.8%	591	2030	2621
01	774	23.1%	135	4.0%	909	2444	3353
02	1389	26.9%	241	4.7%	1630	3542	5172
03	688	24.4%	119	4.2%	807	2015	2822
04	942	30.3%	164	5.3%	1106	2003	3109
Mean	677	29.4%	110	4.8%	787	1561	2348

Distribution of Hatchery and Natural Adults

In 2003, 70.0% of the summer steelhead available to spawn (fish released above TMFD minus all harvest components) were natural origin, and during spawning surveys 68.9% of the spawning steelhead identified were natural-origin (Schwartz et al. 2005; Table 8-66).

Adult steelhead were trapped and counted at Birch Creek by ODFW from 1995 to 1999 (DeBano et el. 2004; Table 8-65). The fish were collected in a fish ladder trap on a diversion dam located approximately 1/4 mile downstream of the confluence of the East and West forks of Birch Creek. An estimated 60% of the adult steelhead that pass this location jump over the diversion dam and are not counted in the trap. In 1995-1996, ODFW biologists conducted a mark/recapture study that led to a total escapement estimate above the trap location of 358 natural-origin and 15 hatchery-origin fish for a total of 373. For that year, this accounted for approximately 30% of the natural-origin fish that were counted at TMFD on the Umatilla. Mark/recapture data in other years were insufficient to make an accurate escapement estimate. A significant proportion of spawners observed on spawning ground surveys from 2001-2004 were hatchery origin in some locations within the population (Schwartz et al. 2005; Table 8-66).

Table 8-65. Adult summer steelhead collected at the fish trap on Birch Creek (Tim Bailey, Oregon Department of Fish and Wildlife, personal communication, January 2001).

Run Year	Natural-origin	Hatchery-origin	% Hatchery	Total
1995-96	143	6	4	149
1996-97	109	6	5	115
1997-98	85	1	1	86
1998-99	73	0	0	73

Table 8-66. Visual observations of natural and hatchery summer steelhead during spawning ground surveys (from Schwartz et al. 2005).

Brood Year	Iskuulpa Creek		NF Meacham Creek		Camp Creek		Boston Canyon Creek		Buckaroo Creek		South Fork Umatilla		Total Observed		Three Mile Dam STS		STS Available To Spawn	
	Nat	Hatch	Nat	Hatch	Nat	Hatch	Nat	Hatch	Nat	Hatch	Nat	Hatch	Nat	Hatch	Nat	Hatch	Nat	Hatch
2001																		
n=	4	3	4	0	2	0	0	1	5	2	2	0	17	6	2563	1099	2455	905
%=	57.1	42.9	100.0	0.0	100.0	0.0	0.0	100.0	71.4	28.6	100.0	0.0	73.9	26.1	70.0	30.0	73.1	26.9
2002																		
n=	14	6	2	0	4	3	0	6	3	4	0	0	23	19	3651	1862	3500	1696
%=	70.0	30.0	100.0	0.0	57.1	42.9	0.0	100.0	43.9	57.1	0.0	0.0	54.8	45.2	66.2	33.8	67.4	32.6
2003																		
n=	17	10	5	0	5	0	0	5	4	0	5	2	36	17	2118	956	2017	865
%=	63.0	37.0	100.0	0.0	100.0	0.0	0.0	100.0	100.0	0.0	71.4	28.6	67.9	32.1	68.9	31.1	70.0	30.0
2004																		
n=	19	7	3	0	0	0	0	6	2	0	0	0	24	13	2111	1277	2007	1246
%=	73.1	26.9	100.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0	0.0	0.0	64.9	35.1	62.3	37.7	61.7	38.3

Similarity between Hatchery-Origin and Natural-Origin Fish

Hatchery summer steelhead are produced primarily from unmarked summer steelhead returning to the subbasin. All hatchery juveniles are released as one-year smolts, compared to natural-origin summer steelhead that emigrate primarily as two-year smolts, with some three- and four-year-old smolts. The adult return timing and relative monthly percent of hatchery and natural

steelhead returning overlap closely. No large-scale seasonal separation exists between natural and hatchery steelhead, however Chi-Square and Kolmolgorov-Smirnov tests reveal significant differences between natural and hatchery frequencies on a monthly scale for most years (Chess et al. 2003a). The female-to-male ratio of natural summer steelhead is higher than hatchery steelhead. Female summer steelhead comprised 69.3 ± 1.3% (mean ± SE) of the natural return for return years 1992-93 through 2001-02, whereas females comprised 57.3 ± 2.3% (mean ± SE) of the hatchery return for the same period (Chess et al. 2003a). Age structure of hatchery and natural steelhead is similar. For run years 1992-93 through 2001-02, natural female summer steelhead were 58.8 ± 4.8% (mean ± SE) one-salt, compared to 57.2 ± 5.1% (mean ± SE) one-salt for hatchery female steelhead (not significantly different: ANOVA, P = 0.82; Chess et al. 2003a). For the same years, natural male steelhead were 68.5 ± 5.1% (mean ± SE) one-salt compared to 74.6 ± 4.4% (mean ± SE) of the hatchery male returns (not significantly different: ANOVA, P = 0.37; Chess et al. 2003a).

Smolt Releases and Acclimation Sites

Umatilla hatchery steelhead have always been released as one-year-old smolts, and are currently released at approximately 4.5 fish per pound (FPP). From the mid 1980s to the present, Bonifer Springs Pond and the Minthorn Springs site have been consistently used for acclimating Umatilla River summer steelhead. Large-grade summer steelhead and small-grade steelhead were acclimated at Bonifer Springs from brood years 1992 to 1998, excluding 1995 when the small-grade steelhead were acclimated at the Thornhollow site (RM 73.5). Bonifer Springs Pond is located at the confluence of Boston Canyon and Meacham creeks, two miles above the confluence with the Umatilla River at RM 80. Bonifer Springs Pond was used to acclimate steelhead because it is a tributary of Meacham Creek, which was identified as a major component of the available summer steelhead habitat in the Umatilla River subbasin (CTUIR and ODFW 1990) and was targeted for steelhead supplementation. Large-grade steelhead were acclimated at the Minthorn Springs site from brood year 1992 to 1998. The Minthorn Springs site is located at RM 64.5 of the mainstem Umatilla River. Minthorn Springs is a large spring system connected to the Umatilla River and floodplain. For brood years 1999 to 2001, small-grade (pass A) steelhead were no longer acclimated at Bonifer Springs, instead smalls were acclimated at Minthorn Springs following acclimation and release of the large-grade steelhead. The second group of large-grade steelhead was acclimated at Bonifer Springs Pond. In an effort to increase smolt survival, co-managers decided to release some steelhead from Pendleton (RM 56), the most downstream acclimation site in the subbasin. From 2002 to present, ungraded steelhead were released in approximately equal numbers (approx. 30,000-50,000 ea.) from the Pendleton and Minthorn acclimation facilities, and direct stream released in Boston Canyon Creek near Bonifer Springs. Acclimated fish are held in ponds for 2-3 weeks, allowed to volitionally migrate for one week, and then forced out of the ponds.

Juvenile Migration Timing

Natural and hatchery steelhead show similar trends in out-migration timing, except for the earlier migration of natural fish (Chess et al. 2003a; Figure 8-19). Hatchery steelhead were released from acclimation sites in early and late April. Small-grade steelhead were reared an extra month in the hatchery, acclimated and released a month later than the large-grade steelhead. If the hatchery steelhead migrated out of the Umatilla River subbasin soon after release, then a distinct, bimodal distribution of hatchery out-migrants would be produced. This was the case for three of

four years. The 1999 out-migrant year was skewed, but unimodal for hatchery steelhead. Natural steelhead started migration earlier than the earliest release hatchery steelhead release date in all four years. A small percentage of natural and hatchery steelhead arrive in late May and early June. Natural and hatchery out-migrants are being detected at Three Mile Falls Dam during rising and falling limbs of the hydrograph.

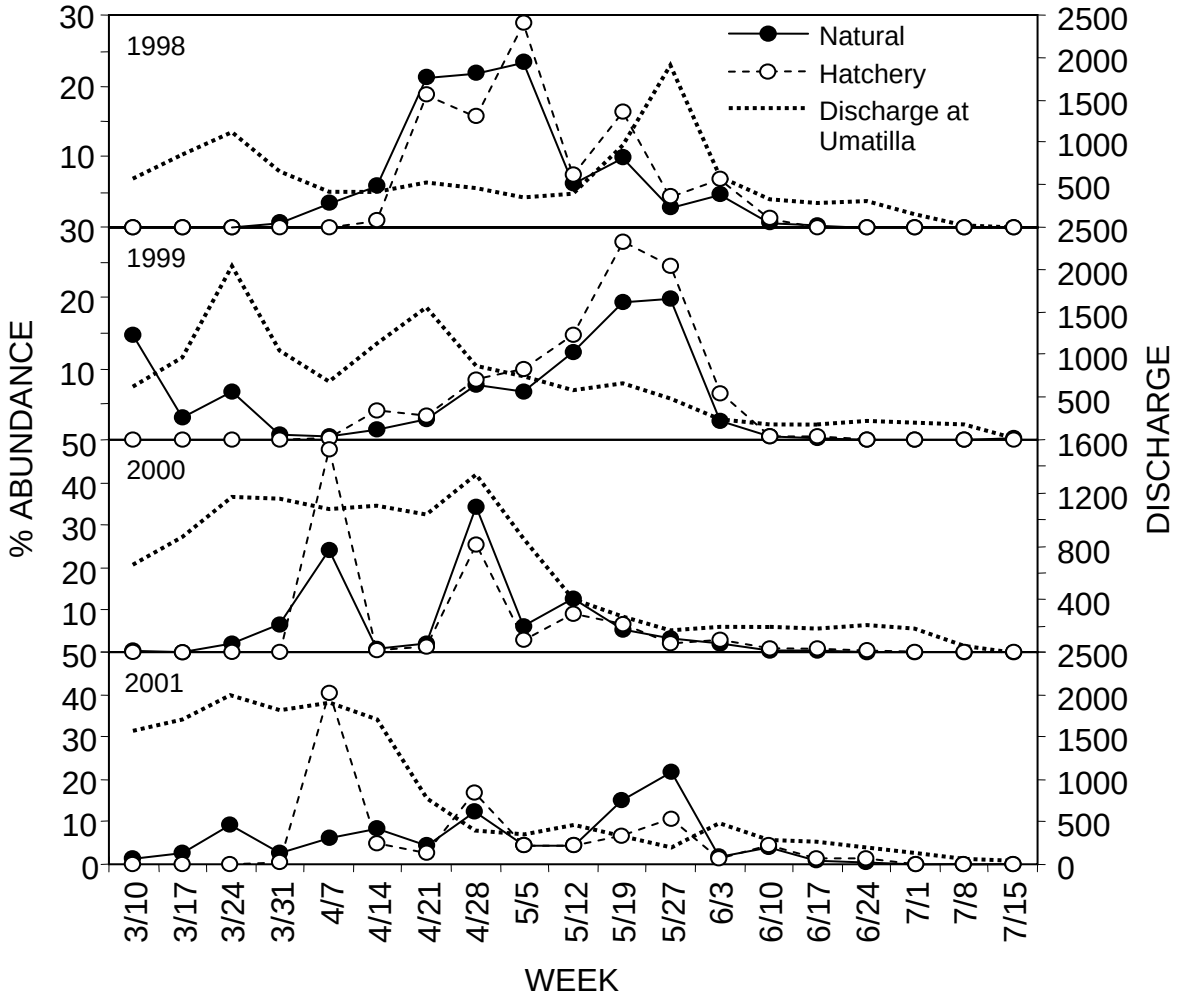


Figure 8-19. Migration timing of natural and hatchery summer steelhead smolts counted at Three Mile Falls Dam. The percentages were from weekly totals of fish divided by the respective total for the out-migration period. Daily Flow data at the lower Umatilla River gauge (RM 2.1) were averaged on a weekly interval (from Chess et al. 2003a).

Residualism

Steelhead, which were the smallest in the fall and were separated by grading for release in the spring, exhibited lower PIT tag detections at TMFD and lower smolt-to-adult survival, suggesting they either had lower out-migration survival or they were residualizing in the Umatilla River (Chess et al. 2003b). There was evidence that small-grade steelhead residualized and did not migrate until the second or third year following acclimation. Only 3 of 20 radio-tagged, small-grade steelhead migrated out of the subbasin after release from the outlet of Bonifer Springs (Stonecypher et al. 2001). Several detections of small-grade steelhead, PIT-tagged two years earlier have occurred at TMFD (White et al. 2003), confirming delayed out-migration of the small-grade production. Contor et al. (1995) estimated that 1,100 hatchery steelhead residualized in Boston Canyon Creek, with evidence of displacement of natural steelhead found in the stream. Approximately 4,000 hatchery steelhead residualize each year in Boston Canyon, Meacham, Minthorn Springs creeks, and in the mainstem Umatilla River (Contor et al. 1995). This estimate was 2.5% to 3.3% of the total steelhead released per year in the Umatilla River. There is evidence that many residual steelhead move into the lower Umatilla River. In recent years, anglers reported catching adipose and ventral fin clipped "trout" in the Stanfield area (RM 32). Summer steelhead are no longer size graded, all are released at approximately 4.5 FPP.

Other Salmonid Releases in the Umatilla Subbasin

Besides summer steelhead, coho salmon and spring and fall Chinook salmon are also released in the Umatilla River annually. Approximately 810,000 spring Chinook salmon are released annually, 600,000 from Umatilla hatchery and an additional 210,000 from Little White Salmon Hatchery (LWSH). All spring Chinook salmon are acclimated at the Imeques acclimation facility (RM 80). Fish raised at Umatilla Hatchery are transferred in fall or winter and released in mid-March at 12 FPP, whereas steelhead raised at LWSH are transferred to the acclimation site in mid-March and released in mid-April at 15 FPP. Approximately 1.5 million coho salmon are released in the Umatilla River annually. All coho salmon are acclimated at the Pendleton acclimation facility and released at 15 FPP. Half (~750,000) are transferred to the acclimation site in mid-February and released in mid-March and the other half are transferred in Mid-March and released in mid-April. Approximately 1.08 million fall Chinook salmon are released in the Umatilla River annually, of which 600,000 are subyearlings and 480,000 are yearlings. Half of the subyearlings (~300,000) are transferred to the Thornhollow acclimation site (RM 73.5) in early May and released in late May at 50 FPP, whereas the other half are direct stream released at Umatilla RM 49 in late May at 35 FPP. All yearling fall Chinook salmon are acclimated and released from the Thornhollow acclimation facility at 10 FPP. One half (240,000) are transferred in mid-February and released in mid-March, while the second half is transferred in mid-March and released mid-April.

Program Performance

The stray rate for hatchery summer steelhead has not been estimated. The mean smolt-to-adult survival rate for brood years 1991-97 was 0.42% (small grade range: 0.03-0.21; large grade range: 0.02-1.52; Chess et al. 2003a). The annual return of summer steelhead to TMFD averaged 819 for the 1992-93 through 2003-04 run years (Table 8-63). Natural-origin summer steelhead returns for the same period averaged 1,668 annually. Harvest has not met expectations, with fewer than 100 steelhead caught annually from 1994 to 1999 (Chess et al. 2003a). However, an

estimated 114 steelhead were caught in 2000-01 and an estimated 278 were caught in 2001-02 (Chess et al. 2003b).

Potential Limiting Factors Influencing Viability
The net effect of the Umatilla hatchery program is unknown, but recent natural-origin escapements have been high (Table 8-63). Almost 30% of steelhead available to spawn naturally originates from the Umatilla Hatchery. The use of natural-origin steelhead for broodstock reduces the potential for divergence of the hatchery-origin steelhead from the natural-origin fish. Smolt releases occur during the normal migration period of natural steelhead, and it appears that most fish emigrate soon after release. However, there is evidence that some smolts residualize and remain in the Umatilla River another year. These fish may compete with naturally produced fish for habitat and prey resources.

Out-of-DPS strays pose several risks to the wild Umatilla steelhead population. A primary risk is spawner composition because out-of-DPS strays account for a mean of 4.8% of fish that return to TMFD, and because average hatchery fraction on the spawning grounds is 29.4%.

8.6.6 Walla Walla River Steelhead

There is one summer steelhead hatchery program in the Walla Walla River, operated by the Washington Department of Fish and Wildlife (Glen Mendel, WDFW, personal communication).

Lyons Ferry Hatchery
The Lyons Ferry Hatchery (LFH) segregated program involves the release of non-endemic LFH steelhead stock in the Walla Walla subbasin. Approximately 100,000 smolts are direct stream released annually in the lower Walla Walla River just downstream of the Mill Creek confluence. Smolts released into the Walla Walla have been targeted at 4.5 fish per pound to reduce residualism, insure rapid emigration, reduce interactions between wild and hatchery steelhead, and increase survival (WDFW 2005).

The LFH stock program utilizes a non-endemic steelhead hatchery stock originally developed from Wells Hatchery (Wells Stock) on the upper Columbia River. Other steelhead stocks were also used in the past to fulfill production needs (Wallowa, Pahsimeroi, Oxbow, and Ringold stocks). Hatchery origin adults (mainly Wells and Wallowa stocks) were later trapped on site at LFH to build LFH stock summer steelhead.

Broodstock Source, Collection and Spawning
Broodstock collection, spawning, incubation, and juvenile rearing for the program are conducted at LFH. Well water (52^{o}F) is the source for all facets of the hatchery production. The hatchery is operated in compliance with all applicable fish health guidelines and facility operation standards and protocols. Fish collected for broodstock are taken throughout the return or spawning period in proportions approximating the timing and age distribution of the population from which broodstock is taken. Annual broodstock collections goals for all LFH stock summer steelhead production programs are 360 adult hatchery returns. Additional fish may be collected to account for pre-spawning loss and incidence of IHNV in egg lots that are destroyed. Adults are spawned two males per female. Eggs are incubated without temperature regulation. Average eggs/female

is about 4,750 eggs. Fry are ponded in indoor rearing tanks and then moved to standard outdoor raceways.

Survival and Distribution

Survival data collected to date indicate 89% survival from green egg to fry, and 68% survival from fry to smolt. Currently, about 100,000 smolts of the 345,000 total LFH Stock fish produced annually are released into the lower Walla Walla River from LFH. Releases were greater in the past (Table 8-67), but have been reduced because of ESA concerns. Currently, smolts are direct stream released at a size of 4-5 fish/lb at RM 35 between April 15 and 25.

Table 8-67. Release of LFH, Wallowa, Wells and Ringold stock steelhead smolts into the Walla Walla River, 1983-2005 release years.

Release Year	Stock	River Mile	Number of smolts
1983	Wells	28	91,260
1984	Wells	35	133,235
1985	Wells	35,40	115,200
1986	Wells	30,32,35	138,845
1987	Wells, LFH	30,32,35	124,973
1988	LFH	22,24,25,27	181,166
1989	LFH,	22,24,25,27	106,140
1990	Wallowa	22,24,25,27	130,217
1991	Ringold	23,25,26,27	198,749
1992	LFH	NA	75,210
1993	LFH	35,36	83,240
1994	LFH	23,24,25,27,30,34,	159,905
1995	LFH	35	158,875
1996	LFH	30,34,35,36	170,000
1997	LFH	30,35	170,980
1998	LFH	30,35	165,855
1999	LFH	30,35	176,000
2000	LFH	35	165,500
2001	LFH	35	103,980
2002	LFH	35	99,859
2003	LFH	35	102,975
2004	LFH	35	80,143
2005	LFH	35	10,4027
		35	

The Walla Walla watershed above Nursery Bridge Dam (NBD) has been designated a wild, endemic steelhead production area. Until 1999, stray hatchery adult steelhead were trapped and removed at NBD, preventing them from entering the natural production area and spawning with wild fish. This trapping was discontinued after 1999.

The termination of trapping at NBD causes a potential threat to the diversity of the endemic steelhead population. For all brood years on record (1993-2005) the proportion of hatchery fish passing NBD and allowed to escape with natural-origin fish to the spawning grounds has remained below 5% (Table 8-68). Nevertheless, the proportion of hatchery adults escaping above NBD has been increasing since adult trapping and removal of strays ceased in 1999. Further increases in the future will increase the risk for the natural steelhead population. There is considerable evidence of genetic introgression of LFH stock into the Walla Walla natural population (Narum et al. 2004). In addition, results of telemetry studies conducted by CTUIR

demonstrated spatial and temporal overlap in LFH and natural-origin fish. Carmichael (2006) concluded that the Walla Walla steelhead population was at moderate risk for the spawner composition viability metric. However, since out-of-DPS strays are no longer removed at NBD this risk level will rise to high in the future. Overall we consider the out-of-DPS spawners to be a key threat to the Walla Walla population.

Table 8-68. Estimated numbers of adult hatchery- and natural-origin summer steelhead passing upstream of Nursery Bridge Dam from brood years 1993-2005.

Brood Year	Hatchery Steelhead	Natural Steelhead	Percent Hatchery
1993	4	1695	0.2%
1994	2	1113	0.2%
1995	10	894	1.1%
1996	15	745	2.0%
1997	10	607	1.6%
1998	6	786	0.8%
1999	2	580	0.3%
2000	27	1069	2.5%
2001	75	1548	4.6%
2002	89	2417	3.6%
2003	46	1252	3.5%
2004	NA	NA	NA
2005	15	374	3.9%
Mean	25	1,090	2.2%

In 2001, WDFW reduced the number of non-endemic smolts released into the lower Walla Walla River to reduce genetic risks to the endemic steelhead population. The reduction was justified because the adult returns were exceeding compensation goals set by the Lower Snake River Compensation Program (Glen Mendel, WDFW, personal communication). Releases in the lower Walla Walla River were reduced from approximately 170,000 smolts annually to 100,000 smolts annually in 2001. It is unknown at this time whether these reduced stocking rates will reduce genetic risks to endemic steelhead in the Walla Walla River.

WDFW is currently developing an endemic steelhead program for the Touchet River population. The Touchet is a tributary to the Walla Walla River located entirely in Washington State. The success of this program will determine whether the Lyons Ferry Hatchery stock used in the Walla Walla and Touchet rivers will continue to be propagated. Evaluation results, available in 1-2 years, will also be used to determine whether to expand the endemic program (Glen Mendel, WDFW, personal communication). If the Touchet River endemic program is successful, it is possible that the endemic stock could be used to produce smolts for release in the lower Walla Walla River.

8.7 Predation and Competition

Oregon Mid-C steelhead are also affected by threats from predation and competition.

8.7.1 Predation by Pinnipeds, Birds and Piscivorous Fish

Predation by pinnipeds, birds, and piscivorous fish in the mainstem Columbia River has become a contributing factor affecting the viability of the Mid-Columbia River steelhead DPS. Anthropogenic changes in the Columbia River have altered the relationships between salmonids and other fish, bird, and pinniped species. Some species' abundance levels have increased dramatically, particularly in localized areas, with associated changes in predation of steelhead juveniles and adults (LCREP 2006).

Predation by Pinnipeds
The abundance of native pinnipeds has steadily increased since passage of the Marine Mammal Protection Act (MMPA) in 1972. Pacific harbor seals, Steller sea lions, and California sea lions all prey on salmon and steelhead in the lower Columbia River (NPCC 2004). Before 1980, few California sea lions were observed in the Columbia River. However, in recent years, more and more sea lions have been traveling as far upstream as Bonneville Dam to prey on returning salmon and steelhead congregating below the dam. The fish often spend several days in the river below the dam before climbing the fish ladders. The minimum daily occurrence of pinnipeds at Bonneville Dam increased from 14 animals in 2002 to 54 in 2007. Some marked individuals have been repeatedly observed at Bonneville since 2002. Estimates of spring-run adult salmonid mortality due to sea lions at Bonneville Dam ranged from 0.4% in 2002 to 3.4% in 2006 and to 4.1% in 2007 (USACE 2007; USACE unpublished data). These estimates do not account for pinniped mortality occurring in the 145 miles of the Columbia River downstream of Bonneville Dam.

A pinniped hazing program has been implemented at Bonneville Dam since 2005, but the efforts have largely been ineffective. Recently, the states of Oregon, Washington, and Idaho have applied to NOAA Fisheries for authorization under Section 120 of the MMPA to lethally remove problem California sea lions. NOAA Fisheries Northwest Regional Office in Seattle has appointed an 18-person panel of experts to review the request.

Predation by Avian Predators
Alteration of the estuary environment has lead to a significant increase in the number of native bird species, such as Caspian terns and double-crested cormorants, in the area, with measurable impacts on stream-type salmonids (BPA, BOR, and USACE 2004). These increases in population in the Columbia River estuary are attributed to the deposition of dredge spoils that represent high-quality habitat for the birds (Bottom et al. 2005). The loss of habitat elsewhere has contributed to terns and cormorants effectively relocating to the Columbia River estuary, with the populations there now representing the largest nesting colonies in North America.

In 1997 it was estimated that avian predators consumed 10 to 30% of the total estuarine salmonid smolt production in that year (NPCC 2004). The draft 2005 season summary of Research, Monitoring, and Evaluation of Avian Predation on Salmonid Smolts in the Lower and Mid-Columbia River (Collis and Roby 2006) estimates that 3.6 million juvenile salmonids were consumed by terns in 2005. Double-crested cormorants consume a similar number of juvenile salmonids (approximately 3.6 million juveniles) from their East Sand Island nesting grounds (LCREP 2006; Collis and Roby 2006). Caspian terns on Crescent Island, an island in the mid-

Columbia that was also created by dredge spoils, consumed an estimated 679,000 juvenile salmonids during the 2001 breeding season (Antolos et al. 2005).

Predation by Piscivorous Fishes

The northern pikeminnow is a native piscivore that preys on juvenile salmon and steelhead in the Columbia River. Although northern pikeminnow have always been a significant source of mortality for juvenile salmonids in the mainstem Columbia, changes in physical habitats may have created more favorable conditions for predation (NPCC 2004). Dams can stress and disorient migrating smolts, making them vulnerable to predators. Dams may also delay migration, thereby increasing travel time and exposure to predators. Northern pikeminnow were found to be the major piscivore responsible for predation on juvenile salmonids, with mortality potentially similar to that caused by dam passage (Rieman et al.1991). Since 1990, the Northern Pikeminnow Management Program (NPMP) has implemented fisheries targeting northern pikeminnow at an exploitation rate of 10-20%. This level of exploitation is expected to reduce predation on juvenile salmonids by 25-50% (Rieman and Beamesderfer 1990).

A wide variety of fish species have been introduced into the mainstem Columbia River. Among these introduced species, walleye, smallmouth bass, and channel catfish are considered to be the most successful as predators of juvenile salmonids (Gray and Rondorf 1986; Poe et al.1991). Densities of non-indigenous predators have been found to be higher in impoundments created by mainstem dams compared to the unimpounded Columbia River below Bonneville Dam (Zimmerman and Parker 1995). Sampling suggests that smallmouth bass abundance in The Dalles and John Day reservoirs, as well as walleye abundance in parts of John Day Reservoir, has increased in recent years (Takata et al. 2007). Although non-indigenous species do not prey on juvenile salmonids to the extent that northern pikeminnow do, they can be an important predator at certain times and locations (Poe et al.1991).

8.7.2 Intra-Species Interactions

Unique to the Deschutes River Westside population is the presence of a highly abundant population of large resident rainbow trout throughout the population. Nowhere in any of the other Oregon Mid-C steelhead populations, except in the mainstem Deschutes River reaches of the Deschutes River Eastside population, are abundant large rainbow trout found. Cramer and Beamsderfer (2006) concluded that habitat conditions (perennial steady flows and cool temperatures) in many areas in the upper Deschutes subbasin favor production of resident rainbow trout over steelhead. Similar habitat conditions are also found in much of the currently available habitat of the Deschutes River Westside population.

Current abundance for steelhead in the Westside population is low relative to the quantity and quality of habitat available. With the exception of the South Fork John Day River population, the Deschutes River Westside population has the lowest current abundance of all other Oregon Mid-C steelhead populations.

Although we cannot quantify the effects of resident rainbow trout on the capacity of steelhead in the Westside population, we hypothesize that the capacity may be significantly reduced by competition with resident rainbow. This hypothesis is supported by the conclusion of Cramer

and Beamesderfer (2006) regarding steelhead production capacity in the upper Deschutes subbasin. Although there may be reduced steelhead capacity resulting from the abundance of resident rainbow trout, this should be viewed as a natural outcome. Thus, no management actions are proposed to address this potential natural interaction effect. If, in the future, additional studies confirm this reduction in capacity in waters with abundant larger rainbow trout, then the abundance criteria for the Deschutes River Westside steelhead should be reevaluated.

8.8 Climate Change

This section describes the potential environment changes that will accompany climate change in the future and some likely life stage specific responses for Oregon's Mid-C steelhead. In addition, we have developed a potential climate change vulnerability risk index based on projected future stream temperatures, projected future springtime water availability, and historical variation in precipitation.

8.8.1 Steelhead Habitat Impacts

Climate change will alter environmental conditions across the entire life cycle for all life stages of Oregon's Mid-Columbia River steelhead. There remains considerable uncertainty regarding the magnitude of loss and degradation of salmonid habitat in the Columbia Basin that will result from climate change. The magnitude of environmental change will vary considerable across ecoregions and thus will have different impacts on viability of steelhead populations within the Mid-C DPS. In general, habitats at lower elevations east of the Cascade Mountains in the southern portion of the Columbia River basin will experience the greatest level of change (ISAB 2007a).

Many of the environmental attributes that will be influenced by climate change (temperature and hydrograph) are those that have already been influenced significantly by past land use and are currently considered key limiting factors. The degree to which climate change will impact a given population is partially dependent on the degree to which natural processes have already been altered. A number of reviews have recently been completed that characterize potential climate change impacts in the Pacific Northwest (O'Neal 2002; Mote et al. 2003; ISAB 2007a; Michael and O'Brien 2008). The environmental changes most often described as significant threats to salmonid viability include:

- Increased air and stream temperatures
- Reduced snow pack and a shift in precipitation from snow to rain
- Altered hydrographs with earlier and higher peak flows, and lower summer-fall flows
- More frequent extreme storm events
- Increased periods of drought
- Changing ocean temperatures and current patterns
- More frequent and severe fire events

8.8.2 Potential Life Stage Specific Impacts

The ISAB (2007) generally characterized potential impacts of climate change to salmonids in the Columbia River basin. Expanding on their conclusions with a specific focus on Oregon's Mid-Columbia River steelhead, we developed the following summary of potential life stage specific impacts of climate change. Again, we emphasize that the life stage specific impacts will vary considerably between populations based on many factors, and our summary attempts to capture the range of potential impacts across all populations.

Egg incubation: The potential for increased mortality exists due to increased flood events in early spring resulting in greater redd scouring and dewatering of redds due to low spring flows (Jager et al. 1997). Increased temperatures will result in accelerated embryo development and earlier fry emergence.

Fry emergence and colonization: Warmer spring temperatures will likely result in earlier fry emergence. Fry emergence timing is critical for successful colonization, thus altered emergence timing may reduce success in colonizing quality habitat and increase mortality.

Summer rearing: Most Mid-C steelhead spend a minimum of two summers srearing prior to smolt seasonal migration. Reduced summer flows and increased temperatures will impact both the quality and quantity of summer rearing habitat. Summer temperatures currently limit habitat quality and quantity in most Oregon Mid-C populations. Lower flows and warmer temperatures have the potential to influence steelhead in many ways. The potential effects include the following:

- Reduced rearing capacity due to loss of habitat that reaches lethal temperatures
- Reduced growth rates due to metabolic stress of high temperatures
- Increased growth rates in some locations that are currently below growth optimum temperatures
- Reduced ability to compete with non-native and native competitors due to elevated temperatures
- Increased predation mortality resulting from more active, abundant, and effective predators at high temperatures

Overwinter Rearing
Environmental changes have the potential to influence growth and survival including:

- Reduced growth rates resulting from higher metabolic demands and low available food resources
- Increased growth rates resulting from increased temperatures
- Increased overwinter mortality resulting from more frequent and intense winter flood events
- Reduced or improved overwinter survival resulting from changes in body size at the onset of winter

Smolt Migration
Environmental changes have the potential to influence migration timing and survival including:

- Alteration of smolt seaward migration timing as a result of hydrographic changes, prior life stage growth patterns, and size-at-age
- Alteration of the proportion of steelhead offspring that express anadromous and resident life history strategies as a result of changes in prior life stage growth rates and size-at-age
- Increased smolt mortality in tributary and mainstem migratory corridor due to elevated temperatures and increased predation
- Increased smolt mortality resulting from prolonged migration timing resulting from reduced flows

Smolt to Adult Ocean Rearing
Environmental changes have the potential to influence survival, growth, and age-at-maturation including:

- Increased mortality at time of ocean entrance due to mismatch in smolt physiology and ocean entrance timing
- Reduced early ocean survival due to changes in temperature, plume dynamics, and predator-prey relationships
- Altered ocean growth patterns due to elevated temperatures and altered current patterns resulting in reduced survival and changes in adult age at return

Adult Migration and Holding
Environmental changes have the potential to influence migration timing, survival, and straying including:

- Reduced migration success and increased mortality due to increased mainstem temperatures during the summer migration period. Increased temperatures can influence migration success and survival in a variety of ways including increased energetic demands, delayed passage, and direct mortality due to lethal temperature encounters
- Potential for increased straying, for some populations, into summer coldwater refugia like the Deschutes River
- Increased pre-spawn mortality due to high late summer and fall temperatures in adult holding habitat

Adult Spawning
Environmental changes have the potential to influence spawn timing and spawner distribution including:

- Shifts in adult spawn timing resulting from increased temperature and associated changes in sexual maturation rates during adult migration and holding periods (some Mid-C adult steelhead spend up to 11 months in freshwater prior to spawning)
- Shifts in adult spawner distribution due to flow and temperature changes in tributary spawning areas.

8.8.3 Potential Vulnerability Risk to Climate Change

Introduction

There is a considerable amount of new information available regarding the potential impacts of climate change on air temperature, precipitation, and rain/snowfall patterns. Although some work is underway to assess the impacts of environmental change on salmon in the Pacific Northwest, there is no spatially explicit information available for Oregon's Mid-C steelhead populations that links climate change to potential vulnerability.

We have taken the first step in linking climate change to potential vulnerability risk by developing an integrated risk analysis. One key objective of this effort is to produce maps that will serve as the basis for comparing the high priority tributary habitat actions and targeted limiting factors with geographic areas that are most vulnerable to climate change impacts. We want to emphasize that this effort is only a first step and that this should serve as a stepping stone for others to build from and improve on.

As discussed earlier, climate change will pose significant challenges to steelhead ecology throughout the entire life cycle. The magnitude of environmental change will vary considerably from one geographic area to another, even within the boundaries of an individual population. Ideally, we would like to assess the potential effects of climate change on abundance, productivity, spatial structure, and diversity of all Oregon Mid-C populations and determine the effectiveness of our management strategies in addressing climate impacts. However, the state of knowledge is not yet advanced to the point to allow this level of quantitative assessment.

To characterize spatially explicit, potential vulnerability risk we utilized available environmental information to develop three risk metrics and a combined overall risk metric that integrates the three individual metrics. We chose key environmental parameters that should change significantly under all climate change scenarios and that should provide adaptive challenges to multiple life stages of Mid-C steelhead. We selected changes in springtime available water (Graves 2008) to index potential future risk for spawning and changes in peak summer temperature (Cooney and Holzer, *in prep*) to index potential future risk for summer rearing capacity and growth, incubation, and emergence/colonization. We also utilized past variation in precipitation (Brown 2009) as an index of adaptive capacity.

Approach

Springtime Water Availability Change (SWAC)

Graves (2008) compiled contemporary climate conditions (1971-2000) from PRISM data (Daly et al. 1994) in a GIS format for Columbia Basin watersheds. He then conducted an analysis to assess monthly water balances from precipitation and snowmelt for three future climate timeframes (2020s, 2040s, and 2080s) using future projections of monthly temperatures and precipitation changes generated by the University of Washington Climate Impact Group (UWCIG 2007). This UWCIG (2007) data included monthly expected change in temperature and precipitation from the baseline period including 2010-2029 (2020s), 2030-2059 (2040s) and 2070-2099 (2080s). These projections of change were applied to the spatial grid of contemporary climate, producing a scalable result. Graves (2008) assessed changes in water availability for seven subbasins that are of importance to Columbia River Basin tribes.

We conducted our analyses in a five step sequence:

1. We obtained percent change in water availability from contemporary climate conditions (1971-2000) to the 2040s future climate scenario (Graves 2008).

2. We aggregated the data for each 6th field hydrologic unit (HUC6) for all Mid-C populations.

3. We calculated the percent springtime water availability change (SWAC) for each month and each HUC6. We selected the months of March, April, and May for our analyses because these months represent the period of time for spawning, incubation, fry emergence and fry colonization for most Oregon Mid-C steelhead. Therefore, hydrograph changes during this critical time period will pose significant adaptive challenges to multiple life stages.

We calculated the mean percent directionless change in springtime water availability for each HUC6 as:

$$\overline{SWAC} = \frac{|SWAC_1| + |SWAC_2| + |SWAC_3|}{N_{SWAC}}$$

where

$SWAC_1$ = March absolute value of percent change in water availability

$SWAC_2$ = April absolute value of percent change in water availability

$SWAC_3$ = May absolute value of percent change in water availability

N_{SWAC} = number of months

4. We developed risk rating criteria to categorize values into four risk levels. Criteria were based on expert opinion, manually selected categories:

Very Low Risk: $\overline{SWAC} = 1.2\%\text{-}5.0\%$
Low Risk: $\overline{SWAC} = 5.1\%\text{-}15.0\%$
Moderate Risk: $\overline{SWAC} = 15.1\%\text{-}35.0\%$
High Risk: $\overline{SWAC} = 35.1\%\text{-}203.1\%$

5. We mapped the $\overline{SWAC}$ and risk rating for each HUC6 for all populations. These results were used in the development of the integrated risk assessment.

Summer Temperature Change (STC)

Interior Columbia basin naturally produced steelhead populations rely on tributary habitats for juvenile rearing. Interior steelhead typically emerge from spawning gravels in the early summer of their natal year, spending two or more summer growth seasons in freshwater prior to

emigrating to the ocean. Smolt outmigration sampling indicates that emigration may be triggered by reaching a size threshold (e.g., Mullan et al. 1992). As with other salmonids, stream temperatures are extremely influential on juvenile growth and mortality rates (McCullough 1999).

Climate modeling projections for the Interior Columbia indicate a warming trend in air temperatures over the next 20 to 80 years (e.g., Mote and Salathe 2009). Mantua et al. (2009) developed statistical models relating patterns in available historical stream temperature records to associated air temperature estimates from throughout Washington State. The stream sites used in that analysis were largely associated with major mainstems or lower sections of river systems, very few of the sample series in their study were from upper tributary habitats used by juvenile steelhead. Cooney and Holzer (*in prep*) used recent historical stream temperature series from upper tributary habitats, exhibiting the physical characteristics associated with juvenile steelhead rearing, to model the potential impacts of increased temperatures on juvenile steelhead growth potential. This analysis had two major objectives: to highlight high intrinsic potential steelhead production areas across populations within the Columbia River basin that are particularly vulnerable to projected temperature increases and to identify representative drainages in which to carry out more detailed temperature assessments that would include groundwater interactions, etc.

Recent historical stream temperature data: Stream temperature data sets were collected from various agencies, including federal (USGS, NOAA), state (Oregon Department of Environmental Quality, Washington State Department of Ecology), and tribal (Nez Perce) sources. The candidate data sets were limited to those that: 1) included at least two summers after 2000, and 2) were located within Interior Columbia basin stream reaches identified as historic or current natural steelhead spawning/rearing areas. In a few cases, locations on streams blocked to anadromous migration were included in order to incorporate data series from underrepresented ecotypes. The Yakima River mainstem sites were excluded due to the influence of the highly modified flow regimes in that system. In addition, locations elsewhere throughout the Interior Columbia basin that are located directly downstream from reservoirs were excluded. Cooney and Holzer (*in prep*) also discarded temperature series in very small tributaries directly associated with springs. After screening, a total of 167 sites were available for the analysis.

Stream temperature models: Stream temperatures in a given tributary reach can be influenced by a number of factors in addition to local air temperatures (e.g., Isaak and Hurbert 2001). Reach specific factors that could influence stream temperatures include air temperature, topography, flow, geology (e.g., potential for groundwater influence), and shading. Stream temperatures in a tributary reach can also be influenced by upstream conditions such as basin area, mean precipitation, ice or snow contribution (such as from glaciers) and geology. A set of candidate variables representing these potential factors was selected from available Interior Columbia basin GIS data sets.

A forward stepwise multiple regression analysis (Statgraphics REGRESS routine) was used to generate statistical models of mean summer stream temperatures (defined as the maximum two week average stream temperature during July or August). A cross-validation approach was used for the analysis, each of the 167 site-series was randomly assigned to one of three groups. The

stepwise multiple regression analysis was repeated three times, leaving out one of the random groups for each repeat. Residuals were calculated for the out-of-sample set for each of the three runs and tabulated. Three variables were identified among the three runs as having the most significant influence: mean maximum air temperature, elevation range (ln) and percent forest cover. A fourth variable, basin alluvial geology, was included in the analyses for two of the three subsets. Given the high degree of consistency among results from the subset analyses, the data sets were combined in an aggregate analysis.

Projected stream temperatures: The resulting aggregated stream temperature model was applied to estimate two-week mean average stream temperatures for current steelhead rearing habitats in accessible stream reaches and potential habitat within extinct population reaches. Estimates were expressed at the reach level for rearing habitats associated with each Interior Columbia steelhead population. The current distribution of steelhead production within stream networks was adapted from ICTRT data and generally reflects the distribution extent developed by state agencies (WDFW, ODFW, and IDFG). Historically occupied areas that are targeted for reintroductions were incorporated using an intrinsic potential habitat analysis (ICTRT 2007) as a proxy for current distribution. Temperature estimates were calculated for current conditions as well as for climate change projections. The potential increases in stream temperatures corresponding to future climate scenarios were generated by increasing the estimated current air temperature input values at the reach level by the average incremental change projected by the climate models (1.1, 1.3 and 3.1 °C by 2020, 2040 and 2080 after Mantua et al. 2009). The resulting point estimates of mean temperature by stream reach were summarized by HUC6 subbasins. Aggregate values were then assigned to potential growth categories. The growth categories were assigned based on information summarized in McCullough (1999) and are presented below:

Stream Temperature	Growth Impact Assumption
<4.5 °C	Zero Growth
4.5 to 10 °C	Cold Growth
10 to 15 °C	Optimum Growth
15 to 19 °C	Warm Growth
19 to 20 °C	Zero Growth
> 20 °C	Negative Growth/Lethality

We mapped the temperatures and growth categories for current conditions and a 2080 temperature scenario.

Risk assessment: The statistical models used to estimate stream temperatures had a relatively high degree of uncertainty. An estimate of the relative uncertainty in predicting stream temperatures based on a residuals analysis was directly incorporated in calculating a relative risk index at the reach level summarized by HUC6. The risk index was expressed relative to the

lower threshold of zero growth temperature zone (19 °C). Using either the aggregate or composite model, approximately 80% of observed temperature values fell above the model predicted value +2 °C. If the point estimate of stream temperature for a HUC6 was between 19 and 21 °C the risk was classified as High. If the point estimate exceeded the 19 °C threshold by 2 °C or more, the risk rating was set at Very High. If the point estimate was more than 2 °C below the threshold (<17 °C), the HUC6 was rated at Low risk. Relative risk levels were assigned based on the following thresholds:

Predicted Temperature	Assigned Risk
< 17 °C	Low
17 to 19 °C	Moderate
19 to 21 °C	High
> 21 °C	Very High

The relative risk levels for the 2080 scenario were mapped and incorporated into the integrated risk analyses.

Historical Precipitation Variation (HPV)

We used historical precipitation variation as a metric to index adaptive capacity. As discussed earlier adult spawn timing, egg incubation, and fry emergence are key Mid-C steelhead life stages that are likely to be impacted by climate change, specifically hydrograph and temperature changes.

A variety of salmon life history traits have been shown to vary with environment characteristics including flow, elevation, and temperature (Waples et al. 2004; Quinn 2005). Characteristic life history strategies, that are often geographically unique, represent adaptation to local environmental conditions (Lichatowich 1999). Many authors have concluded that life history strategies are an adaptive response to environmental conditions and when climate or habitat changes occur some life history strategies will perform better than others (Lichatowich 1999). McClure et al. (2008) concluded that some key adult and early life-stage traits are closely linked with environmental conditions and have moderate to high levels of heritability. Particularly relevant to Mid-C steelhead vulnerability to hydrograph and temperature changes, phenotypic traits such as adult migration timing, spawn timing, developmental rate, and emergence timing are known to be heritable and vary between populations.

Life history diversity and degree of local adaptation are key elements influencing population capacity to deal with variable and changing environments. The ability of populations to adapt to changing environments depends, in part, on the rate and magnitude of environmental change as well as the inherent life history variation. Those populations that persist in highly variable environments and that exhibit diverse life history patterns will likely have greater capacity to

adapt to changing environments. Brown (2009) hypothesized that the capacity of basins to adapt to water availability changes will likely be dependent on the level of historic precipitation. We hypothesize that populations which persist in areas with highly variable precipitation patterns will have greater resilience to future climate change than populations which reside in low precipation variability areas.

To link environmental variation to adaptive capacity risk, we conducted the HPV analyses in a four step sequence:

1. We obtained precipitation coefficient of variation data from Brown (2009) with the original data source of PRISM.

2. We aggregated the data for each HUC6 for all Mid-C steelhead populations.

3. We developed risk rating criteria to categorize values into four risk levels. Categories were based on natural break (Jenks 1967) methodology:

Very low risk:	CV = 0.688 – 0.865
Low risk:	CV = 0.596 – 0.687
Moderate risk:	CV = 0.513 – 0.595
High risk:	CV = 0.413 – 0.512

4. We mapped HPV and risk ratings for each HUC6 for all populations. We then used the HPV results in the integrated risk assessment.

Integrated Potential Vulnerability Risk

We combined the three individual risk metrics to develop an integrated potential vulnerability risk index. The integrated risk index was developed to identify the geographic areas where climate change is projected to influence multiple environmental factors and life stages. We weighted the influence of STC risk greater than $\overline{SWAC}$ risk, and $\overline{SWAC}$ risk greater than HPV risk. We placed the greatest weight on STC because of the potential impacts to capacity, survival, and life history that are associated with the magnitude of temperature changes that are projected to occur.

We developed rating criteria to categorize risk into four levels. Table 8-69 shows the combinations of $\overline{SWAC}$, STC and HPV which were designated as very low, low, moderate and high risk.

Very low risk: assigned when the metric combinations were low risk and very low risk.

Low risk: assigned when the metric combinations included one metric at moderate risk with two metrics at low or very low risk, or, all three metrics with low risk.

High risk: assigned when STC was very high risk regardless of the other metric ratings, when there were two high risks with any other risk rating, and if $\overline{SWAC}$ or STC were high and the other two metrics were moderate.

Moderate risk: assigned to all other risk combinations.

We mapped the integrated risk index for each currently occupied HUC6 for all populations and HUC6s in the Deschutes Basin where steelhead reintroductions are planned.

Table 8-69. Criteria for considering springtime water availability change ($\overline{SWAC}$), summer temperature change (STC), and historical precipitation variation (HPV) climate change risk metrics into an integrated potential climate change vulnerability index. The order of individual metric risk ratings is $\overline{SWAC}$, STC, HPV. (VH=Very High; H=High, M=Moderate, L=Low, VL=Very Low)

Integrated Risk Category			
High Risk	Moderate Risk	Low Risk	Very Low Risk
H VH H	M H L	L M L	L L VL
H VH M	M H VL	L M VL	VL L L
H VH L	L H M	VL M L	VL L VL
H VH VL	L H L	VL M VL	
M VH H	L H VL	M L L	
M VH M	VL H M	M L VL	
M VH L	VL H L	L L M	
M VH VL	VL H VL	L L L	
L VH H	H M L	VL L H	
L VH M	H M VL	VL L M	
L VH L	M M H		
L VH VL	M M M		
VL VH H	M M L		
VL VH M	M M VL		
VL VH L	L M H		
VL VH VL	L M M		
H H H	VL M H		
H H M	VL M M		
H H L	H L M		
H H VL	H L L		
M H H	H L VL		
M H M	M L H		
L H H	M L M		
VL H H	L L H		
H M H			
H M M			
H L H			

Results and Discussion

Springtime Water Availability Change

The percent change in springtime water availability and the associated risk levels are shown for each HUC6 in Figure 8-20. We observed a similar pattern in springtime water availability as described in Graves (2008) and Mantua et al. (2009). Mantua et al. (2009) concluded that many of the Washington State Mid-Columbia River steelhead basins will transition from rain and snow basins to rainfall dominant basins resulting in significant hydrograph shifts. In our analysis, moderate to higher elevation areas showed the greatest $\overline{SWAC}$, and thus the highest risk levels. There were only a few populations with substantial areas that were rated as high risk, including the North Fork, Middle Fork, and Upper Mainstem John Day populations. The geographic areas with the highest risk levels were those areas with significant at-risk snow (Nolin and Daly 2006; Brown 2009) that are projected to shift from snow-dominated to rain-dominated precipitation patterns by mid-century (Graves 2008). Much of the currently occupied spawning habitat within all populations, except the Deschutes River Eastside and Lower John Day River, was classified at moderate risk.

The water availability at HUC6 scale serves as a reasonable index of potential hydrograph changes for headwater and lower order streams. However, flow in larger mainstem, higher order streams is not influenced significantly by local area water availability, rather by upstream tributary flow inputs. Therefore, the $\overline{SWAC}$ analysis does not effectively index potential hydrograph changes for mainstem higher order stream reaches. The effect of this bias on our analysis is somewhat minimized because steelhead spawning distribution is concentrated in lower order tributary streams. The development of hydrologic models (see Mantua et al. 2009) to characterize future hydrograph changes would significantly improve the ability to characterize geographic specific risk to Mid-C steelhead in Oregon. In addition, inclusion of ground water inputs as well as water withdrawals would increase the value and applicability of the analysis.

Summer Temperature Change

Modeled, mean stream temperatures and the associated steelhead growth zones for current conditions and the 2080 climate scenarios are shown in Figures 8-21 and 8-22 respectively (Cooney and Holzer, in prep). Significant proportions of the Deschutes River Eastside, Lower Mainstem John Day River, Umatilla River, and Walla Walla River populations currently exhibit mean summer temperatures residing in the zero net growth and negative growth zones (Figure 8-21). Many of the streams and rivers within the Mid-Columbia Oregon population boundaries exhibited mean summer temperatures in the negative growth zone in the 2080 climate scenario (Figure 8-22). A majority of the streams and rivers within the boundaries of the Deschutes River Eastside, Lower Mainstem John Day River, Umatilla River, and Walla Walla River populations show predicted mean summer temperatures exceeding 20 °C in the 2080 climate scenario (Figure 8-22).

Maximum mean summer stream temperature risk levels are shown in Figure 8-23. All populations showed areas with Very High and/or High risk. Populations that showed the greatest vulnerability with large proportions of the streams and rivers in Very High and High risk included the Deschutes River Eastside, Lower Mainstem John Day River, Umatilla River and Walla Walla River. All populations exhibited Low and Moderate risk categories at the higher elevation headwater reaches (Figure 8-23).

Historical Precipitation Variation

The historical coefficient of variation and associated risk levels are presented in Figure 8-24. A pattern emerged that showed low precipitation variation and high risk ratings in currently occupied areas within populations in the eastside of the DPS (SF, Upper Mainstem, MF, NF John Day River, Umatilla River, and Walla Walla River) whose headwaters originate in the Blue Mountains. In contrast, currently occupied areas within populations in the westside of the DPS (Fifteenmile Creek and Deschutes River Westside) whose headwaters originate from the eastslope of the Cascades Mountains showed moderate to high precipitation variation and moderate to low risk ratings (Figure 8-24).

Integrated Potential Vulnerability Risk

Extensive geographic areas within all populations, except Fifteenmile Creek and Deschutes River Eastside, exhibit high vulnerability risk (Figure 8-25). In addition, all populations have a substantial proportion of the geographic area rated at moderate risk.

Two patterns emerged that are characteristic of the areas rated at high risk. High risk levels for higher elevation areas within the John Day River populations were attributable to the combination of high risk for $\overline{SWAC}$ and HPV. In contrast, the high risk ratings for lower elevation areas in many of the populations, particularly evident in the Lower Mainstem John Day, Umatilla and Walla Walla populations, resulted primarily from the STC risk.

Results that are of particular concern for Oregon's Mid-C steelhead populations include:

1. The very small number of HUC6s that were at low or very low risk.

2. Many populations, including the South Fork John Day, Upper Mainstem John Day, Middle Fork John Day, North Fork John Day, Umatilla and Walla Walla, have the entire geographic area within the population boundaries rated at moderate or high risk.

3. The combination of environmental characteristics that are projected to change under future climate scenarios will threaten capacity, productivity, diversity and spatial distribution from both lower elevations upward and higher elevations downward. The life stages, capacity, and productivity impacts will vary depending on the specific environmental factors that are altered and the adaptive capacity.

As discussed earlier, we recognize this is a first step in development of a climate change vulnerability index for Oregon's Mid-C steelhead. Significant improvements to the approach can be made with use of hydrologic models that project reach scale flow changes, use of historical flow variation instead of precipitation variation, and incorporation of other environmental factors and life stages in the analysis. In addition, it would be beneficial to examine the relationship between current life stage specific habitat use and potential vulnerability risk for each population.

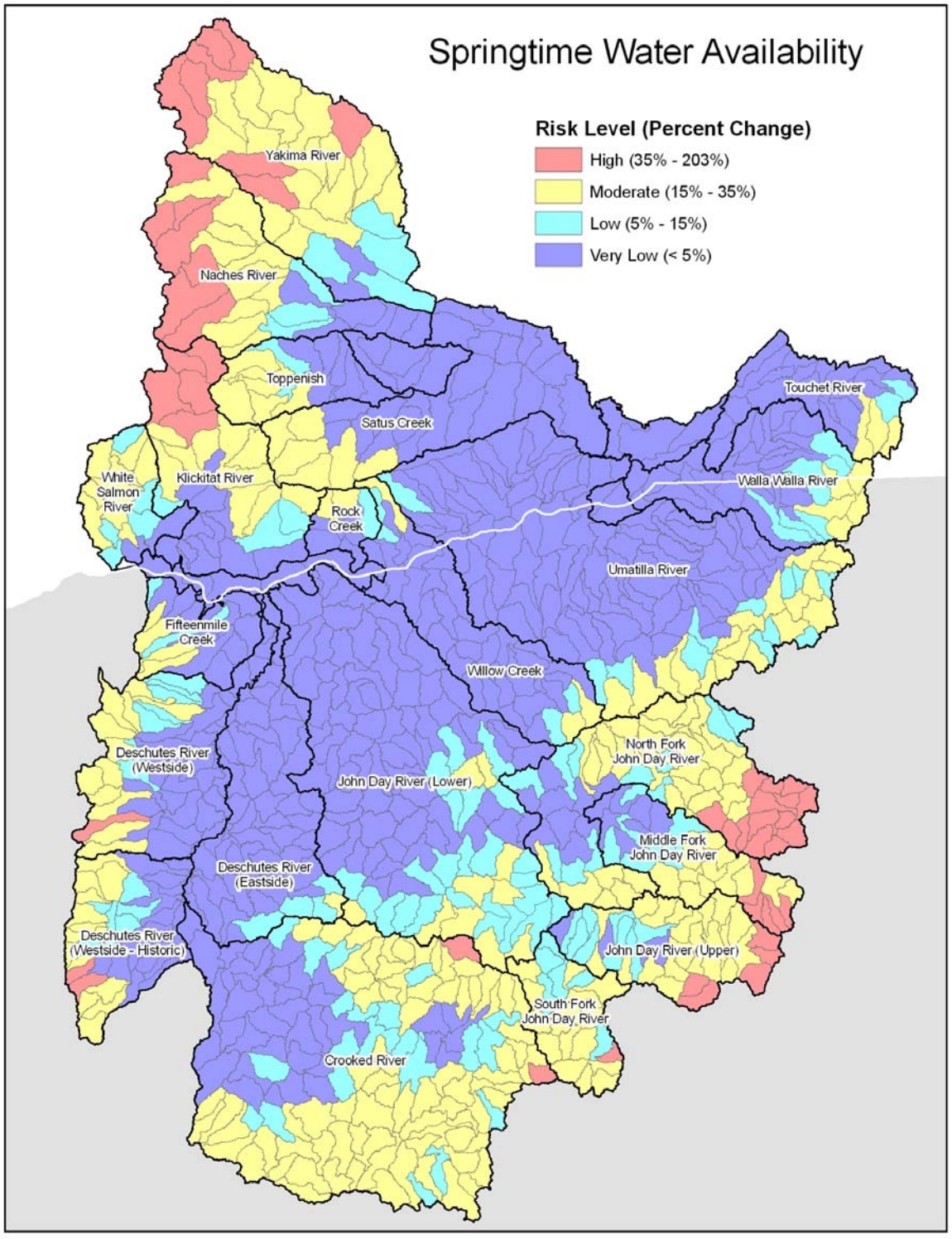


Figure 8-20. Percent change in springtime water availability (March-May) from baseline conditions (1971-2000) to future conditions (2040s) and projected future relative risk to Mid-Columbia River steelhead (6th field hydrologic units). Data sources include Graves (2008) and UWCIG (2007).

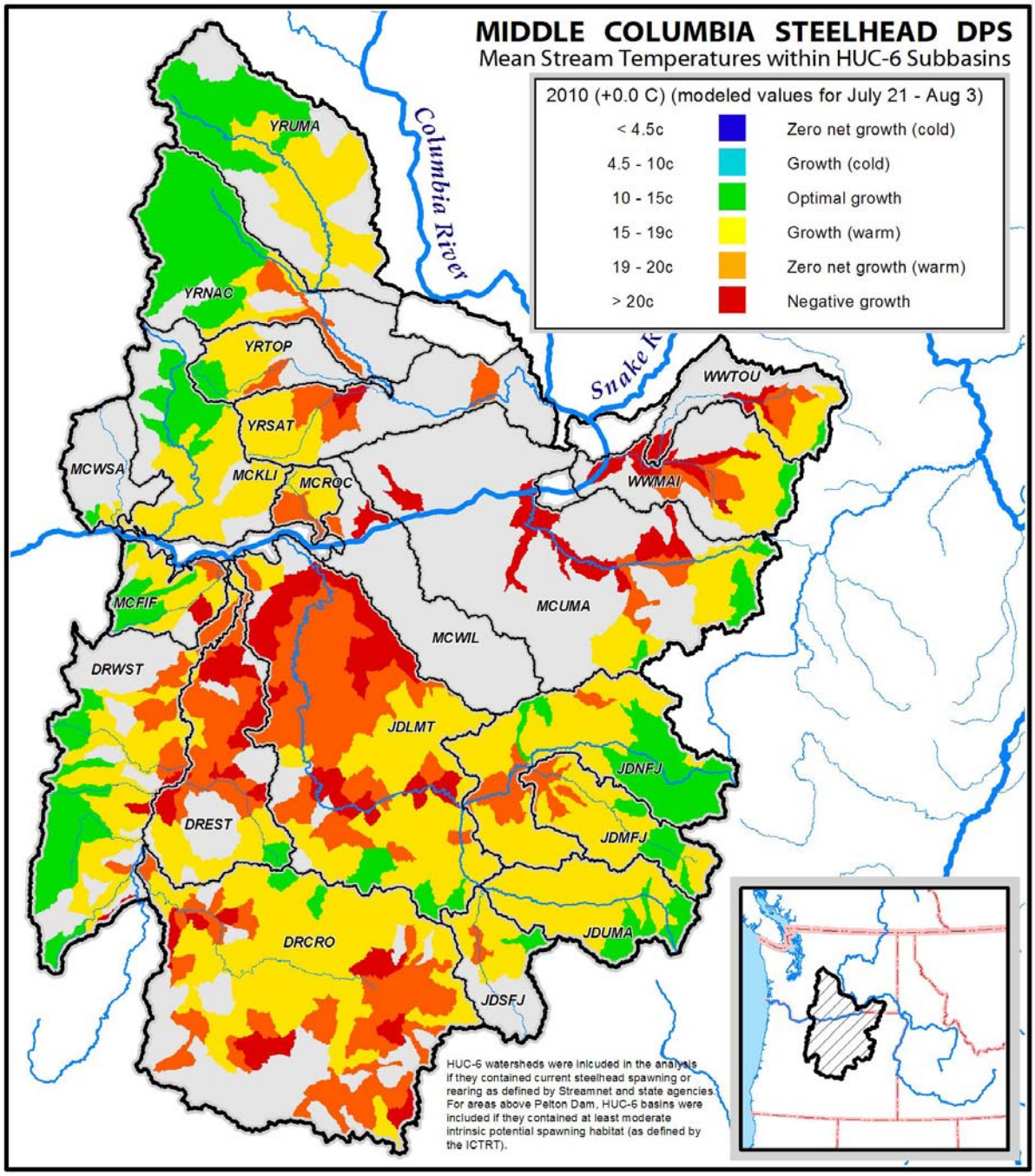


Figure 8-21. Modeled current summer (July 21-August 3) stream temperatures and growth zone characterization for Mid-Columbia River steelhead (6th field hydrologic units). From Cooney and Holzer, *in prep*. All areas shown in the Crooked River and Deschutes River Westside-Historic are currently unoccupied; however, reintroduction efforts are currently underway in some areas.

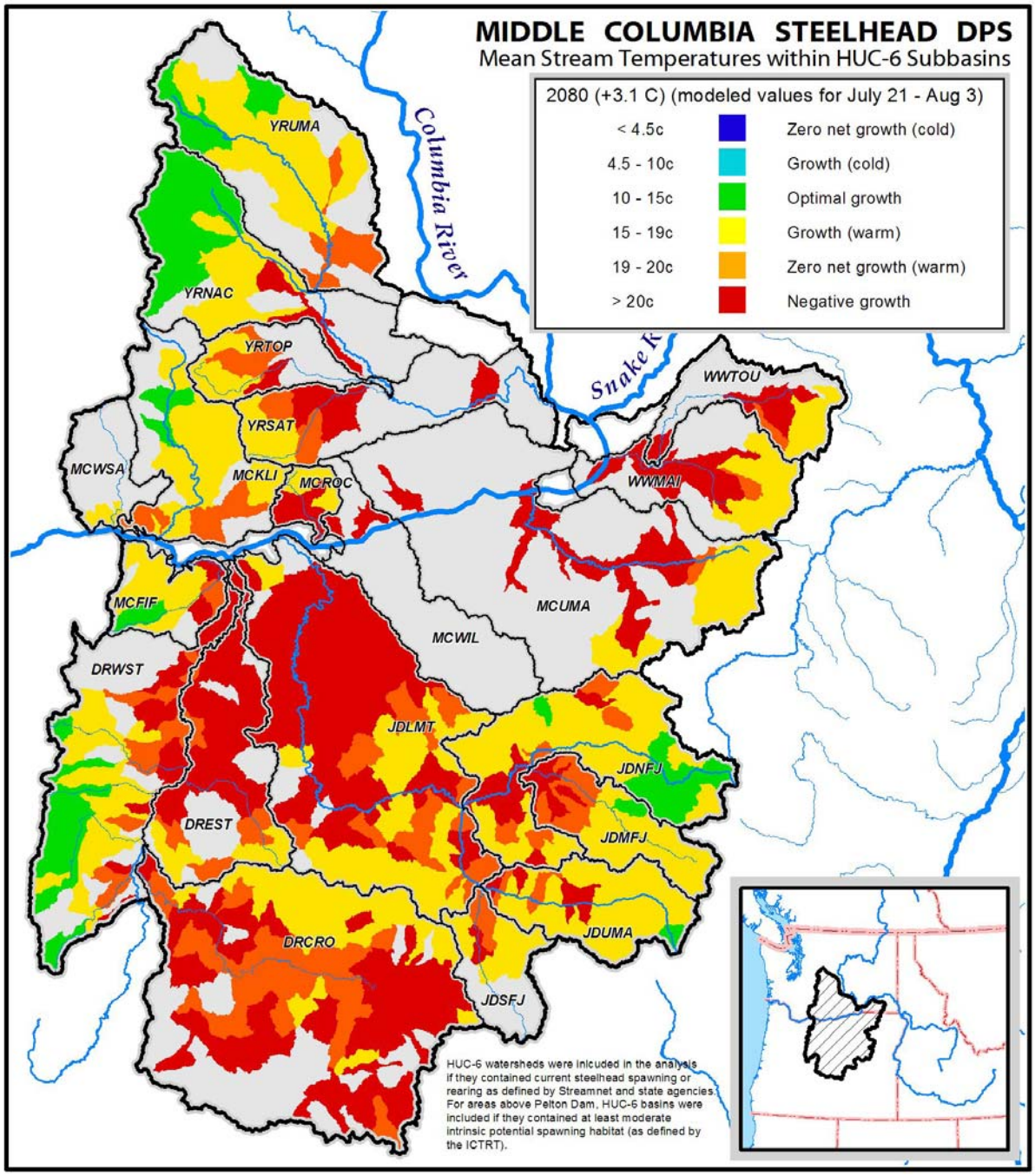


Figure 8-22. Modeled future (2080) summer (July 21-August 3) stream temperatures and growth zone characterization for Mid-Columbia River steelhead (6th field hydrologic units). From Cooney and Holzer, *in prep*. All areas shown in the Crooked River and Deschutes River Westside-Historic are currently unoccupied; however, reintroduction efforts are currently underway in some areas.

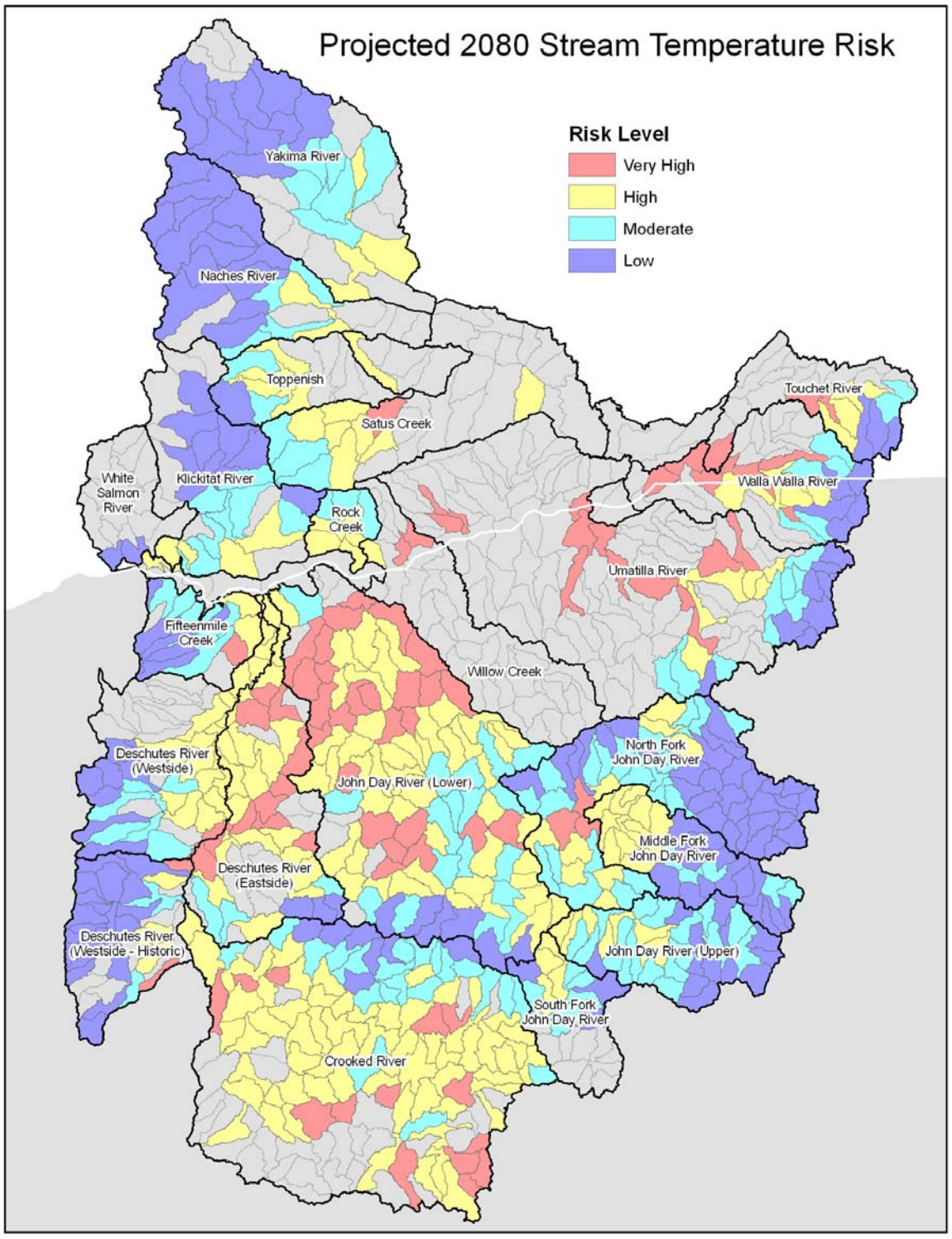


Figure 8-23. Projected future relative risk to Mid-Columbia River steelhead habitat (6th field hydrologic units) due to changes in summer (July 21-August 3) stream temperatures from current (2010) to future (2080) conditions. Data source is Cooney and Holzer, *in pre*p. All areas shown in the Crooked River and Deschutes River Westside-Historic are currently unoccupied; however, reintroduction efforts are currently underway in some areas.

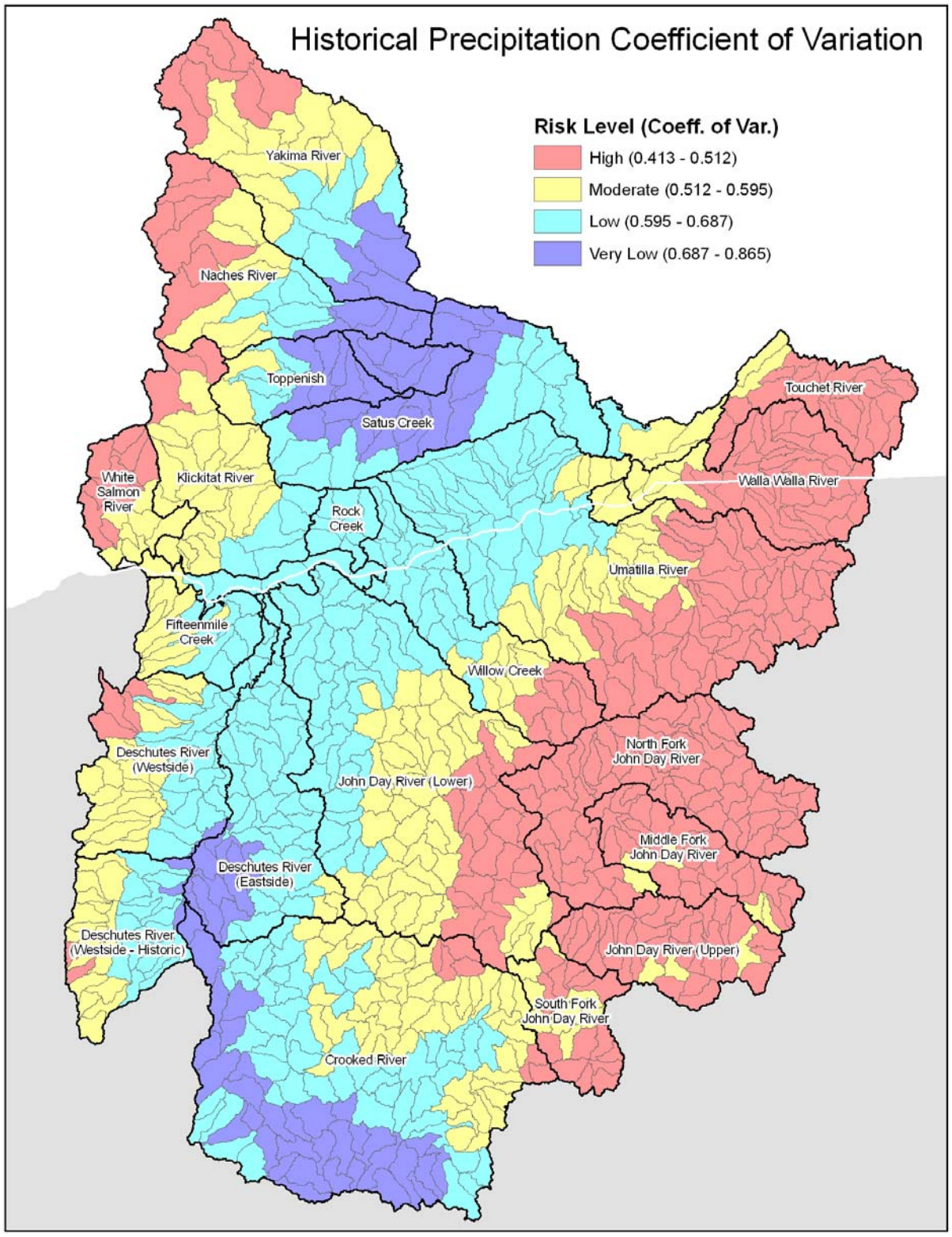


Figure 8-24. Precipitation coefficient of variation for the period (1971-2007) and relative risk for Mid-Columbia River steelhead (6th field hydrologic units). Data sources include Brown (2009) and PRISM Climate Group (2007).

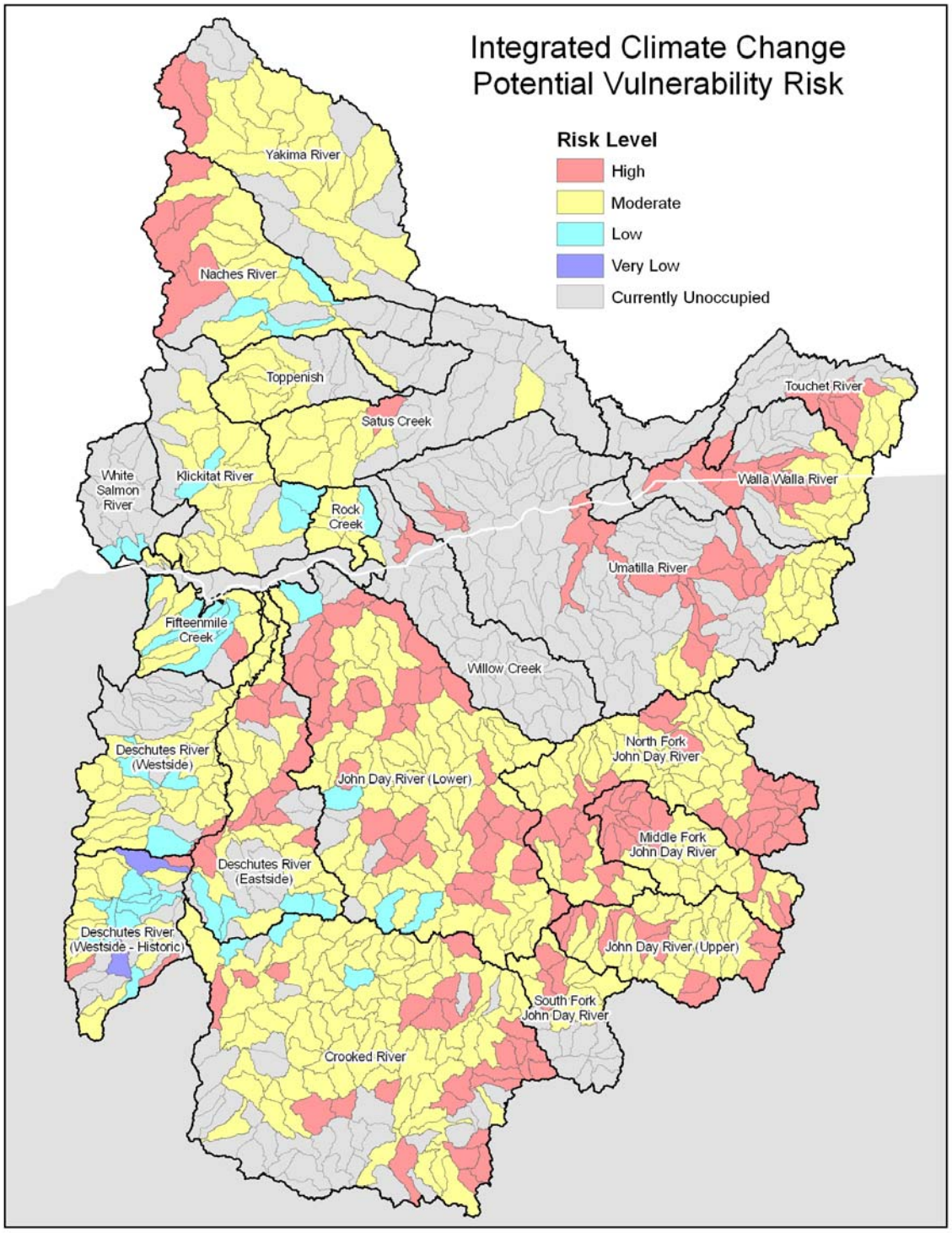


Figure 8-25. Integrated climate change potential vulnerability risk for Mid-Columbia River steelhead (6th field hydrologic units). Integrated risk index was developed from springtime water availability change risk, summer temperature change risk, and historical variation in precipitation.

Section 9 Recovery Strategies and Management Actions

This section describes strategic guidance, strategies and specific management actions proposed for achieving recovery of Oregon populations in the Mid-Columbia River steelhead DPS. The strategic guidance supplies the framework for developing strategies and prioritizing actions at all scales. The management strategies and actions provide an integrated approach to address threats across the entire life cycle. These are identified in sections 9.3 (Tributary Habitat), 9.4 (Hydrosystem), 9.5 (Estuarine and Plume Habitat), 9.6 (Harvest), 9.7 (Hatcheries) and 9.8 (Predation and Competition). Together the strategies and actions provide broad guidance for recovery efforts at the local and regional level, consistent with both regional and local visions, as well as detailed management actions.

While fundamentally intended to produce biological results, strategies and actions included in this plan also reflect economic, political, social, and cultural considerations. In particular, they are framed to regain DPS viability as well as make progress beyond delisting criteria to broad sense recovery goals. These considerations are critical to the prospects for developing and implementing an effective and equitable plan. It is expected that additional actions will be incorporated over time as part of the ongoing adaptive management process.

9.1 Strategic Guidance for Management Actions

Achieving recovery for the Mid-Columbia River steelhead DPS will depend on restoring the viability of extant populations in major population groups to levels that support the proper functioning of the DPS. This will require intensive effort by individuals at the regional, watershed and local levels. It is clear that not all of the management actions that should be implemented can be done in the near-term due to various constraints.

The purpose of this strategic framework is to provide guidance for developing and prioritizing management actions to recover Mid-C steelhead populations. Prioritized actions will lead to more timely and effective results. Our strategic vision recognizes that reversing the decline of key populations, life histories, and habitats requires use of well-formulated scientifically sound approaches. Since multiple causes are responsible for impaired population viability and disrupted ecosystem function, limiting factors and threats throughout the entire life cycle will need to be addressed in concert. Efforts must also be focused to protect and enhance populations that are critical to achieving DPS recovery.

As part of this and other planning processes, management actions and strategies were developed at multiple scales including tributaries, watersheds, and the Columbia River mainstem and estuary to achieve recovery of local populations. This strategic framework is used as strategic guidance for where, when, and how actions identified in this plan are implemented to address factors and threats limiting viability of extant and extirpated Mid-C steelhead populations.

Managing for past, current and future adverse impacts of human activities throughout the life cycle is critical to achieving recovery goals. Development and implementation of management actions that lead to recovery will require a sound understanding of conservation biology

principles and ecosystem management as well as integration of leadership, planning, funding, monitoring, policy and science such that each contributes synergistically in a timely and effective manner. The approaches to ecosystem restoration and management actions needed to achieve recovery goals will necessarily vary by ecosystem type, management objectives of the various lands and ownerships within the ecosystem, and social and economic capacity to support the effort. Actions that balance achievement of sustainable environmental, social, cultural and economic processes have the best chance of success for the long term.

The primary goals of the recovery plan are to:

1) Sustain the ecosystem processes that currently, and will in the future, support high quality habitats and their productive capacity.
2) Enhance ecosystem processes that are impaired but are currently important to productive capacity.
3) Restore habitat and ecosystem processes that were historically important but do not currently contribute to productive capacity.

We identified some key principles (adapted from Meffe and Carrol 2002) that form the basis for sound salmon recovery efforts, including:

1) Set aside or protect the highest quality habitat
2) Prevent any further habitat degradation
3) Maintain and restore critical ecological processes
4) Develop goals and objectives based on thorough understanding of ecological processes and properties of the systems
5) Conserve and restore evolutionary processes
6) Manage in an adaptive manner that is minimally intrusive

Conservation of the existing quality habitat that supports core production and primary life history types — as well as quality migration habitats within populations and across the DPS — is the critical first step toward recovery. This needs to include a shared vision of desired ecosystem conditions that integrates ecological, socioeconomic, and institutional perspectives and identifies ways in which all parties can contribute to and benefit from achieving the desired ecosystem conditions. Protecting and restoring the normative natural ecological processes throughout the entire life cycle is essential for conserving the productive capacity of the habitat.

These principles provide general guidance but are difficult to apply specifically for prioritizing a broad list of actions at the population, major population group, and DPS levels. Because we have the need for criteria that deal with setting priorities across broad geographic and ecological scales, we propose more detailed prioritization considerations that are formulated from the broader conservation principles. In simplistic terms, the order of priority is first to protect and conserve high quality habitats and natural processes that currently support productive capacity and implement actions that provide immediate abundance and productivity benefits through reduction of key limiting factors and threats; second to enhance habitat and restore natural processes that are impaired but are currently important to productive capacity; and last to restore

habitat and natural processes that were historically important but do not currently contribute to productive capacity.

9.1.1 Prioritization Considerations

Setting priorities for management actions is difficult because of the scientific complexity and diverse policy issues and economic implications. Although priorities must be science based, they are ultimately policy choices. The following considerations are used as guidance and criteria for the development, prioritization, and implementation of management strategies and actions for recovery of Mid-C steelhead populations in Oregon.

We consider actions that achieve the following to be highest priority:

- Actions that provide long-term protection of habitat conditions and conservation of natural ecological processes that support the viability of priority extant populations and their primary life history strategies throughout their entire life cycle. A population is considered a priority if it is critical for MPG or DPS viability.
- Actions that protect or enhance viability of multiple steelhead populations.
- Actions that support conservation of unique and rare functioning habitats, habitat diversity, life histories and genetic attributes.
- Actions that target the key limiting factors and that contribute the most to closing the gap between current status and desired future status of priority populations.
- Actions that provide immediate benefits to enhancing the viability of priority populations.
- Actions that provide critical information needed for assessing success and making adaptive management decisions.

We consider the following types of actions to be high priority but less than highest:

- Actions that enhance the habitat conditions and restore natural ecological processes of priority extant populations and their primary life history strategies throughout the entire life cycle.
- Actions that enhance the viability across the entire life cycle of priority extant populations.
- Actions that are required to protect and enhance habitats for populations that are not critical for MPG or ESU viability but must be maintained.

Other things being equal, actions that demonstrate the following have enhanced priority:

- Actions where opportunity for success is high (rather than those of limited feasibility).
- Actions that likely produce a large (rather than small) improvement in viability attributes.
- Actions that support restoration of normative ecological processes rather than short-term substitutions for normative processes.
- Actions that are complementary to other land management, water quality, environmental management and recreational objectives as specified in fish management, conservation, recovery or other plans developed with and supported by regional and subbasin stakeholders (rather than those that are isolated, stand-alone efforts).

- Actions that have regional and local support and generate increased participation.
- Actions that demonstrate cost effectiveness relative to alternative means of achieving the same objectives.
- Actions that have high degree of certainty in effectiveness and outcome.

9.2 An Integrated Approach

In previous sections of this plan we identified delisting goals, broad sense recovery goals, current status and viability gaps, as well as limiting factors and threats across the entire life cycle. These elements serve as essential building blocks for identifying the strategies and actions needed to close viability gaps, reach delisting status, and progress toward our broad sense recovery goals.

The strategies and actions are developed to address the viability gaps and primary threats and factors currently limiting recovery of Oregon's Mid-C steelhead populations. Our integrated approach is designed to ensure that recovery efforts are developed and implemented in a scientifically sound and systematic manner. We strive to ensure that all recovery actions effectively complement and support each other in achieving the broad sense recovery goals.

Recovery strategies are designed to address the twelve types of factors discussed in Section 8, Limiting Factors and Threats, that affect steelhead viability throughout their entire life cycle. These factors fall into six different categories: tributary habitat; estuary/mainstem habitat; mainstem hydropower configurations and operations; in-subbasin and out-of-subbasin harvest; hatcheries; and predation and competition. Similarly, strategies and actions described in this section address threats and limiting factors in each of these categories. Table 9-1 illustrates the kinds of connections that exist between limiting factors, strategies, and actions.

The integrated approach is also intended to ensure that costs and consequences of achieving recovery are equitable across the affected constituencies. Recovery can be achieved with different combinations of actions implemented at different intensities among and on varying timelines. Thus, the plan defines expectations and direction for the various parties who will implement elements of the plan in a broader context of scientific, technical, economic, political, social, and cultural considerations. The plan also includes a strategic prioritization framework to provide flexibility for implementing parties to select, scale, and adapt regional and local strategies and actions to optimize effectiveness and efficiency in plan implementation, while also ensuring that steps toward recovery are consistent with regional goals and objectives.

Recovery of the Mid-C steelhead DPS is predicated on assumptions that: 1) remaining populations still retain the inherent characteristics needed to sustain healthy, harvestable levels when suitable conditions are provided; 2) declining trends can be reversed with appropriate actions; and 3) society is willing and able to implement appropriate strategies and their associated actions in a suitable timeframe. Guidance from the ICTRT recognizes that it may not be feasible, nor required, to protect and restore all existing populations to viable status. ICTRT criteria allow some populations to maintain status below viability standards. The plan assumes that a focused and broadly based effort will protect and restore a sufficient number of populations to ensure long-term viability and opportunities for harvest. This effort will require concerted and substantive action by people throughout the region.

Table 9-1. Integrated approach to address threats and factors limiting recovery of Oregon's Mid-Columbia River steelhead populations.

Strategies	Types of Actions	Limiting Factors and Threats Addressed
Tributary Habitat		
Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.	Protect highest quality habitats through acquisition and conservation. Adopt and manage Cooperative Agreements. Conserve rare and unique functioning habitats. Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	Degradation of tributary habitat-forming processes and functions (loss of channel structure, floodplain connectivity, riparian vegetation, and LWD recruitment)
Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.	Provide passage at Pelton-Round Butte Complex. Remove or replace barriers blocking passage such as dams, road culverts and irrigation structures. Provide screening at 100% of irrigation diversions. Replace screens that do not meet criteria.	Loss of historical habitat because of blocked or impaired fish passage (dams, culverts, unscreened diversions)
Maintain and restore floodplain connectivity and function.	Reconnect side channels and off-channel habitats to stream channels. Restore wet meadows. Reconnect floodplain to channel.	Degraded floodplain connectivity and function (loss of off-channel habitat, side channels, connected hypotheic zone)
Restore degraded and maintain properly functioning channel structure and complexity.	Place stable wood and other large organic debris in streambeds. Stabilize streambanks. Restore natural channel form.	Degraded channel structure and complexity (loss of spawning and rearing habitat, LWD, pools)
Restore riparian condition and LWD recruitment and maintain properly functioning conditions.	Restore natural riparian vegetative communities. Develop grazing strategies that promote riparian recovery.	Degraded riparian condition (native riparian vegetative communities, LWD recruitment)
Restore natural hydrograph to provide sufficient flow during critical periods.	Implement agricultural water conservation measures. Improve irrigation conveyance and efficiency. Lease or acquire water rights and convert to instream.	Altered hydrology (low flow, scouring peak flows due to degraded watershed conditions, streamflow alterations and/or withdrawals for irrigation and other uses)
Improve degraded water quality and maintain unimpaired water quality.	Reduce chemical pollution inputs. Apply BMPs to animal feeding operations. Restore natural functions and processes through remediation actions.	Degraded water quality (high temperatures, nutrients, pesticides and other chemicals)
Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.	Achieve 95% conversion to no till farming. Upgrade or remove problem forest roads. Restore native upland plant communities. Employ BMPs to forest practices, livestock grazing, road management and agricultural practices.	Altered sediment routing and runoff patterns due to upland management activities.
Estuarine and Plume Habitat		
Restore degraded estuarine and plume habitats and associated ecological processes	Protect/restore riparian areas Remove pile dikes Protect remaining high-quality off-channel habitat Breach or lower dikes and levees Identify and reduce sources of pollutants Monitor and restore contaminated sites	Degraded estuarine and nearshore marine habitat reduces refugia available to juvenile steelhead in Columbia River estuary and plume as they prepare for ocean life.
Hydropower Systems		
Operate the FCRPS to more closely approximate the shape of the natural hydrograph to enhance flows and water quality to improve juvenile and adult fish survival.	Draft storage reservoirs (Libby, Hungry Horse, Grand Coulee, and Dworshak) in attempt to meet seasonal and weekly flow objectives in the lower Columbia River during July and August. Pursue negotiations with Canada to provide 1 million acre feet of storage to augment summer flows. Meet Non-Treaty storage refill responsibilities and pursue a new long-term agreement on use of non-treaty space in Canadian reservoirs. Implement drafts and other measures to improve flows	Altered steelhead migration conditions and delayed passage due to hydrosystem development and operations in mainstem Columbia River.

Strategies	Types of Actions	Limiting Factors and Threats Addressed
	during the lowest 20th percentile years. Implement Water Quality Plan for Total Dissolved Gas and Water Temperature in the Mainstem Columbia and Snake rivers.	
Modify Columbia and Snake River dams to maximize juvenile and adult survival.	Implement project specific configurations and operations at the eight mainstem dams on the lower Snake and Columbia rivers.	Altered juvenile and adult steelhead migration conditions due to mainstem Columbia River hydrosystem.
Implement spill and juvenile transportation improvements at Columbia and Snake River dams.	Provide spill to improve juvenile fish passage. Implement interim transportation program to improve survival of transported fish.	Altered juvenile and adult steelhead migration conditions due to mainstem Columbia River hydrosystem.
Operate and maintain juvenile and adult fish passage facilities at Corps mainstem projects to maintain biological performance.	Corps will operate juvenile and adult passage facilities year around with the regionally coordinate Fish Passage Plan.	Altered juvenile and adult steelhead migration conditions due to mainstem Columbia River hydrosystem.
Restore sustainable natural steelhead production to blocked habitats in the Deschutes River Westside, Deschutes River Eastside and extinct Crooked River populations.	Develop downstream collection and passage through Pelton-Round Butte Complex. Improve flow patterns through reservoir for juvenile migration. Modify hydro operations to restore water quality.	Tributary hydrosystem operations and configurations block access to historical habitats and alter habitat conditions in Deschutes River system.
Improve hydrosystem operations and facilities to enhance steelhead survival and viability in the Umatilla and Walla Walla river systems.	Modify bypass flows at Boyd Project as needed to mimic instream water right. Modify fish passage facilities at Boyd Project to meet current standards. Remove weir panels from diversion dam at Boyd Project during non-operation. Maintain trash racks at Boyd Project. Modify fishway at Twin Reservoirs Project to meet juvenile fish passage standards.	Tributary hydrosystem operations and configurations impair passage and alter habitat conditions in the Umatilla and Walla Walla river systems.
Harvest		
Manage to maintain current low impact fisheries and reduce harvest-related adverse effects in those fisheries that have significant impacts.	Maintain current low impact fisheries and reduce harvest-related adverse effects in those fisheries that have significant impacts.	Commercial, recreational and tribal fisheries in ocean, mainstem Columbia River and tributaries
Utilize tributary harvest to reduce abundance and proportion of stray hatchery spawners in Deschutes and John Day subbasins.	Develop educational outreach program to promote use of selective recreational fisheries to reduce the number of out-of-subbasin hatchery strays.	Straying of out-of-DPS hatchery spawners into tributary spawning grounds.
Reduce catch and release mortality on natural-origin fish in John Day subbasin.	Promote voluntary curtailment of fishing at higher water temperatures (above 21°C) to reduce hook-and-release mortality	Adverse effects of tributary harvest on natural steelhead in John Day subbasin.
Improve quality of harvest and natural-origin fish in John Day subbasin.	Expand the creel surveys to monitor fisheries effort and catch.	Adverse effects of tributary harvest on natural steelhead in John Day subbasin.
Hatcheries		
Reduce uncertainty of origin of hatchery strays and increase ability to recognize hatchery-origin fish.	Implement representative coded-wire-tagging program so all hatchery stocks have adequate CWT groups released annually. Recommend development of alternative broodstocks to reduce stray rates for programs that contribute significantly to stray problem.	Straying of out-of-DPS hatchery fish into natural spawning grounds.
Reduce uncertainty in abundance and proportion of hatchery strays spawning naturally with Fifteenmile, Deschutes Eastside and Lower John Day populations.	Increase efforts to monitor incidence of hatchery fish on spawning grounds through additional stream surveys and other methods.	Straying of out-of-DPS hatchery fish into natural spawning areas of Fifteenmile, Deschutes Eastside and Lower Mainstem John Day populations.
Reduce abundance and proportion of stray hatchery fish that spawn naturally with Deschutes Westside, Deschutes Eastside, Umatilla and	Construct, improve trapping facilities and expand operations. Eliminate adult hatchery strays above Nursery Bridge Dam.	Straying of out-of-DPS hatchery fish into natural spawning areas.

Strategies	Types of Actions	Limiting Factors and Threats Addressed
Walla Walla populations.		
Reduce genetic risks to Deschutes Westside population from Round Butte Hatchery Program.	Investigate opportunities and risks associated with incorporating naturally produced Deschutes River summer steelhead into RBH broodstock.	Inside-DPS hatchery genetic risks
Restore natural production into historically utilized habitats in the Deschutes Westside and Umatilla populations.	Develop plan for steelhead reintroduction into historical habitat above Pelton-Round Butte Complex when passage is restored. Re-establish natural production in Little Butter and Butter creeks and some minor spawning areas.	Risks related to steelhead reintroductions to historical habitat using inside-DPS hatchery fish.
Reduce genetic influence of hatchery fish in hatchery broodstock in the Umatilla subbasin.	Eliminate use of hatchery produced adults in the broodstock	Potential divergence in genetic and phenotypic traits between hatchery and natural-origin steelhead.
Reduce interactions between residual hatchery steelhead and natural steelhead in the Umatilla subbasin.	No consensus actions.	Risk of hatchery fish competing with and preying on natural steelhead juveniles
Reduce potential negative ecological interactions between coho salmon and natural steelhead in the Umatilla subbasin.	Reduce number of hatchery coho released in Umatilla River and relocate releases downstream to areas not currently important to steelhead production	Potential for coho smolts to compete with juvenile steelhead for prey resources and space
Predation and Competition		
Reduce predation and competition in the Columbia River mainstem, estuary and plume.	Reduce predation by pinnipeds Redistribute Caspian terns Redistribute cormorants	Increased predation on steelhead due to degraded estuarine and plume habitats, and to hydrosystem development and operations in mainstem Columbia River.

9.2.1 Building on Current Efforts

We recognize that many steps have already been taken or are currently underway that will improve the status of different Oregon Mid-C steelhead populations. In tributary watersheds state and federal natural resource managers, tribes, local governments, watershed councils, soil and water conservation districts, non-profit organizations, local land owners and others continue to improve stream conditions to support viable steelhead populations throughout their freshwater life stages. They are also improving land use practices on uplands and floodplains that are allowing natural ecosystem functions and processes to recover. State of Oregon Forest Practices Rules were adopted in 2002 and provide improved protection through a variety of guidelines. The rules address roads built in critical locations, and in addition, private landowners implement voluntary actions to address conditions on roads built prior to 2002. Private forest landowners have experienced disincentives to active placement of large wood in the past. A recent decision has led to the ability of private landowners to place large wood under the authority of the Oregon Forest Practices Act without additional permits. This streamlined process has renewed landowner enthusiasm to place large wood. Federal lands are managed under PACFISH and Northwest Forest Plan guidelines. These guidelines provide significantly improved protection and restoration standards on federal lands.

Oregon Water Resources Department has made progress in enhancement of streamflows. Live surface flow is closed to new appropriations in 99% of the Mid-C area during the low flow period in the month of August. To date, 1,760 stream miles are protected by in-stream water rights, and in 2006, 85 cfs was restored to Mid-C streams. Interest in voluntary flow restoration is gradually increasing.

To illustrate the magnitude of effort that is underway and the types of projects completed, we compiled a list of habitat projects that have been implemented in each population on all types of lands over the past 11 years (Appendix C). Similar efforts are underway in the Columbia River estuary that will improve estuarine and plume habitats and reduce predation (Appendix D). In the mainstem Columbia River, hydrosystem managers and fish resource mangers continue to refine hydropower system operations to address the needs for survival and recovery of the Mid-C steelhead DPS and other ESA-listed salmon and steelhead. Many hydropower configuration and operational improvements have been implemented in recent years that have provided survival benefits for Mid-C steelhead (Appendix D). In the Hydro BiOp remand process, new hydropower configuration and operational improvements are proposed.

Hatchery programs operated within the DPS have been modified substantially over the past 10 years to reduce threats and improve contribution to recovery. Programs have been reduced in scope, release locations have been modified, and considerable emphasis has been placed on assessing the source and potential impacts of strays. As described earlier, extensive harvest management changes in both the mainstem and tributaries have been implemented to reduce the impacts of fisheries.

This plan is designed to build upon past and current efforts that are already improving population viability and habitat conditions. Many of these efforts are described in the plan along with their sufficiency and gaps so that future actions expand from and improve the effectiveness of the efforts. Spreading the responsibility among a range of parties lessens the cost to any one group, increases the certainty of success, and compounds the benefits of moderate improvements in each factor.

Together, the strategies and actions identified in the following subsections outline an integrated approach that will support the viability of Oregon's Mid-C steelhead populations and their primary life history strategies throughout their life cycle. These strategies and actions are designed to address threats to population viability from tributary habitat degradation, estuarine and nearshore marine habitat degradation, the Columbia River hydropower system, harvest management, hatchery management, and predation.

9.3 Tributary Habitat Strategies and Actions

The suites of strategies and actions proposed in this section will protect and improve ecosystem functions and restore normative ecological processes to levels that support recovery of Oregon's Mid-C steelhead populations. The strategies and actions were developed by planning teams comprised of natural resource specialists for the Fifteenmile, Deschutes, John Day, Umatilla and Walla Walla watersheds. The actions reflect direction identified in related regional and local plans, recent modeling and research findings, and local expert input provided by the planning team members. Together, these strategies and actions call for maintaining high quality habitats and their productive capacity, improving ecosystem processes and habitats that are impaired but are currently important to productive capacity, and habitat restoration through passive and active measures. The strategies and actions represent a complete list of needs, somewhat unconstrained by logistic and financial concerns.

- Protection of existing high quality habitats is a broad economical approach of ensuring no net loss in habitat quality and maintenance of normative ecological processes. Many objectives are likely to be met through habitat protection and the associated natural recovery of upland and riparian areas. Land acquisitions, easements, cooperative agreements, and protective land designations facilitate the accomplishment of high quality habitat protection.

- Maintaining improved habitats and halting further degradation in habitats that are not at desired condition but are still important to productive capacity is an important element of habitat management. Changes resulting from improved land use practices can be an important element to improve habitat management and ecosystem function. Education, comprehensive land use planning, and regulations can provide habitat protection and support ecosystem functions by managing growth and land use so that critical habitats and watershed functions are preserved. Those that are integrated with social and economic goals while providing desired protection are most sustainable.

- Broad opportunities exist to improve habitat conditions for Mid-C steelhead populations through restoration. The success of these strategies is enhanced when actions build from existing restoration efforts, incorporate a range of project types that address the many interrelated habitat impairments, and take into account socioeconomic and institutional perspectives. Generally, our strategies and actions stress passive approaches to restoration (such as changes in grazing management that promote riparian recovery) over active restoration (manual placement of structures) as the preferred approaches to overall habitat restoration. In some areas, regulations are expected to provide passive restoration; however, we recognize that riparian function may take a long time to fully recover. Active restoration can provide improvements in some cases while natural processes are being restored through passive approaches.

We defined eight tributary habitat strategies that are directly linked to the limiting factors. We organized the habitat actions and associated information for each population by the habitat strategies:

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.

Strategy 3. Maintain and restore floodplain connectivity and function.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.

For each strategy, we examined key programs that currently contribute to actions that serve to achieve the strategy, as well as the sufficiency of the existing programs. We identified specific actions needed to fill the gaps between what is currently being implemented and what is needed in the long term to fully achieve the strategy. Actions differ from strategies in that they address specific needs for a specified geographic area, program deficiencies, as well as biophysical habitat impairments and threats.

We also identified priority areas and actions for each population based on relative importance in meeting local and regional recovery objectives for Mid-C steelhead (Figure 9-1). Priority 1 reaches represent the habitats where management actions will yield the greatest benefits towards improving the viability. The strategic guidance provided earlier in this section served as the basis for identifying priority areas and actions within each population. We realize that the result of our process is a long list of priority 1 and priority 2 habitat actions for each population. We view the population specific implementation plans as the vehicles for developing the specific time and place roadmap for implementation of priority actions. We recognize there is repetition in the actions between populations. We envision local groups using the individual population action tables for development of specific implementation plans.

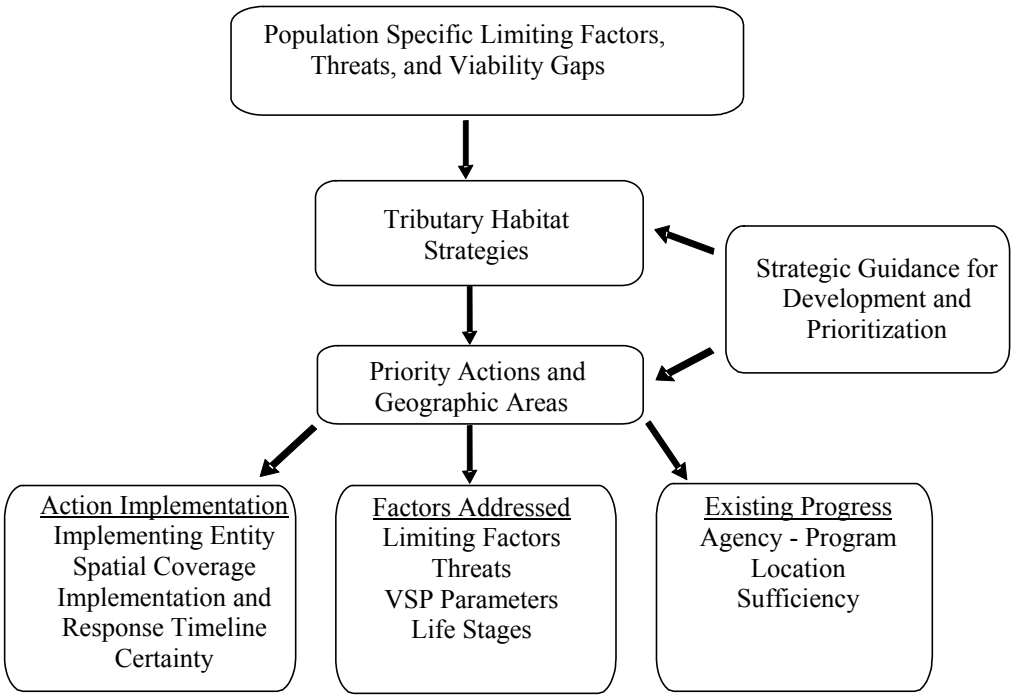


Figure 9-1. Flow chart illustrating the process for development of tributary habitat strategies, actions, and programs and their characteristics.

The following tables show strategies and actions needed to address tributary habitat limiting factors and threats for Oregon Mid-C steelhead populations. The tributary habitat strategies are not presented in priority order. Strategy tables for each population identify specific actions, limiting factors and threats addressed, and viability parameters and life stages that are most affected. Individual actions are described in terms of the status of current efforts, implementing entities, strategies addressed, spatial coverage, implementation timeframe, expected biophysical response timeframe and certainty of outcome. Priority locations are stream reaches or areas where actions should be implemented first to achieve the greatest benefit. Education and outreach actions are discussed in the first strategy only; however, they need to be applied to the implementation of all eight of the habitat strategies for all populations.

The tables also identify key programs that are currently implementing actions and discuss program sufficiency and gaps. Program sufficiency, sufficiency rationale, and program improvement needs for State of Oregon programs and most Federal programs were assessed through a formal process conducted by the State of Oregon and the Federal entities. These reviews resulted in independent reports that were then used to compile the sufficiency information in the action tables. The Oregon State Agencies program sufficiency report is not finalized; therefore, the actual sufficiency ratings were not available for use in this document. However, rationale related to the strengths and weaknesses of the State Agency programs is available and appended to this plan. For the non-state and non-federal programs, as well as federal programs that were not reviewed in the USFS/BLM Program Sufficiency Assessment, program sufficiency was assessed by the management action teams in cooperation with the implementing entities. Program sufficiency assessments are difficult to conduct. In many cases the legal mandates of a specific program were not necessarily developed for the purposes of recovering steelhead. The conclusions of an assessment can be biased when the assessment is conducted by the managers of the program for a variety of reasons. Unbiased outside reviews are probably the best approach, but can be very costly and take considerable time. We caution readers not to place too much emphasis on the sufficiency ratings themselves. We view the value of the sufficiency assessments primarily in characterizing the constraints, types of improvements, and modifications that would result in improved effectiveness of programs contributing to recovery of Mid-C steelhead.

9.3.1 Habitat Strategies and Actions for Fifteenmile Creek Steelhead Population

Primary limiting factors: low flows, high water temperatures, sedimentation, channel confinement, impaired riparian ecosystems, and reduced habitat quality.

Primary threats: roads, residential development, agricultural practices and forest uses.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Protect the highest quality habitats through acquisition or conservation measures	1-Fifteenmile Cr. (Hwy 197 upstream to FS boundary) 1-Eightmile Cr. (Hwy 197 upstream to FS boundary) 1-Ramsey Cr. (mouth to FS boundary) 2-Fivemile Creek from Hwy 197 upstream to headwaters.	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing	All	All	All	Protecting high quality habitats is the most cost effective way to ensure fish have good quality habitat. It is much less expensive over the long term to protect high quality habitat than it is to degrade the habitat and then try to restore it. Protection of existing high quality habitat areas is a broad strategy capable of contributing to meeting all of biological habitat objectives. Land acquisitions, easements, and cooperative agreements will facilitate the implementation of protection and conservation.
Protect and conserve rare and unique functioning habitats	Considering the unique winter life history form present for the MaSA, and no other winter steelhead in DPS, they are all unique. Entire MaSA 1-South Fork Mill Cr. (Water treatment to falls)	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing	All	All	All	Protecting high quality unique habitats is the most cost effective way to ensure fish have good quality habitat. South Fk. Mill Creek from water treatment plant to falls is in pristine condition. One of few areas in the MiSA that remains pristine.
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes	1-Fifteenmile Creek MaSA and MiSA	All factors	All	All	All	To prevent habitat degradation BMPs and existing laws that protect habitat should be applied throughout the population.
Conduct outreach to resource users and managers	1-Entire population	All factors	All	All	All	Program efficiencies will be improved through increased knowledge and understanding of the importance of habitat conditions and land use practices.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Protect the highest quality habitats through acquisition or conservation measures.	CTWSRO, ODFW, SWCD, USDA FSA, land trusts, NGOs	Ongoing	Population-wide	Existing conservation agreements are complete. Full implementation of conservation measures will take 25 years or more	Conservation benefits are immediate	High
Protect and conserve rare and unique functioning habitats.	Land trusts, CTWSRO, ODFW, SWCD, NGOs, USFS	Ongoing	Population-wide	Immediate	Immediate	High
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	SWCD, USFS, private landowners, ODA, CTWSRO	Ongoing	Population-wide	Long term	Degradation prevention immediate, improved conditions 15-25 years	High
Conduct outreach to resource users and managers.	ODFW, NOAA Fisheries, USFWS, USFS, BLM, CTWSRO, Watershed Councils, SWCDs	Ongoing	Entire subbasin	Long term	Variable lag time	Unknown, depends upon action taken as a result of being more informed

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
USFS	Fifteenmile Riverkeeper	USFS lands and non-forest lands under Wyden Amendment Authority	Likely	Positive results where the program has been implemented, but it could be expand to more forest lands in the population, and become more available off forest lands. Contingent on year to year funding appropriations
ODFW	Fifteenmile Creek Fish Habitat Restoration Project	Private lands throughout population	No	Positive results where the program has been implemented, but funding and landowner cooperation limits the amount of available projects. In addition, limited legal guarantees that landowners remain in program.
USFS	Northwest Forest Plan	All Mt. Hood National Forest lands	Yes	See USFS/BLM Program Sufficiency Assessment -- Appendix E.
Wasco County SWCD/USDA FSA	CREP, CRP	Private riparian areas and qualified uplands throughout population	Uncertain	Both programs are effective at protecting riparian areas and uplands, however additional lands need to be enrolled. CRP program is near capacity for Wasco County. Some landowners reluctant to enter the federal programs. See State of Oregon programmatic review -- Appendix F.
Oregon Water Trust or other entity	Lease or purchase instream water rights	Fifteenmile, Eightmile, Fivemile MaSA	No	Program has been effective at obtaining water rights, but maintaining water instream to the mouth of the river is difficult. Many landowners reluctant to enter into program. It is important to secure water rights to guarantee instream flow.
Wasco County SWCD	No-till Conversion	Uplands throughout population		An effective program at reducing erosion, but needs to be expanded to additional properties.
OWEB	Watershed Councils	Fifteenmile and The Dalles		See State of Oregon programmatic review -- Appendix F.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.				
		watershed council		
ODA	Agricultural Water Quality Management Program	Fifteenmile population unit		See State of Oregon programmatic review -- Appendix F.
CTWSRO	Watershed Restoration	Tribal lands on Fifteenmile Creek	No	Various programs designed to improve riparian, stream, and upland conditions along tribal lands. Additional restoration and protection efforts are needed.
ODF	Oregon Forest Practices Act	Private and state forestlands in Fifteenmile, Eightmile, Ramsey , and Fivemile creeks		See State of Oregon programmatic review – Appendix F.
Local Government, irrigation districts	City and County Planning and Zoning	Private lands throughout the entire population	Yes	Compliance with zoning requirements is high
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Many programs already in place in the subbasin are designed to restore physical habitat. These programs have proven effective, but it will take years to return the stream to a more natural condition. Existing forest plans include special management designations for riparian reserves. Adding additional wilderness areas and wild and scenic river segments would require designation by Congress. The forest plans and BLM plans have been amended by the Northwest Forest Plan that requires riparian reserve boundaries of two site potential tree heights on both sides of any fish bearing stream and contains very restrictive standards and guidelines to ensure protection of aquatic and riparian resources. Compliance with riparian reserve standards and guidelines for a variety of land use activities including forest practices operations, cattle grazing, and others has been very good. Farm Service Agency (FSA) programs that protect riparian areas and upland watersheds include the Conservation Reserve Program (CRP) and the Conservation Reserve Enhancement Program (CREP). The CRP program pays landowners not to farm highly erodible soils and the CREP program pays landowners for setting riparian corridors aside from grazing and farming. The long term effectiveness of both programs is limited by the relatively short duration of the contracts which ranges from 10 to 15 years. ODA's Agricultural Water Quality Management Program is designed to prevent and control water pollution from agricultural activities and soil erosion on non-Federal and non-Tribal Trust or Reservation lands. ODA relies on voluntary measures to protect water quality, but also enforces pollution and streamside vegetation requirements.				

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Replace barriers blocking passage including dams, road culverts and irrigation structures	1-Barriers that limit adult access: Ramsey Creek (culvert FS 4450 Rd), Ramsey Creek (Olsen Irrigation Diversion RM 3.5), Fifteenmile Tenold Diversion (RM 2.0), Culvert at FS Rd. 44, Dam at Boys Scout Camp Baldwin on Ramsey Creek (RM 11.0) 2-Barriers that limit juvenile access: Fifteenmile same as adults Threemile Creek (Hwys. I-84 & 197) Chenowith Creek Bridge at Hwy. 30 Fixed Long, Douglas, Standard Hollows Mays Canyon	Impaired fish passage	Dams, culverts, instream structures	Spatial structure, productivity	Primarily adults and 0+juveniles	Spatial structure of the Fifteenmile winter steelhead population has been modified and restricted by culvert barriers and hostile environmental conditions in the middle and lower elevations (NPCC 2004).
Provide screening at 100% of irrigation diversions	1-Additonal survey needed to identify unscreened diversions	Impaired fish passage	Irrigation diversions	Spatial structure,	Primarily adults and	Known diversions are screened to criteria.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
	2-All known diversions are screened in the Fifteenmile MaSA.			productivity	0+juveniles	
Replace screens that do not meet criteria	1-Additional survey needed 2-Fifteenmile all known screens meet criteria.	Impaired fish passage	Irrigation diversions	Spatial structure, productivity	Primarily adults and 0+juveniles	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Replace barriers blocking passage including dams, road culverts and irrigation structures	USFS, SWCD, ODFW	Ongoing	At barriers	Ongoing	Immediate	High
Provide screening at 100% of irrigation diversions	ODFW, BPA, NOAA Fish	Ongoing	At point of diversion	All legal diversions screened in Fifteenmile. Need further survey work to determine number of screens in other areas	Immediate	High
Replace screens that do not meet criteria	ODFW, BPA, NOAA Fish	Ongoing	At point of diversion	Legal diversion meets criteria. Need further survey work in MiSA to determine number of screens	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	Fish Passage/Screening—State and Federal funded programs	Unscreened or poorly screened diversions throughout population	Uncertain	Continued funding of federal program is uncertain. New and replaced screens are sufficient. See Appendix F for State program review.
ODOT	Culvert replacement or retrofit	Threemile Creek culvert at Hwy. I-84 and Hwy. 197; Chenowith Creek Bridge at Hwy. 30		See State of Oregon programmatic review -- Appendix F.
USFS	Culvert replacement	USFS lands	Likely	Funding and priority of programs is uncertain. Timeframe for completing work uncertain.
Wasco County Road Department, OWEB, Wasco County SWCD	Culvert replacement	North Fk Mill Creek (RM 6.0)		Funding and priority of programs is uncertain. See State of Oregon programmatic review -- Appendix F.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
The technology to provide sufficient passage conditions with screens and culverts is available and in use. Programs implementing these improvements are generally underfunded thus resulting in uncertain sufficiency ratings. The Forest Service Pacific Northwest Region's Aquatic Restoration Strategy (USDA-FS, 2005) provides guidance that will help prioritize culvert replacements for this population.

Strategy 3. Maintain and restore floodplain connectivity and function.

Strategy 3. Maintain and restore floodplain connectivity and function.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Reconnect floodplains to channels	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Ramsey Cr. (Mouth to new FS boundary)	Degraded floodplain, altered hydrology, altered	Removal of wetlands, side channels, off-stream	Abundance, productivity,	Primarily fry, summer parr,	Floodplains and channels that are in balance are essential for proper

Strategy 3. Maintain and restore floodplain connectivity and function.						
	1-Eightmile Cr. (Hwy 197 to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary) 2-Dry Cr.(Mouth to headwaters) 2-Mill Cr.(Mouth to North Fork) 2-North Fk. Mill Cr. (mouth to FS boundary)	sediment routing, degraded water quality	habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	spatial structure	winter parr	stream function.
Reconnect side channels and off-channel habitats to stream channels	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Ramsey Cr. (Mouth to new FS boundary) 1-Eightmile Cr. (Hwy 197 to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary) 2-Dry Cr.(Mouth to headwaters) 2-Mill Cr.(Mouth to North Fork) 2-North Fk. Mill Cr. (mouth to FS boundary)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity, spatial structure	Primarily fry, summer parr, winter parr	Side channels provide habitat for spawning and rearing and refugia from high flows.
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes	Population-wide	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat	Abundance, productivity, spatial structure	Primarily fry, summer parr, winter parr	Beaver have started to recolonize many areas in the watershed.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Reconnect floodplain habitats	ODFW, watershed council, SWCD, USFS Riverkeeper	Ongoing	Improved connectivity with channel will be localized; improved water table will increase streamflow and lower water temperatures downstream.	Long term	5-15 years	Moderate
Reconnect side channels and off-channel habitats to stream channels	ODFW, watershed council, SWCD, USFS Riverkeeper	Ongoing	Improved connectivity with channel will be localized; improved water table will increase streamflow and lower water temperatures downstream.	Long term	5-15 years	Moderate
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes	ODFW, USFS	Ongoing		Long Term	5-15 years	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
USFS	Fifteenmile Riverkeeper	USFS lands and non-forest lands under Wyden Amendment Authority	Likely	Positive results where the program has been implemented, but it could be expanded to more forest lands in the population, and become more available off forest lands. Contingent on year to year funding appropriations.
ODFW	Fifteenmile Creek Habitat Restoration Project	Private lands in MaSAs from forest service boundary downstream to mouth.	No	Additional projects may be available. Funding may be an issue.
ODF	Oregon Forest Practices Act	Private and state forestlands in Fifteenmile, Eightmile, Ramsey , and Fivemile Creeks		See State of Oregon programmatic review -- Appendix F.
Wasco SWCD	Watershed restoration	Areas from forest service boundary		Conservation protection and outreach measures needed

Strategy 3. Maintain and restore floodplain connectivity and function.				
		downstream		on private lands. See State of Oregon programmatic review -- Appendix F.
ODA	Agricultural Water Quality Management Program	Fifteenmile population unit		See State of Oregon programmatic review -- Appendix F.
CTWSRO	Watershed restoration	Reservation lands	No	Various programs designed to improve riparian, stream, and upland conditions along tribal lands. Additional restoration and protection efforts are needed.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
The Forest Service Pacific Northwest Region's Aquatic Restoration Strategy (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.				

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural channel form	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Ramsey Cr. (Mouth to new FS boundary) 1-Eightmile Cr. (Hwy 197 to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary) 2-Dry Cr.(Mouth to headwaters) 2-Mill Cr.(Mouth to North Fork) 2-North Fk. Mill Cr. (mouth to FS boundary)	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature, flows	Stream channelization, berming, bank armoring, large wood removal, beaver removal, overgrazing in riparian areas	Abundance, productivity	Primarily egg, alevins, fry, summer parr, winter parr	Fifteenmile has been extensively channelized and straightened and has subsequently downcut. Historical aerial photos indicate that the stream is shorter and steeper now than before the 1970s (NPCC 2004).
Increase role and abundance of wood and large organic debris in streambeds	1- Fifteenmile Cr.(Mouth to City of Dufur intake) 1-Eightmile Cr. (Hwy 197 to Walston Grade (RM19.0)) 1-Fivemile Cr. (Mouth to FS boundary) 2-Dry Cr.(Mouth to headwaters)	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	Large wood removal	Abundance, productivity	Primarily egg, alevins, fry, summer parr, winter parr	Many legacy effects of past land use practices continue to affect channel form and instream habitat. Current practices have less effect.
Increase instream habitat through manual placement of structures	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Ramsey Cr. (Mouth to new FS boundary) 1-Eightmile Cr. (Hwy 197 to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary) 2-Dry Cr.(Mouth to headwaters) 2-Mill Cr.(Mouth to North Fork) 2-North Fk. Mill Cr. (mouth to FS boundary)	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	Large wood removal	Abundance, productivity	Primarily egg, alevins, fry, summer parr, winter parr	Considered an active form of restoration while habitat conditions are restored through more passive efforts. Limited opportunities exist in reaches identified.
Stabilize streambanks	Limited areas throughout population	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	Stream channelization, berming, bank armoring, overgrazing in riparian areas	Abundance, productivity	Primarily egg, alevins, fry, summer parr, winter parr	Most actively eroding banks have been protected.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.						
Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Restore natural channel form	ODFW, SWCD, USFS, BPA, OWEB, CTWSRO	Expansion of existing efforts	Local to treatment area	Ongoing	Increased habitat diversity (0-10 years)	High
Increase role and abundance of wood and large organic debris in streambeds	ODFW, USFS	Expansion of existing efforts	Local to treatment area	Ongoing	Increased habitat diversity (0-10 years)	High
Increase instream habitat through manual placement of structures	ODFW, USFS	Expansion of existing efforts	Local to treatment area	Ongoing	Increased habitat diversity (0-10 years)	High
Stabilize streambanks	ODFW, SWCD, USFS	Expansion of existing efforts	Local to treatment area	Ongoing	Increased habitat diversity (0-10 years)	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, likely, uncertain, no)**	**Sufficiency Rationale**
USFS	Fifteenmile Riverkeeper	USFS lands and non-forest lands under Wyden Amendment Authority	Likely	Positive results where the program has been implemented, but it could be expanded to more forest lands in the population, and become more available off forest lands. Contingent on year to year funding appropriations.
USFS	Northwest Forest Plan	All Mt. Hood National Forest lands	Yes	See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005).
ODFW	Fifteenmile Creek Habitat Restoration Project	Private lands in population from forest service boundary downstream to mouth	Uncertain	Additional projects may be available. Funding may be an issue.
ODF	Oregon Forest Practices Act	Private and state forestlands in Fifteenmile, Eightmile, Ramsey , and Fivemile creeks		See State of Oregon programmatic review -- Appendix F.
Wasco SWCD	Watershed restoration	Private agricultural lands		Additional opportunities exist for projects, outreach, and education. See State of Oregon programmatic review -- Appendix F.
ODA	Agricultural Water Quality Management Program	Private agricultural lands		See State of Oregon programmatic review -- Appendix F.
CTWSRO	Watershed restoration	Reservation lands	No	Various programs designed to improve riparian, stream, and upland conditions along tribal lands. Additional restoration and protection efforts are needed.
OWEB	Watershed Councils	Private lands population-wide		See State of Oregon programmatic review -- Appendix F.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
The Forest Service Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funds where it is most needed.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural riparian communities including vegetative planting	1-Eightmile Cr (RM 7 upstream RM 17 mostly complete, some opportunities exist) 1-Fivemile Cr. Hwy 197 to RM 5, RM 7 upstream to FS boundary) 2-Fifteenmile Cr. (Mostly fenced or protected from livestock in recovering condition.) 2-Mill Cr. (mouth to forks)	Bank degradation, degraded riparian communities, LWD recruitment, temperatures, flow, sediment routing	Livestock grazing, agricultural conversion, roads, urban development, loss of beaver dams	Abundance, productivity	All	Riparian areas have been altered throughout the subbasin. Many areas are recovering through newly implemented conservation practices. Approximately 126 miles of stream are currently protected through some form of riparian buffer. Additional opportunities for conservation easements exist. Primary methods of riparian enhancement include riparian corridor fences to exclude livestock while controlling weeds, changes in grazing management that promote riparian recovery, and planting of native shrubs.
Develop grazing strategies that promote riparian recovery	1-Eightmile RM 8.5 2-USFS grazing allotments	Bank degradation, degraded riparian communities, flow, sediment routing	Livestock grazing	Abundance, productivity	All	Area of heavy grazing by horses. The USFS has several grazing allotments in headwater areas of several streams.
Eradicate invasive plant species from riparian areas	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Dry Cr.(Mouth to headwaters) 1-Ramsey Cr. (Mouth to FS boundary) 1-Eightmile Cr (Mouth to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary)	Degraded riparian communities	Conversion of natural riparian vegetative communities	Abundance, productivity	All	Riparian lease agreements with ODFW and CREP programs require control of noxious weeds.
Install fencing to exclude livestock from riparian areas	1-Eightmile Cr (RM 7 upstream RM 17 mostly complete, some opportunities exist) 1-Fivemile Cr. Hwy 197 to RM 5, RM 7 upstream to FS boundary) 2-Fifteenmile Cr. (Mostly fenced or protected from livestock in recovering condition.) 2-Mill Cr. (mouth to forks)	Bank degradation, degraded riparian communities, flow, sediment routing	Livestock grazing	Abundance, productivity	All	A considerable amount of riparian fencing has been completed in the population unit, however, some opportunities remain. Long term maintenance of riparian fence is needed.
Install off-stream livestock watering	1-Fifteenmile Cr. (4 sites in Dufur Valley, multiple sites mouth to Hwy 197) 1-Eightmile Cr. Multiple sites needed 1-Fivemile Cr. Multiple sites needed 2-Ramsey Cr. Multiple sites needed 2-Dry Cr. Some sites available	Degraded riparian communities, sediment routing	Livestock grazing	Abundance, productivity	All	Off-stream watering sites reduce livestock impacts on stream banks. Many solar and other innovative techniques are currently being deployed.
Plant riparian vegetation where appropriate		Bank degradation, degraded riparian communities, LWD recruitment, temperatures, flow, sediment routing	Livestock grazing, agricultural conversion,	Abundance, productivity	All	Natural vegetation restoration generally occurs without planting, some planting occurs along with fencing projects and CREP projects.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
			roads, urban development			

Action Implementation

Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural riparian communities including vegetative planting	ODFW,SWCD, NRCS, FSA, ODF	Expansion of existing efforts	Within treated area and downstream	Ongoing	Riparian restoration (10-25 years)	High
Develop grazing strategies that promote riparian recovery	ODA, SWCD, NRCS, USFS	Unknown	Within treated area	Ongoing	Riparian restoration (10-25 years)	Moderate
Eradicate invasive plant species from riparian areas	ODFW, SWCD, Wasco County, USFS	Expansion of existing effort	Within treated area	Ongoing	Immediate	High
Install fencing to exclude livestock from riparian areas	ODFW, SWCD, CTWSRO, NRCS, FSA	Expansion of existing effort	Within treated area and downstream	Ongoing	Riparian restoration (10-25 years)	High
Install off-stream livestock watering	ODFW, SWCD, NRCS, FSA	Expansion of existing effort	Within treated area and downstream	Ongoing	Riparian restoration (10-25 years)	High
Plant riparian vegetation where appropriate	ODFW, SWCD, FSA	Expansion of existing effort	Within treated area and downstream	Ongoing	Riparian restoration (10-25 years)	Moderate

Status of Existing Programs through which Actions are Implemented

Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
Wasco SWCD	Watershed restoration including all actions	Private agricultural lands		Additional opportunities exist for projects, outreach, and education. See State of Oregon programmatic review -- Appendix F.
USDA FSA, SWCD, NRCS	CREP	Qualified private riparian areas throughout population	No	Effective at protecting riparian areas, however additional lands need to be enrolled. Some landowners reluctant to enter the federal programs.
ODFW	Fifteenmile Creek Fish Habitat Restoration Project	Private lands throughout population	No	Positive results where the program has been implemented, but funding and landowner cooperation limits the amount of available projects. In addition, limited legal guarantees that landowners remain in program.
USFS	Fifteenmile River keeper	USFS lands and non-forest lands under Wyden Amendment Authority	Likely	Positive results where the program has been implemented, but it could expand to more forest lands in the population, and become more available off forest lands. Contingent on year to year funding appropriations.
USFS	Northwest Forest Plan	All Mt. Hood National Forest lands	Yes	See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005).
ODA	Agricultural Water Quality Management Program	Private agricultural lands		See State of Oregon programmatic review -- Appendix F.
CTWSRO	Watershed restoration	Reservation lands	No	Various programs designed to improve riparian, stream, and upland conditions along tribal lands. Additional restoration and protection efforts are needed with additional funds.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.				
ODF	Oregon Forest Practices Act	Private and state forestlands in Fifteenmile, Eightmile, Ramsey , and Fivemile Creek		See State of Oregon programmatic review -- Appendix F.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Constant maintenance of the fence lines must be conducted to keep livestock out and protect the riparian vegetation. Construction of more off channel watering sites or water gaps would help to address part of the issue. The Forest Service Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize stream enhancement actions for this population, and helps deploy limited active restoration funds where it is most needed.				

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Implement agricultural water conservation measures	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Ramsey Cr. (Mouth to new FS boundary) 1-Eightmile Cr. (Hwy 197 to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary)	Altered hydrology, low flows, high temperatures	water withdrawals, land conversion on uplands, road network	Abundance, productivity	Primarily fry and summer parr	EDT results indicate that high and low flows reduce steelhead populations in every reach (NPCC 2004).
Improve irrigation conveyance and efficiency	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Ramsey Cr. (Mouth to new FS boundary) 1-Eightmile Cr. (Hwy 197 to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary)	Low flows, high temperatures	Water withdrawals, loss during conveyance	Abundance, productivity	Primarily fry and summer parr	Considerable water savings may be possible by utilizing new technology irrigation.
Finish piping Orchard Ridge and Wolf Run diversions	1- Fifteenmile Cr (Orchard Ridge) 1- Eightmile Cr (Wolf Run)	Impaired flows	Irrigation diversions	Spatial structure, productivity	primarily adults and 0+juveniles	Open ditches lose considerable water through evaporation and leakage.
Implement urban conservation measures	1-Mill Creek (City of The Dalles) 2-Fifteenmile Cr. (City of Dufur)	Low flows, high temperatures	Water withdrawals	Abundance, productivity	All	Much of the flow of Mill Creek is utilized for domestic drinking water.
Lease or purchase water rights and convert to instream	Population-wide.	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily fry and summer parr	Program has been effective when rights have become available. Senior rights generally not available. Many landowners reluctant to sell water rights.
Monitor/regulate water withdrawals	Population-wide	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily fry and summer parr	Annual fluctuations in flow levels are intensified by irrigation withdrawals
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop	Population-wide	Low flows, high temperatures	Water withdrawals	Abundance, productivity, spatial structure, diversity	All stages	New programs in development

strategies to meet long-term needs						

Action Implementation

Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Implement agricultural water conservation measures	SWCD	Expands existing program, proposes new projects	Point of diversion downstream	Ongoing	Immediate increase in streamflow	High
Improve irrigation conveyance and efficiency	SWCD, USFS, OWRD, OWEB landowners	Expands existing program, proposes new projects	Agricultural lands throughout subbasin	Ongoing	Increased streamflow (0-5 years)	High
Finish piping Orchard Ridge and Wolf Run diversions	SWCD, USFS	Expansion of existing project	Upper Fifteenmile and Eightmile	Unknown	Potentially less water diverted as a result of water savings.	High
Implement urban conservation measures	SWCD, City of The Dalles	Expands existing program, proposes new projects	Mill Cr. MaSA	Ongoing	Immediate increase in instream flow, however, increases may be moderated by urban growth and increased demand.	High
Lease or purchase water rights and convert to instream	OWRD, Oregon Water Trust, others	Ongoing	Population-wide	Unknown	Immediate increase in instream flow	High
Monitor/regulate water withdrawals	OWRD	Ongoing	Population-wide	Ongoing		High
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs	OWRD	Ongoing	Population-wide	2007-2009 except incentive funding ongoing	Long term	Moderate

Status of Existing Programs through which Actions are Implemented

Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
USFS	Fifteenmile Riverkeeper	USFS lands and non-forest lands under Wyden Amendment authority	Likely	Positive results where the program has been implemented, but it could be expanded to more forest lands in the population, and become more available off forest lands. Contingent on year to year funding appropriations.
USFS	Northwest Forest Plan	All Mt. Hood National Forest lands	Yes	See USFS/BLM Program Sufficiency Assessment -- Appendix E.
ODFW	Fifteenmile Creek Fish Habitat Restoration Project	Private lands throughout Fifteenmile population	No	Positive results where the program has been implemented, but funding and landowner cooperation limits the amount of available projects. In addition, limited legal guarantees that landowners remain in program.
OWRD	Streamflow Monitoring and Restoration, Flow Restoration, Lease/Transfer Water Rights, Administration of Water Rights, Water Use Measurement, Water Needs Assessment, Storage Assessment, Conservation Assessment	Population-wide		See State of Oregon programmatic review -- Appendix F.

Oregon Water Trust or other entity	Lease or purchase instream water rights	Fifteenmile, Eightmile, Fivemile MaSAs	No	Program has been effective at obtaining water rights, but continually to maintain water instream to the mouth of the river is difficult. Many landowners have been reluctant to enter into program in past, but recently program is increasingly popular. Yes, important to secure water rights to guarantee instream flow.
USFS, Wasco Co. SWCD, NRCS, OWEB	Irrigation conveyance efficiency	Population-wide	USFS likely	Piping open ditches and other efficiency projects will decrease irrigation demand on streams. Program could be expanded to many additional irrigators. See State of Oregon programmatic review -- Appendix F for SWCD and OWEB.
Wasco Co. SWCD	No-till conversion, watershed restoration	Uplands population-wide		Program has proven effective at reducing erosion, but additional lands could be enrolled. See State of Oregon programmatic review -- Appendix F.
Wasco County SWCD/USDA FSA	CREP, CRP	Private riparian areas and qualified uplands throughout population	Uncertain	Both programs are effective at protecting riparian areas and uplands, however additional lands need to be enrolled. CRP program is near capacity for Wasco County. Some landowners reluctant to enter the federal programs.
CTWSRO	Watershed Restoration	Tribal lands	No	Various programs designed to improve riparian, stream, and upland conditions along tribal lands. Additional restoration and protection efforts are needed.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Peak flows are mitigated via upland vegetation, channel and riparian complexity, and closure of excess roads, particularly those with insufficient drainage. Highly successful programs now address upland and riparian conditions. Programs addressing channel complexity and road closure have, to date, only addressed a small portion of the watershed. Low summer flows are affected by the same factors that affect peak flows, but are more directly affected by irrigation withdrawals from the stream and associated aquifers. Programs have addressed irrigation efficiency on some but not all farms. They have addressed conveyance efficiency on the Wolf Run Ditch, but not the Orchard Ridge Ditch. Few if any efficiency programs have resulted in conversion to instream water rights. Fifteenmile Creek has 124 miles of stream protected by instream water rights. Voluntary restoration projects restored approximately 8.6 cfs in 2006.				

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Manage irrigation return flow to reduce extreme stream temperatures	1-Fifteenmile(Underhill return diversion)	Altered stream temperatures, degraded water quality	Water withdrawals	Abundance, productivity	Fry dispersal and rearing	Excessive summer temperatures have been identified as a major limiting factor for Fifteenmile Creek. Temperatures often approach or exceed lethal levels for salmonids in some of the subbasin.
Minimize unnatural factors that lead to fluctuations in dissolved oxygen levels	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Ramsey Cr. (Mouth to new FS boundary) 1-Eightmile Cr. (Hwy 197 to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary)	Depleted oxygen		Abundance, productivity	Fry dispersal and rearing	Warm temperatures reduce the dissolved oxygen capacity of the water.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
	2-Dry Cr.(Mouth to headwaters) 2-Mill Cr.(Mouth to North Fork) 2-North Fk. Mill Cr. (mouth to FS boundary)					
Reduce chemical pollution inputs	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Ramsey Cr. (Mouth to new FS boundary) 1-Eightmile Cr. (Mouth to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary) 2-Dry Cr.(Mouth to headwaters) 2-Mill Cr.(Mouth to North Fork)	Chemical pollution	Pesticides, fertilizers, herbicides, vehicle hydrocarbons, etc.	Abundance, productivity		Amounts of chemical pollution reaching streams are unknown and need to be determined. Widespread use of chemicals is common in agricultural practices near streams. Reduced streamflow may accentuate pollution.
Implement Agricultural Water Quality Management Plan	1-Fifteenmile Cr. (Mouth to FS boundary) 1-Ramsey Cr. (Mouth to new FS boundary) 1-Eightmile Cr. (Hwy 197 to FS boundary) 1-Fivemile Cr. (Mouth to FS boundary) 2-Dry Cr.(Mouth to headwaters)	Degraded upland processes, altered hydrology, water quality, altered sediment routing	Land conversion and agricultural practices	Abundance, productivity	Fry dispersal and rearing	Recent conservation measures have greatly reduced sediment inputs; however, sedimentation remains elevated beyond historical conditions. Fifteenmile and Ramsey creeks are on the 303(d) list for sedimentation and EDT modeling identified sedimentation as a key factor limiting steelhead production.
Continue TMDL monitoring	Population-wide	Degraded water quality, sediment routing	Land use practices, water withdrawals, pesticides, fertilizers, herbicides	Abundance, productivity	All	
Acquire conservation easements or agreements, and important habitats when available.	Significant properties when they become available.	All	All	Abundance, productivity	All	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Manage irrigation return flow to reduce extreme stream temperatures	ODEQ, OWR, SWCD	Ongoing	Subbasin-wide	Ongoing	0-5 years	High
Minimize unnatural factors that lead to fluctuations in dissolved oxygen levels	ODEQ, SWCD, FSA, NRCS, ODFW	Ongoing		Ongoing	0-5 years	Moderate
Reduce chemical pollution inputs	ODEQ, WyEast RC&D, others	Ongoing		Ongoing	0-5 years	Moderate
Implement Agricultural Water Quality Management Plan	ODA, SWCD	Ongoing	Subbasin-wide	Ongoing	variable	High
Continue TMDL monitoring	USFS, ODFW, SWCD, ODEQ	Ongoing	Subbasin-wide	Ongoing	Immediate	High
Acquire conservation easements or agreements, and important habitats when available.	NGO's	New	Subbasin-wide		Variable	High

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.				
Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
Wasco Co. SWCD, OWEB, Irrigators	Irrigation conveyance efficiency	Population-wide		Piping open ditches and other efficiency projects will decrease irrigation demand on streams. Program could be expanded to many additional irrigators. See State of Oregon programmatic review -- Appendix F.
ODEQ	TMDL Development	Population-wide		See State of Oregon programmatic review -- Appendix F.
ODEQ, Wasco Co. SWCD, ODFW, USFS	Temperature TMDL Implementation Monitoring	Fifteenmile Creek	USFS likely	Continuation of existing level of monitoring efforts could be expanded. Funding may not be sufficient. See State of Oregon programmatic review -- Appendix F.
ODEQ, ODA, Wasco SWCD, USFS	Sedimentation Monitoring (TMDL Development and Implementation)	Fifteenmile Creek	USFS likely	See State of Oregon programmatic review -- Appendix F. See USFS/BLM Program Sufficiency Assessment -- Appendix E.
ODEQ, WyEast RC&D	Toxics monitoring program doesn't actually exist yet	Population-wide		See State of Oregon programmatic review -- Appendix F.
ODA	Agricultural Water Quality Management Program	Private agricultural lands		See State of Oregon programmatic review -- Appendix F.
WyEast RC&D	IFPnet	Fifteenmile and Mill Creek	No	Program needs expansion to assist agriculture with reducing chemical demand.
Wasco Co. SWCD	No-till conversion, watershed restoration	Uplands population-wide		Program has proven effective at reducing erosion, but additional lands could be enrolled. See State of Oregon programmatic review -- Appendix F.
Wasco County SWCD/USDA FSA	CREP, CRP	Private riparian areas and qualified uplands throughout population		Both programs are effective at protecting riparian areas and uplands, however additional lands need to be enrolled. CRP program is near capacity for Wasco county. See State of Oregon programmatic review -- Appendix F. Some landowners reluctant to enter the federal programs.
CTWSRO	Watershed Restoration	Reservation lands	No	Various programs designed to improve riparian, stream, and upland conditions along tribal lands. Additional restoration and protection efforts are needed.
ODF	Oregon Forest Practices Act	Private and state forestlands in Fifteenmile, Eightmile, Ramsey , and Fivemile creeks		See State of Oregon programmatic review -- Appendix F.
ODFW	Fifteenmile Creek Fish Habitat Restoration Project	Private lands throughout population	No	Positive results where the program has been implemented, but funding and landowner cooperation limits the amount of available projects. In addition, limited legal guarantees that landowners remain in program.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
ODA's Agricultural Water Quality Program is designed to prevent and control water pollution from agricultural activities and soil erosion on non-Federal and non-Tribal Trust or Reservation lands. ODA relies on voluntary measures to protect water quality, but also enforces pollution and streamside vegetation requirements.				

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and . unimpaired natural upland processes.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Continue to promote no-till and other seeding techniques that reduce erosion where site conditions are suitable	Fifteenmile Creek subbasin uplands	Altered hydrology, sediment routing	Upland land use practices, loss of water storage capacity	Abundance, productivity	All	Over half of the agricultural land in the watershed has been converted to direct seed/no till, leaving 50,000-60,000 acres that could be converted (NPCC 2004).
Convert to perennial crops/vegetation		Altered hydrology, sediment routing	Upland land use practices, loss of water storage capacity	Abundance, productivity	All	
Develop Integrated Fruit Production (IFPnet) plans	Orchard lands throughout subbasin	Water quality, hydrology, sediment	Pollution	Abundance, productivity	All	
Upgrade or remove problem forest roads	Forest lands	Altered hydrology, sediment routing	Road network	Abundance, productivity	All	
Promote fuels management	Private and federal forest lands	Altered hydrology, sediment	Conversion of vegetative communities	Abundance, productivity	All	
Initiate upland improvement demonstration projects	Subbasin-wide	Altered hydrology, sediment routing	Upland land use practices	Abundance, productivity	All	
Demonstration projects to restore forest health and resilience to wildfire	Private and state forest lands	Altered hydrology, sediment, water quality, riparian functions, LWD recruitment	Conversion of vegetative communities	Abundance, productivity	All	Suppression of fires has altered fire regimes and increased threat of high intensity fires.
Employ BMPs to minimize unnatural rates of erosion	Population-wide	Altered hydrology, sediment routing, water quality	Upland land use practices, erosion, loss of water storage capacity	Abundance, productivity	all	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Continue to promote no-till and other seeding techniques that reduce erosion where site conditions are suitable	SWCD	Existing program	Croplands, MaSAs	Ongoing (completed by 2012)	Reduce runoff, sediment supply, immediate increase in base flow	High
Convert to perennial crops/vegetation	SWCD	Develop new program	uplands	Ongoing	Reduce runoff, sediment supply immediately	High
Develop Integrated Fruit Production (IFPnet) plans	WyEast RC&D	Existing effort	Orchard lands throughout subbasin	Ongoing	Reduce chemical pollution immediately	High
Upgrade or remove problem forest roads	USFS, ODF, private forestland owners	Expansion of existing project	USFS lands	Long term	Variable depending on individual treatment (5-20 yrs)	Moderate

Promote fuels management	USFS, ODF, private forestland owners	Expansion of existing project	USFS lands and private forest lands	Long term	Variable depending on individual treatment (5-20 yrs)	Moderate
Initiate upland improvement demonstration projects	SWCD, ODA, OSU extension	Ongoing	Subbasin-wide	Ongoing	Variable lag time depending on action taken	Unknown
Demonstration projects to restore forest health and resilience to wildfire	ODF	Ongoing	Private and state forest lands	Long term	Variable 5-20 years	Moderate
Employ BMPs to minimize unnatural rates of erosion	SWCD, USFS, ODA, CTWSRO, private landowners	Ongoing	High dispersal downstream	Intermediate	Up to 15 years	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
Wasco County SWCD/USDA FSA	CREP, CRP	Private riparian areas and qualified uplands throughout population		Both programs are effective at protecting riparian areas and uplands, however additional lands need to be enrolled. CRP program is near capacity for Wasco County. Some landowners reluctant to enter the federal programs. See State of Oregon programmatic review -- Appendix F.
Wasco County SWCD	No-till conversion, watershed restoration	Uplands population-wide		Program has proven effective at reducing erosion, but additional lands could be enrolled. See State of Oregon programmatic review -- Appendix F.
ODF	Private land protection from fire, Private Forest Program	Private and state forestlands in Fifteenmile, Eightmile, Ramsey , and Fivemile Creek		See State of Oregon programmatic review -- Appendix F.
ODF	Oregon Forest Practices Act	Private and state forest lands		See State of Oregon programmatic review -- Appendix F.
USFS	Fifteenmile River keeper	USFS lands and non-forest lands under Wyden Amendment Authority	Likely	Positive results where the program has been implemented, but it could be expanded to more forest lands in the population, and become more available off forest lands. Contingent on year to year funding appropriations.
USFS	Northwest Forest Plan	All Mt. Hood National Forest lands	Yes	See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005).
ODA	Agricultural Water Quality Management Program	Private agricultural lands		See State of Oregon programmatic review -- Appendix F.
OSU extension	Various	Private agricultural lands	Uncertain	Provide education and outreach information. Program could be expanded to be more effective.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize active watershed restoration for this population, and helps deploy limited active watershed restoration funding where it is most needed.

9.3.2 Habitat Strategies and Actions for Deschutes River Eastside Steelhead Population

Primary limiting factors: riparian condition, low flow, temperature, habitat diversity, and lack of fish passage.

Primary threats: grazing, roads, residences, and agriculture practices that simplify habitat; irrigation withdrawals; soil tilling, forest practices, dams and roads.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Protect the highest quality habitats through acquisition or conservation easements.	1-Bakeoven Cr. (mouth to Deep Cr) 1-Buck Hollow Cr (mouth to Macken Canyon) 1-Trout Cr. (Little Trout Cr. to headwaters) 2-Trout Cr. (Degner Cyn to Little Trout Cr.) 2-Deschutes R. (Harris Cr. to Buck Hollow Cr.) 2-Ward Cr. (mouth to Pole Cr.) 2-Deep Cr. (mouth to Cottonwood Cr)	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing	Overgrazing, channelization, stream bank armoring, agricultural practices, fire suppression,	Abundance, productivity	All	Protecting functioning floodplains and channels that are in balance with their ability to transport water and sediment is identified as one of the highest priorities in the Subbasin Plan. Wild and scenic protection for Deschutes in place.
Protect and conserve rare and unique functioning habitats	1-Seasonal tributaries 2-Trout Cr. (mouth to Willowdale)	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing	All	Abundance, productivity	All	Seasonal spawning tributaries provide habitat for unique life history trait that utilize seasonal habitats with age 0 migration into Deschutes.
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	1-Entire population	All factors	All	Abundance, productivity	All	To prevent habitat degradation BMPs and existing laws that protect habitat should be applied throughout the population.
Develop new and manage existing habitat Cooperative Agreements	Trout Cr. (mouth to headwaters)	Degraded floodplain, channel structure, riparian areas	All	Abundance, productivity	All	
Conduct outreach to resource users and managers	1-Entire population	All factors	All	All	All	Program efficiencies will be improved through increased knowledge and understanding of the importance of habitat conditions and land management practices.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Protect the highest quality habitats through acquisition or conservation easements.	CTWSRO, PGE, DRC, DBLT, NGOs, ODFW, SWCD, USDA FSA	Ongoing	High dispersal downstream	Immediate	Variable depending on habitat condition	High
Protect and conserve rare and unique functioning habitats	Land trusts, CTWSRO, ODFW, SWCD, NGOs, USFS, PGE, BLM	Ongoing		Immediate	Immediate halt to degradation	High
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	SWCD, USFS, private landowners, ODA, NRCS, CTWSRO, watershed councils, BLM, counties		All MaSAs	Long term	Degradation stop immediately habitat recovery 15-25 years depending on status	High
Adopt and manage Cooperative Agreements	ODFW	Ongoing	High dispersal downstream	Agreements are for 10-15 years	Immediate	High, although not in perpetuity
Conduct outreach to resource users and managers	ODFW, NOAA Fisheries, USFWS, USFS, BLM, CTWSRO, Watershed Councils, SWCDs	Ongoing	Entire subbasin	Long term	Variable lag time	Unknown, depends upon action taken as a result of being more informed

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, likely, uncertain, no)**	**Sufficiency Rationale**
USFS and BLM	Wilderness Areas, Wilderness Study Areas, Wild and Scenic River corridors, Special Management Area designations PACFISH	USFS and BLM lands throughout population	Yes	Continual implementation of programs. See USFS/BLM Program Sufficiency Assessment -- Appendix E. Currently no additional opportunities to expand programs on BLM lands.
ODFW/BPA	Trout Creek Fish Habitat Restoration Project	Private lands in the Trout Creek subbasin	No	Additional lands can be enrolled into the program. Conservation agreements are for only 10-15 years length.
USDA FSA/SWCDs	CREP/CRP	Private agricultural lands throughout population	Likely	Additional lands can be enrolled, and programs are not permanent in duration. See State of Oregon programmatic review -- Appendix F.
CTWSRO	Integrated Resources Management Plan	Reservation lands	Yes	Adaptive 10-year management plans to guide future.
CTWSRO	Watershed Maintenance/ Riparian Fence Program	Reservation lands	No	Need to expand riparian fence network and maintenance of those fence lines.
ODA/SWCDs	Agricultural Water Quality Management Program	Private agricultural lands throughout population		See State of Oregon programmatic review -- Appendix F.
Local Government	County Planning and Zoning	Private lands throughout population	Uncertain	
PGE	Pelton Habitat Mitigation Fund	Upper population	Uncertain	Newly implemented program, results not yet available.
NGOs (Deschutes Basin Land Trust, Nature Conservancy, Deschutes River Conservancy, Oregon Water Trust etc.)	Lease or purchase of land or instream water rights	Private lands throughout population	No	Limited opportunities arise, but programs can be expanded when opportunities become available.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.				
Watershed Councils	Various Watershed Councils	Population-wide	No	Programs can be expanded to included additional interested parties in watershed restoration and protection.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Existing forest plans include special management designations for riparian habitat conservation areas (RHCAs). Adding additional wilderness areas and wild and scenic river segments would require designation by Congress. The forest plans and BLM plans have been amended by PACFISH which generally requires 300-foot buffers on any fish bearing stream for tree removal with limited exceptions when conditions are met, as well as specific guidelines for livestock grazing and riparian vegetation use. See guidelines for Timber Management for specific rules governing the RHCA. Compliance with the 300-foot buffer for timber harvest operations has been very good. FSA programs that protect riparian areas and upland watersheds include the CRP, which pays landowners not to farm highly erodible soils, and the CREP program, which pays landowners for setting riparian corridors side from grazing and farming. The long term effectiveness of both programs is limited by the relatively short duration of the contracts which ranges from 10 to 15 years. ODA's Agricultural Water Quality Management Program is designed to prevent and control water pollution from agricultural activities and soil erosion on non-Federal and non-Tribal Trust or Reservation lands. ODA relies on voluntary measures to protect water quality, but also enforces pollution and streamside vegetation requirements.				

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Replace or remove barriers blocking passage including dams, road culverts, irrigation structures, infiltration galleries	1-Mud Springs Cr. (at RR culvert in section 15, above Gateway)--Jefferson County 1-Hay Creek (new channel near mouth)--private 2-Antelope Cr. (mouth to headwaters)--not culverts 2-Trout Cr. (mouth to Clover)--not culverts	Impaired fish passage	Dams, culverts, instream structures	Abundance, spatial structure, productivity	Primarily adults and 0+juveniles	Adult passage is the first priority, juvenile passage is secondary. Cumulative effects of anthropogenic factors, increase temperatures and reduce streamflow impair juvenile passage on Trout Creek downstream from Forest boundary.
Maintain irrigation diversions and screens	1-Where diversions exist throughout population	Impaired fish passage	Irrigation diversions	Abundance, spatial structure, productivity	Primarily juveniles, but also adults at facilities with ladders.	All known diversion are maintained and generally meet screening criteria.
Provide screening at 100% of irrigation diversions	1-unscreened diversions (all known diversions screened, need comprehensive survey to identify additional needs)	Impaired fish passage	Irrigation diversions	Abundance, spatial structure, productivity	Juveniles	All known legal diversions screened. More surveys are needed in Trout Creek subbasin to identify add'l diversions.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Remove/replace barriers blocking passage including dams, road culverts and irrigation structures	CTWSRO, USFS, SWCDs, watershed councils, NRCS	Ongoing	Access between upstream and downstream habitats	Immediate	Immediate	High
Maintain irrigation diversions and screens	ODFW	Ongoing	Diversions subbasin-wide	Based on funding	Immediate	High
Provide screening at 100% of irrigation diversions	ODFW Fish Passage and Screening	Ongoing	Access between upstream and	Immediate as need is identified	Immediate	High

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
			downstream habitats			
Status of Existing Programs through which Actions are Implemented						
Agency/Organization	Program Name	Geographic Locations		Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale	
ODFW	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA		No	Project has made significant improvement in overall fish habitat, needs to be expanded to other properties in subbasin. Recent large scale stream rehabilitation projects conducted on properties on Trout Creek have been successful at removing berms, restoring stream function, and creating additional habitat. Needs to be expanded in scope.	
Jefferson SWCD	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA		No	This companion project to the ODFW Habitat Project has made significant improvement is overall fish habitat, needs to be expanded to other properties in subbasin. Project has assisted in several infiltration gallery projects and other passage issues.	
ODFW	Fish Passage/Screening, State program and federal funded	Population-wide		Uncertain	The program completes a minimum of one project per year, but is dependent upon landowner cooperation and limited funding. See State of Oregon programmatic review -- Appendix F.	
PGE/CTWSRO	Pelton Fish Passage Plan	Pelton complex		Uncertain	Program is currently being implemented; uncertain of success of downstream passage.	
CTWSRO/ODFW	Salmon and Steelhead Reintroduction Plan	Areas above Pelton complex		No	Adaptive plan over life of FERC license.	
ODOT	Culvert replacement or retrofit	Population-wide			See State of Oregon programmatic review -- Appendix F.	
CTWSRO	IRMP	Reservation Lands		Yes	Adaptive management plan guides implementation.	
CTWSRO/USFS	Culvert replacement	Population-wide		USFS likely with current program.	Needs expansion.	
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)						
A comprehensive fish screen inventory needs to be completed throughout the population. The Forest Service Pacific Northwest Region's Aquatic Restoration Strategy (USDA-FS, 2005) provides guidance that will help prioritize culvert replacements for this population.						

Strategy 3. Maintain and restore floodplain connectivity and function.

Strategy 3. Maintain and restore floodplain connectivity and function.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Reconnect floodplains to channels	1-Trout Cr. (Little Trout Cr. To Clover Creek) 1-Trout Cr. (sections from mouth to Antelope Creek) 1-Antelope Cr. (mouth to headwaters)	Degraded floodplain, degraded riparian area, channel structure	Removal of interaction between river and floodplain, grazing, agricultural use, loss of	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	Floodplains and channels that are in balance are essential for proper stream function. Bakeoven and Buck Hollow Creeks affected primarily from

Strategy 3. Maintain and restore floodplain connectivity and function.						
	1-Hay Cr. (mouth to headwaters) 2-Bakeoven Cr. (mouth to headwaters) 2-Buck Hollow Cr (mouth to headwaters)		beaver dams			livestock grazing.
Reconnect side channels and off-channel habitats to stream channels	1-Trout Cr. (Little Trout Cr. To Clover Creek) 1-Trout Cr. (sections from mouth to Antelope Creek) 1-Antelope Cr. (mouth to headwaters) 1-Hay Cr. (mouth to headwaters) 2-Bakeoven Cr. (mouth to headwaters) 2-Buck Hollow Cr (mouth to headwaters)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	Off channel habitat important juvenile rearing habitat. Bakeoven and Buck Hollow Creeks effected primarily from livestock grazing.
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	1-Throughout population	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat	Abundance, productivity	All	As riparian areas recovery beaver recolonization occurs naturally.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Reconnect floodplain habitats.	CTWSRO, ODFW, watershed council, BLM, SWCDs, USFS, PGE, counties	Ongoing	High dispersal downstream from site	Long term	5-15 years	High
Reconnect side channels and off-channel habitats to stream channels.	CTWSRO, ODFW, watershed council, SWCD, USFS, BLM, PGE	Ongoing	High dispersal downstream from site	Long term	5-15 years	High
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	CTWSRO, ODFW, USFS, BLM	Ongoing	Subbasin-wide	Long term	Within 15 years	Moderate, high

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
Sherman and Wasco SWCD, Landowners, Oregon State agencies.	Bakeoven and Buck Hollow Watershed Restoration Projects.	Bakeoven and Buck Hollow Creek	Likely	Project is underway in Bakeoven watershed and is planned over a 10-year period. Project is transitioning to effectiveness monitoring. See State of Oregon programmatic review -- Appendix F.
NRCS,SWCD, USDA FSA, Private Landowners	CREP/CRP	Private lands throughout population	SWCD likely Others uncertain	An effective program that could be expanded to more landowners. See State of Oregon programmatic review -- Appendix F.
BLM Prineville District	Various range and upland restoration projects.	BLM lands throughout population	Likely	Most lands currently meeting BLM Standards and Guidelines, continued monitoring is needed to ensure long-term compliance. Program implementation may need to expand in scope. See USFS/BLM Program Sufficiency Assessment -- Appendix E.
ODFW	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	Project has made significant improvement is overall fish habitat, needs to be expanded to other properties in subbasin.

Strategy 3. Maintain and restore floodplain connectivity and function.				
Jefferson SWCD	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	This companion project to the ODFW Habitat Project has made significant improvement is overall fish habitat, needs to be expanded to other properties in subbasin.
PGE/CTWSRO	Relicensing of Pelton-Round Butte Complex	Throughout population	No	Habitat restoration and protection projects to mitigate effects of hydro projects. Additional opportunities exist.
CTWSRO	Various projects	Reservation lands	No	Improving riparian conditions, grazing remains problematic in some areas. Program needs expansion.
BLM, Oregon State Parks, CTWSRO	Wild and Scenic Rivers	Deschutes from mouth to Trout Creek		See State of Oregon and Federal agencies' programmatic reviews.
ODA/SWCD	Agricultural Water Quality Management Program	Private lands		See State of Oregon programmatic review -- Appendix F.
USFS	Stream Restoration Program (PACFISH)	Forest lands only when specifically identified that passive restoration is not working	Likely	The USFS preferred strategy is passive restoration; managing riparian areas to protect channel-forming processes. Program implementation needs to expand in scope. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005).
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
CRP in uplands and riparian protection in the Buckhollow watershed have and will provide short term benefits, but instream physical habitat improvements may not accrue until the longer term. The future status of habitat benefits accruing from CRP enrollments could be unknown, since economic decisions by the landowners and government entities involved will influence the area under agreements. Planning and implementation of restoration and protection measures for Bakeoven Creek are similar to the Buck Hollow project, but began more recently. A draft watershed assessment has been completed and includes an action plan with a 10-year time frame (Clark and Lamson, 2005). The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.				

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural channel form, includes berm and levee removal	1-Trout Cr. (Little Trout Cr. To Clover Creek) 1-Trout Cr. (sections from mouth to Antelope Cr.) 1-Antelope Cr. (mouth to headwaters) 1-Hay Cr. (mouth to headwaters) 2-Bakeoven Cr. (mouth to headwaters) 2-Buck Hollow Cr. (mouth to headwaters)	Degraded channel structure and complexity, floodplain, degraded riparian area, altered hydrology, degraded water quality, sediment routing	Grazing, agricultural practices, channelization, berms, roads, railroad bank armoring, floodplain, loss of beaver dams	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	Channelization, berm construction, and bank armoring, following floods has isolated the stream from the floodplain in many areas. Large wood and other instream habitat complexity is lacking in the Buck Hollow watershed.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.						
Increase role and abundance of wood and large organic debris in streambeds	1-Trout Cr. (Mouth to Board Hollow Cr.) 1-Antelope Cr. (mouth to headwaters)	Degraded channel structure and complexity, floodplain, degraded riparian area , altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	Large woody debris in Deschutes River mainstem consists mostly from white alder trees downstream of hydro projects, currently little or no recruitment from upstream sources. Most problematic upstream of Warm Springs River.
Increase instream habitat through manual placement of structures		Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	Large wood removal	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	Considered an active form of restoration while habitat conditions are restored through more passive efforts
Stabilize streambanks with passive restoration processes	1-Trout Cr. (Little Trout Cr. To Clover Creek) 1-Trout Cr. (sections from mouth to Antelope Creek) 1-Antelope Cr. (mouth to headwaters) 1-Hay Cr. (mouth to headwaters) 2-Bakeoven Cr. (mouth to headwaters) 2-Buck Hollow Cr. (mouth to headwaters)	Degraded channel structure and complexity, floodplain connectivity, degraded riparian areas, sediment routing, flows	Stream channelization, berming, bank armoring, overgrazing in riparian areas	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural channel form, includes berm and levee removal	CTWSRO, ODFW, SWCD, USFS, BLM, watershed councils	Ongoing	High dispersal downstream	Long term	5-15 years	High
Increase role and abundance of wood and large organic debris in streambeds	ODFW, USFS, PGE, CTWSRO, watershed councils	Ongoing	Localized to treatment area	Long term	Immediate	High
Increase instream habitat through manual placement of structures	ODFW, USFS, CTWSRO	Ongoing	Limited application throughout population	Long term	Immediate	High
Stabilize streambanks	CTWSRO, ODFW, SWCD, watershed councils, USFS, BLM, ODA	Ongoing	High dispersal downstream	Long term	5-15 years	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
Sherman and Wasco SWCD, Landowners, Oregon State agencies, BPA	Bakeoven and Buck Hollow Watershed Restoration Projects	Bakeoven and Buck Hollow Creeks		Effective project, but could be developed onto more private lands. See State of Oregon programmatic review -- Appendix F.
NRCS,SWCD, USDA FSA, Private Landowners	CREP/CRP	Riparian and upland areas throughout population	Uncertain	An effective program for both upland and riparian protection, but could be expanded to additional private lands. See State of Oregon programmatic review -- Appendix F.
BLM Prineville District	Various range and upland restoration projects.	BLM lands	Likely	Most lands currently meeting BLM Standards and

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.				
				Guidelines, continued monitoring is needed to unsure long-term compliance.
ODFW	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	Project has made significant improvement is overall fish habitat, needs to be expanded to other properties in subbasin.
Jefferson SWCD	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	This companion project to the ODFW Habitat Project has made significant improvement is overall fish habitat, needs to be expanded to other properties in subbasin.
PGE/CTWSRO	Relicensing of Pelton-Round Butte Complex	Throughout population	No	Habitat restoration and protection projects to mitigate effects of hydro projects. Additional opportunities exist.
CTWSRO	Various projects	Reservation lands	No	Improving riparian conditions, grazing remains problematic in some areas, needs expansion.
BLM, Oregon State Parks, CTWSRO	Wild and Scenic Rivers	Deschutes from mouth to Trout Creek	Likely	See State of Oregon programmatic review -- Appendix F. See USFS/BLM Program Sufficiency Assessment -- Appendix E.
ODA/SWCD	Agricultural Water Quality Management Program	Throughout population		See State of Oregon programmatic review -- Appendix F.
USFS	Stream Restoration Program (PACFISH)	Forest lands only when specifically identified that passive restoration is not working	Likely	The USFS preferred strategy is passive restoration; managing riparian areas to protect channel-forming processes. Needs to be expanded to more streams in Trout Creek Subbasin. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (UDSA-FS, 2005).

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

CRP in uplands and riparian protection have and will provide short term benefits, but instream physical habitat improvements may not accrue until the longer term. The upper third of Buck Hollow remains a restoration priority. The future status of habitat benefits accruing from CRP enrollments are unknown, since economic decisions by the landowners and government entities involved will influence the area under agreements. Planning and implementation of restoration and protection measures for Bakeoven Creek are similar to the Buck Hollow project but began more recently. Some riparian areas are still unbuffered through fences or grazing management plans. Where riparian buffers do exist, habitat complexity will develop over the longer term if buffers are maintained. Some benefits from trees will be slow to accrue because their size is relatively small, and only when larger age-classes are present, will the biological and physical results of large wood recruitment be realized.

Recent large scale stream rehabilitation projects in the Trout Creek watershed have been successful at removing berms, restoring stream function, and creating additional habitat, however long-term monitoring is needed. Several landowners with sensitive key spawning and rearing habitats in the Upper Trout Creek may be willing to participate in conservation efforts.

The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural riparian	1-Trout Cr. (Little Trout Cr. To Clover	Bank degradation, degraded riparian	Livestock grazing,	Abundance,	All	Riparian areas in the Bakeoven,

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
communities including vegetative planting	Creek) 1-Trout Cr. (sections from mouth to Antelope Creek) 1-Antelope Cr. (mouth to headwaters) 1-Hay Cr. (mouth to headwaters) 2-Bakeoven Cr. (mouth to headwaters) 2-Buck Hollow Cr. (mouth to headwaters) 2-Deschutes R. (Harris Cr. to Buck Hollow Cr.) 2-Deschutes R. (Eagle Cr. to Shitike Cr.)	communities, LWD recruitment, temperatures, flow, sediment routing	agricultural conversion, roads, bank armoring, residential development, loss of beaver dams	productivity		Buck Hollow and Trout Cr MaSAs have been reduced or damaged by grazing. Riparian canopy cover is relatively low. Streambank erosion and loss of riparian vegetation has led to wide shallow channels and width-to-depth ratios are greater than desirable throughout the watershed. Existing riparian vegetation contributes little to LWD. Loss of riparian function has led to increased sedimentation. Along Deschutes River, railroad armored banks limit riparian growth, campgrounds and heavy recreational use trample streamside vegetation, landowners have cleared vegetation around residences to improve river views and access.
Develop grazing strategies that promote riparian recovery	Limited opportunities may exist throughout the population	Bank degradation, degraded riparian communities, flow, sediment routing	Overgrazing	Abundance, productivity	All	
Eradicate invasive plant species from riparian areas	Where opportunities exist throughout the MaSA	Degraded riparian communities	Conversion of natural riparian vegetative communities	Abundance, productivity	All	
Install/maintain fencing to exclude livestock from riparian areas	1-Trout Cr. (Little Trout Cr. to Clover Cr.) 1-Trout Cr. (sections from mouth to Antelope Cr.) 1-Antelope Cr. (mouth to headwaters) 1-Hay Cr. (mouth to headwaters) 2-Bakeoven Cr. (mouth to headwaters) 2-Buck Hollow Cr. (mouth to headwaters) 2-Deschutes R. (Harris Cr. to Buck Hollow Cr.) 2-Deschutes R. (Eagle Cr. to Shitike Cr.)	Bank degradation, degraded riparian communities, flow, sediment routing	Overgrazing	Abundance, productivity	All	Cattle grazing along the mainstem Deschutes River., damages riparian vegetation and causes increases in erosion.
Install off-stream livestock watering	Limited opportunities may exist throughout the MaSA	Degraded riparian communities, sediment routing	Overgrazing	Abundance, productivity	All	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural riparian communities including vegetative	CTWSRO, USFS, SWCDs, ODFW, watershed councils,	Ongoing	High dispersal downstream	Long term	5-15 years	High

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
planting	BLM, OWEB					
Develop grazing strategies that promote riparian recovery	CTWSRO, USFS, ODA, SWCDs, BLM	Ongoing	High dispersal downstream	Long term	5-15 years	High
Eradicate invasive plant species from riparian areas	CTWSRO, USFS, ODA, SWCDs, watershed councils, BLM	Ongoing		Immediate	5-15 years	
Install/maintain fencing to exclude livestock from riparian areas	SWCDs, NRCS, CTWSRO, ODA, SWCDs, ODFW, BLM	Ongoing	High dispersal downstream	Immediate	Riparian restoration (0-20 years); increased streamflow, stabilized hydrograph (0-10 yrs)	High
Install off-stream livestock watering	ODFW, CTWSRO, USFS, ODA, SWCD, BLM	Expansion of existing effort	Private lands	Ongoing	Riparian restoration (0-5 years)	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
CTWSRO	Watershed Maintenance	Reservation	No	Needs to be expanded and continued.
CTWSRO	IRMP	Reservation	No	Adaptive management plan.
BLM, Oregon State Parks, CTWSRO	Wild and Scenic Rivers	Deschutes from mouth to Trout Creek	Likely	See State of Oregon programmatic review -- Appendix F. See USFS/BLM Program Sufficiency Assessment -- Appendix E.
ODFW	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	Project has made significant improvement in overall fish habitat, needs to be expanded to other properties in subbasin, needs expansion and additional funds.
Jefferson SWCD	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	This companion project to the ODFW Habitat Project has made significant improvement is overall fish habitat, needs to be expanded to other properties in subbasin, and needs additional funds.
USFS	Stream Restoration Program (PACFISH)	Forest lands	Likely	Needs to be expanded to more streams in Trout Creek Subbasin. See USFS/BLM Program Sufficiency Assessment -- Appendix E and Regional Aquatic Restoration Strategy. See discussion in Gaps commentary below.
NRCS,SWCD, USDA FSA, Private Landowners	CREP	Throughout population	Uncertain	An effective program for both riparian protection and restoration, but could be expanded to additional private lands.
ODA	Agricultural Water Quality Management Program	Throughout population		See State of Oregon programmatic review -- Appendix F.
Watershed Councils/OWEB	Various restoration projects	Throughout population	Uncertain	Effective program for developing restoration/protection projects and supplying outreach information on resource management. Participation could be expanded.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

Bakeoven Project is beginning and is planned over a 10-year period. Some riparian areas are still unbuffered through fences or grazing management plans. Habitat complexity will develop over the longer term if existing buffers are maintained. Some benefits from trees will be slow because the trees are small. Only when larger age-classes exist will biological and physical results of large wood recruitment be realized.

Riparian improvements in Trout Creek watershed have improved water quality, but additional protection is needed throughout the subbasin.

Public land managers have implemented PACFISH standards for protection and restoration of USFS and BLM lands. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize stream enhancement actions for this population, and helps deploy limited active restoration funding where it is most needed.

The USFS requires fence maintenance for all grazing allotments. New fencing may be part of adjustments to existing grazing strategies by the USFS/BLM to promote riparian recovery.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Implement agricultural water conservation measures	1-Trout Cr. (mouth to Clover Cr.) 1-Antelope Cr. (mouth to headwaters) 2-Hay Cr. (mouth to headwaters)	Altered hydrology, low flows, high temperatures	Water withdrawals, land conversion on uplands, road network	Abundance, productivity	Primarily fry and summer parr	Consumptive use of flows in Trout Creek exceeds the natural streamflow. Streamflow below Amity Creek averages < 1cfs during the summer (WPN 2002). Flows in Trout Cr. below diversions in the Ashwood and Willowdale areas frequently become intermittent from mid-summer to late fall. Trout Cr. from Hay Creek to Little Trout Creek is listed as priority in EDT.
Improve irrigation conveyance and efficiency	1-Trout Cr. Forest boundary downstream	Low flows, high temperatures	Water withdrawals, loss during conveyance	Abundance, productivity	Primarily fry and summer parr	Conversion of flood to sprinkler irrigation, irrigation efficiency improvement, and piping would increase flows.
Lease or purchase water rights and convert to instream	1-Trout Cr. subbasin (where available) 2-Buck Hollow Creek	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily fry and summer parr	One surface water right exists (0.57 cfs) in a lower reach of Buck Hollow.
Monitor/regulate water withdrawals	1-Trout Cr. MaSA	low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily fry and summer parr	Most water withdrawals are not monitored for compliance.
Water retention structures	1-Uplands in Bakeoven and Buck Hollow Creeks	Altered hydrology, low flows	Degradation on uplands	Abundance, productivity	Primarily fry and summer parr	
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	Population-wide	Altered hydrology, low flows, high temperatures, impaired natural functions and processes on uplands, floodplains, riparian areas	Degradation and conversion of uplands, floodplains, riparian areas	Abundance, productivity	Primarily fry and summer parr	Flow fluctuations are now larger than they were historically. High flows have scoured out channels reducing habitat diversity. Reduction of native upland vegetation has reduced its ability to retain and slowly release runoff. Lack of water in the lower reaches and Bakeoven and Deep creeks impedes upstream and downstream fish passage.
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs	Population-wide	Low flows, high temperatures	Water withdrawals	Abundance, productivity, spatial structure, diversity	All stages	New programs in development

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Implement agricultural water conservation measures	SWCD, CTWSRO, USBOR, irrigation districts, landowners	Expands existing program, new projects	Croplands, MaSAs	Based on funding	Immediate increase in Streamflow; habitat diversity, floodplain connection (0-5 yrs)	High
Improve irrigation conveyance and efficiency	SWCD, USFS, OWRD, CTWSRO, OWEB, landowners	Expands existing program, proposes new projects	High dispersal downstream	Ongoing	Increased streamflow (0-5 years)	High
Lease or purchase water rights and convert to instream	OWRD, Oregon Water Trust, PGE, DRC, others	Ongoing	Point of diversion to mouth of Deschutes	Long term	Immediate increase in instream flow	High
Monitor/regulate water withdrawals	OWRD	Ongoing	Point of diversion to mouth of Deschutes	Long term		High
Water retention structures	SWCDs	Ongoing	Uplands	Intermediate	0-10 years	Moderate
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	SWCD, USFS, OWRD, OWEB, ODFW, CTWSRO, landowners	Ongoing	Subbasin-wide	Intermediate	Up to 15 years	High
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs	OWRD	Ongoing	Population-wide	2007-2009 except incentive funding ongoing	Long term	Moderate

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, likely, uncertain, no)**	**Sufficiency Rationale**
Sherman and Wasco SWCD, Property Owners, CTWSRO, and Oregon State agencies	Bakeoven Watershed Project	Bakeoven Creek		Effective programs that will take time before results are available. Program could be expanded to additional landowners. See State of Oregon programmatic review -- Appendix F.
ODFW	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	Project has made significant improvement is overall fish habitat, needs to be expanded to other properties in subbasin. Recent large scale stream rehabilitation projects conducted on properties on Trout Creek have been successful at removing berms, restoring stream function, and creating additional habitat. Project needs expansion.
Jefferson SWCD	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	This companion project to the ODFW Habitat Project has made significant improvement is overall fish habitat, needs to be expanded to other properties in subbasin. Project has

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.				
				assisted in several infiltration gallery projects and other passage issues. Project needs expansion.
BLM	Various projects related to rangeland improvements in uplands	BLM lands	Uncertain	Effective programs. Long-term monitoring of effectiveness is needed. See USFS/BLM Program Sufficiency Assessment--Appendix E.
NRCS,SWCD, FSA, Private Landowners	CRP, CREP	Riparian and upland areas within population	No	An effective program for both upland and riparian protection, but could be expanded to additional private lands.
FSA, OWEB	Lease instream water rights	Specific locations determined by opportunities		Both OWEB and FSA have partnered with landowners to return water instream. Additional opportunities should be pursued.
OWRD	Stream Flow Monitoring and Restoration, Flow Restoration, Lease/Transfer Water Rights, Administration of Water Rights, Water Use Measurement, Water Needs Assessment, Storage Assessment, Conservation Assessment	Specific locations determined by opportunities		See State of Oregon programmatic review -- Appendix F.
Oregon Water Trust	Lease water rights and return instream	Specific locations determined by opportunities	Uncertain	Program works well, could be expanded with more willing landowners. Need assurance that instream leases remain instream.
Jefferson SWCD, NRCS	Various irrigation efficiency improvements, CRP, CREP	Specific locations determined by opportunities	Uncertain	Needs expansion.
ODA/SWCD	Agricultural Water Quality Management Program	Population-wide		See State of Oregon programmatic review -- Appendix F.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
The Deschutes subbasin plan's (NPCC 2004) inventory notes that Buck Hollow "runs clean", intermittent tributaries have become perennial. Opportunities may exist to increase summer flows, reduce temperature, and decrease sedimentation through water development (Lower Deschutes River Management Plan). In 2001, 1 to 1.5 cfs from a headwater well in Buck Hollow Cr. was used to supplement flow to protect fish from the drought (BPA #200105400). The Deschutes River subbasin has 578 miles of stream protected by instream water rights. Voluntary flow restoration restored 13.4 cfs in 2006, of which 3.2 cfs was permanent.				

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Manage irrigation return flow to reduce extreme stream temperatures	1-Trout Cr. (mouth to Clover Cr.) 1-Antelope Cr. (mouth to headwaters) 2-Hay Cr. (mouth to headwaters)	Altered stream temperatures, degraded water quality	Water withdrawals	Abundance, productivity	Fry dispersal and rearing	Reaches of Buck Hollow, Bakeoven and Trout creeks are included on the 303(d) list for exceeding temperature and sediment limits. Temperatures in the systems typically exceed criteria for salmonid rearing during summer months. Several reaches are also listed

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
						because of sediment concerns.
Minimize unnatural factors that lead to fluctuations in dissolved oxygen levels	1-Trout Cr. (mouth to sagebrush)	Depleted oxygen		Abundance, productivity	Fry dispersal and rearing	Warm temperatures and potential pollutants reduce the dissolved oxygen capacity of the water.
Implement Agricultural Water Quality Management Program	Agricultural lands throughout population	Degraded upland processes, altered hydrology, water quality, altered sediment routing	Land conversion and agricultural practices	Abundance, productivity	Fry dispersal and rearing	
Continue TMDL monitoring	Population-wide	Degraded water quality, sediment routing	Land use practices, water withdrawals, pesticides, fertilizers, herbicides	Abundance, productivity	All	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Manage irrigation return flow to reduce extreme stream temperatures	SWCDs	Ongoing	High dispersal downstream	Less than 5 years	Immediate	High
Minimize unnatural factors that lead to fluctuations in dissolved oxygen levels	ODA, SWCD, ODEQ	Ongoing	Localized and downstream	Long term	Long term	Moderate
Implement Agricultural Water Quality Management Plan	ODA, SWCD		Subbasin-wide	Ongoing	Variable	High
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	SWCD	Ongoing	Subbasin-wide, high dispersal downstream	Intermediate	Up to 15 years	High
Continue TMDL monitoring	USFS, ODFW, SWCD, ODEQ	Ongoing	Subbasin-wide	Ongoing	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
Oregon Water Trust, NGOs	Lease or purchase instream water rights.	Trout Creek MaSA	No	Program has been effective, difficult to obtain senior water rights and keep water instream. Program could be expanded.
ODFW	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	Project has made significant improvement is overall fish habitat, needs to be expanded to other properties in subbasin. Recent large scale stream rehabilitation projects conducted on properties on Trout Creek have been successful at removing berms, restoring stream function, and creating additional habitat. Project needs expansion.
Wasco SWCD, Property Owners, CTWSRO, and Oregon State agencies, BPA	Bakeoven/Buck Hollow Watershed Project	Bakeoven Cr. and Buck Hollow Cr.	Uncertain	Effective programs that will take time before results are available. Program could be expanded to additional landowners.
BLM	Various projects related to rangeland improvements in uplands	BLM lands	Likely	Effective programs. See USFS/BLM Program Sufficiency Assessment -- Appendix E.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.				
Jefferson SWCD	Trout Creek Fish Habitat Restoration Project (BPA)	Trout Creek MaSA	No	This companion project to the ODFW Habitat Project has made significant improvement in overall fish habitat, needs to be expanded to other properties in subbasin. Project has assisted in several infiltration gallery projects and other passage issues. Needs expansion.
FSA, NRCS,SWCD, Private Landowners	CRP, CREP	Riparian and upland areas throughout population	Uncertain	An effective program for both upland and riparian protection, but could be expanded to additional private lands. See State of Oregon programmatic review -- Appendix F for SWCD.
ODA/SWCD	Agricultural Water Quality Management Program	Throughout population		See State of Oregon programmatic review -- Appendix F.
USFS	Stream Restoration Program (PACFISH)	USFS lands	Uncertain	Needs expansion. See USFS/BLM Program Sufficiency Assessment -- Appendix E and Regional Aquatic Restoration Strategy.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize stream enhancement actions for this population, and helps deploy limited active restoration funding for riparian planting where it is most needed.				

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Continue to promote no-till and other seeding techniques that reduce erosion where site conditions are suitable	1-Buck Hollow Cr. uplands 1-Bakeoven Cr. uplands	Altered hydrology, sediment routing	Upland land use practices, loss of water storage capacity	Abundance, productivity	All	
Convert to perennial crops/vegetation (CRP)	1-Buck Hollow Cr. uplands 1-Bakeoven Cr. uplands	Altered hydrology, sediment routing	Upland land use practices, loss of water storage capacity	Abundance, productivity	All	
Remove junipers	1-Trout Cr. uplands 2-Bakeoven Cr. uplands 2-Buck Hollow Cr. uplands	Altered hydrology	Loss of water storage capacity	Abundance, productivity	All	
Restore native upland plants and remove noxious weeds	1-Buck Hollow Cr. MaSAs 1-Bakeoven Cr. MaSAs 2-Trout Cr. MaSAs	Altered hydrology, sediment routing	Upland land use practices, loss of water storage capacity	Abundance, productivity	All	
Upgrade or remove problem forest roads	1-Trout Cr. Private Forest Lands 2-Trout Cr. USFS Forest Lands	Altered hydrology, sediment routing	Road network	Abundance, productivity	All	
Promote reforestation and fuels management	1-Trout Cr. Private Forest Lands 2-Trout Cr. USFS Forest Lands	Altered hydrology, sediment	Conversion of vegetative communities	Abundance, productivity	All	
Demonstration projects to restore forest health and resilience to wildfire	Private and state forest lands	Altered hydrology, sediment, water quality, riparian functions, LWD recruitment	Conversion of vegetative communities	Abundance, productivity	All	Suppression of fires has altered fire regimes and increased threat of high intensity fires.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
Employ BMPs to minimize unnatural rates of erosion	Population-wide	Altered hydrology, sediment routing, water quality	Upland land use practices, erosion, loss of water storage capacity	Abundance, productivity	All	

Action Implementation

Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Continue to promote no-till and other seeding techniques which reduce erosion where site conditions are suitable	SWCD	Existing program	Croplands, MaSAs	Ongoing	Reduce runoff, sediment supply, immediate increase in base flow	High
Convert to perennial crops/vegetation (CPR)	NRCS, SWCDs	Ongoing	Croplands	Immediate	0-10 years	High
Remove junipers	SWCDs, NRCS	Ongoing	Uplands	Immediate	0-20 years	High
Restore native upland plants	USFS, BLM, NRCS, SWCDs, watershed councils, CTWSRO, BIA	Ongoing	High dispersal downstream	Juniper control can be quick, other actions such as control of invasive plants may take 20 years or more	0-20 years	High
Upgrade or remove problem forest roads	CTWSRO, USFS, ODOT, ODF	Ongoing	High dispersal downstream	Long term	Immediate for sediment, other parameters 5-15 yrs	High
Promote reforestation and fuels management	CTWSRO, USFS, watershed councils, SWCDs, counties	Ongoing	Forestlands	Long term	0-10 yrs	High
Demonstration projects to restore forest health and resilience to wildfire	ODF	Ongoing	Private and state forest lands	Long term	Variable 5-20 years	Moderate
Employ BMPs to minimize unnatural rates of erosion	SWCD, USFS, ODA, ODF, BLM, CTWSRO, watershed councils, NRCS, private landowners	Ongoing	High dispersal downstream	Intermediate	5-15 years	High

Status of Existing Programs through which Actions are Implemented

Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
NRCS,SWCD, Private Landowners	CRP, CREP, Environmental Quality Incentive Program (EQUIP)	Private upland and riparian lands	Uncertain	An effective program for both upland and riparian protection, but could be expanded to additional private lands. Continued implementation of program dependent on funding. See State of Oregon programmatic review -- Appendix F for SWCD.
SWCDs	Voluntary Watershed Restoration	Private agricultural lands		Dependent on funding, and landowner interest. See State of Oregon programmatic review -- Appendix F.
BLM	Various projects related to rangeland improvements in uplands.	BLM lands	Likely	Effective programs that could be expanded to additional lands.
CTWSRO	IRMP	Reservation Lands	Yes	Adaptive plan could be expanded.
USFS	Stream Restoration Program (PACFISH), Vegetation Management Programs, Range Management Programs	USFS forest lands	Uncertain	Effectiveness of program unproven. May need expanded monitoring. See USFS/BLM Program Sufficiency Assessment -- Appendix E and Regional Aquatic Restoration Strategy. See discussion in Gaps commentary below.
ODF	Private land protection from fire, Private Forest Program	Private and state forestlands throughout population		See State of Oregon programmatic review -- Appendix F.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.				
ODF	Oregon Forest Practices Act	Private and state forest lands		See State of Oregon programmatic review -- Appendix F.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Many benefits to steelhead have accrued through changes in upland and riparian management plans since the 1987 Farm Bill. CRP in uplands and riparian protection have and will provide short term benefits, but instream physical habitat improvements may not accrue until the longer term. The upper third of Bakeoven and Buck Hollow creeks remain restoration priorities. The future status of habitat benefits accruing from CRP and CREP enrollments could be unknown, since economic decisions by the landowners and government entities involved will influence the area under agreements. No areas within the Bakeoven or Buck Hollow watersheds are in a "protected" status. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize active watershed restoration for this population, and helps deploy limited active watershed restoration funding where it is most needed.				

9.3.3 Habitat Strategies and Actions for Deschutes River Westside Steelhead Population

Primary limiting factors: degraded floodplain connectivity and function, altered sediment routing, water temperatures, degraded channel structure and complexity, degraded riparian area, altered hydrology, and degraded fish passage – particularly lack of passage over Pelton-Round Butte Complex.

Primary threats: road networks (including Hwy 26 Beaver Creek, USFS roads, Tribal road networks), logging practices, grazing practices, removal of overstory trees and bank vegetation from the riparian corridor, stream channelization, water withdrawal (Whychus Creek).

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Protect the highest quality habitats through acquisition or conservation easements	Spawning areas in mainstem Deschutes River below Pelton-Round Butte Complex	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing	All	All	All	Protecting high quality habitats is the most cost effective way to ensure fish have good quality habitat. Land acquisitions, easements, and cooperative agreements may facilitate the implementation of active restoration projects.
Protect and conserve rare and unique functioning habitats	Throughout population	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing	All	All	All	
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	MaSAs in Warm Springs River subbasin, MaSA in Shitike Creek, potential MaSAs in Whychus Creek and Metolius River	All	All	All	All	
Adopt and manage Cooperative Agreements	Private and public lands	Degraded floodplain, channel structure, riparian areas	All	All	All	
Special management designations on public lands	Public lands	All	All	All	All	
Conduct outreach to resource users and managers	1-Entire population	All	All	All	All	Program efficiencies will be improved through increased knowledge and understanding of the importance of habitat practices.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Protect the highest quality habitats through acquisition or conservation easements.	CTWSRO, PGE, DRC, DBLT, NGOs, ODFW, SWCD, USDA FSA	Ongoing	High dispersal downstream	Existing conservation agreements are complete. Full implementation of conservation measures will take 5-15 years or more	Immediate halt to degradation--recovery long term	High
Protect and conserve rare and unique functioning habitats.	Land trusts, CTWSRO, ODFW, SWCD, NGOs, USFS	Ongoing	Population-wide	Immediate	Immediate halt to degradation--recovery long term	High
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	SWCD, USFS, private landowners, ODA, CTWSRO	Ongoing	Population-wide	Long term	5-15 years	High
Adopt and manage Cooperative Agreements.	CTWSRO	Ongoing	High dispersal downstream	Agreements are for 10-15 years	Immediate	High, although not in perpetuity
Special management designations on public lands.	USFS, BLM	Ongoing	High dispersal downstream	Complete; potentially subject to change in Forest Plan revisions	Immediate in some cases, long term for recovery of habitat	High, although subject to change from Forest Plan or management plan revision
Conduct outreach to resource users and managers.	ODFW, NOAA Fisheries, USFWS, USFS, BLM, CTWSRO, Watershed Councils, SWCDs	Ongoing	Entire subbasin	Long term	Varies depending on location and issues	Unknown, depends upon action taken as a result of being more informed

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, likely, uncertain, no)**	**Sufficiency Rationale**
USFS and BLM	Wilderness Areas, Wilderness Study Areas, Wild and Scenic River corridors, Special Management Area designations, PACFISH	Three Sisters Wilderness; Mt Jefferson Wilderness; Metolius River; Whychus Creek	Uncertain	See USFS/BLM Program Sufficiency Assessment—Appendix E. Additional areas could be considered for Wilderness or similar management designations. PACFISH applies to all BLM and FS management programs and lands in the Mid-C.
ODFW	Cooperative Agreements	Spring Creek Deschutes River	No	The agreements are for only 10-15 years and should be extended.
USDA FSA	CREP	Seekseequa Creek	Uncertain	The agreements are for only 10-15 years and should be extended.
CTWSRO	Integrated Resources Management Plan III	Warm Springs 5th field HUCs (8) Shitike Cr 5th Field HUC	Yes	Managed under 10-year adaptive management plan.
CTWSRO	Watershed Maintenance/ Riparian Fence Program	Warm Springs River RM 0.0 – 3.5 Warm Springs River RM 27.5 - 30 Lower Deschutes River RM 73-84 Beaver Creek RM 0.25-3.5	No	Need to continue to expand riparian fence network and maintenance of those fence lines.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.				
		Beaver Creek RM 14-18 Bager Creek RM 0.5-2.5 Skookum Creek RM 0-1.0 Mill Cr. (RM 5.5 to RM 6)		
ODA	Agricultural Water Quality Management Program	Population-wide		See State of Oregon programmatic review -- Appendix F.
Local Government	City and County Planning and Zoning	Whychus Creek floodplain zoning - In Progress	Yes	Could be expanded.
NGOs	Deschutes Basin Land Trust, Nature Conservancy, Deschutes River Conservancy, etc.	Land purchase on Lake Creek Land purchase on Whychus Creek	Uncertain	Need to increase minimum flows by another 10 cfs through the city of Sisters.
SWCD	CREP	Population-wide		Agreements are for only 10-15 years and should be extended.
Watershed Councils	Upper Deschutes River Watershed Council	Upper Deschutes		
Deschutes River Conservancy or other entity	Lease or purchase instream water rights	Whychus Creek 20cfs secured instream flow	Yes	Important to secure water rights to guarantee instream flow, could be expanded.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
The majoriy of the Deschutes Westside steelhead spawning areas occurs within the CTWSRO boundaries. The CTWSRO has developed and implemented the Integrated Resources Management Plan on Reservation lands. Adding additional wilderness areas and wild and scenic river segments would require designation by Congress. Existing forest plans include special management designations for RHCAs. The forest plans and BLM plans have been amended by PACFISH, which requires 300-foot buffers on any fish bearing stream for tree removal, as well as specific guidelines for livestock grazing and riparian vegetation use. Compliance with the 300-foot buffer for timber harvest operations has been very goods. FSA programs that protect riparian areas and upland watersheds include the CRP, which pays landowners not to farm highly erodible soils, and the CREP program, which pays landowners for setting riparian corridors aside from grazing and farming. The long-term effectiveness of both programs is limited by the relatively short duration of the contracts which ranges from 10 to 15 years. ODA's Agricultural Water Quality Management Program is designed to prevent and control water pollution from agricultural activities and soil erosion on non-Federal and non-Tribal Trust or Reservation lands. ODA relies on voluntary measures to protect water quality, but also enforces pollution and streamside vegetation requirements.				

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore passage at Pelton-Round Butte Complex	1- Deschutes R. (RM 100, Pelton-Round Butte)	Blocked fish passage, altered flows, sediment routing, degraded channel structure and complexity	Dam	Spatial structure, productivity, abundance	All	Dam construction in 1964 and failure of downstream fish passage led to extirpated steelhead populations above the complex. Currently efforts underway to restore passage as part of FERC process.
Replace barriers blocking passage including dams, road culverts and irrigation structures	1- Warm Springs R. 1- Beaver Cr. 1- Shitike Cr. There are six culverts that need replacement on CTWSRO lands.	Impaired fish passage	Dams, culverts, instream structures	Spatial structure, productivity	Primarily adults and 0+juveniles	Irrigation diversions occur primarily above the project. There has been a culvert inventory conducted on the CTWS Reservation identifying problem areas.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
Provide screening at 100% of irrigation diversions	1-Whychus Cr. – Three Sisters irrigation diversion	Impaired fish passage	Irrigation diversions	Spatial structure, productivity	Primarily smolts and 0+juveniles	
Replace screens that do not meet criteria	1-Whychus Cr.	Impaired fish passage	Irrigation diversions	Spatial structure, productivity	Primarily smolts and 0+juveniles	

Action Implementation

Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore passage at Pelton-Round Butte Complex	PGE, CTWSRO, ODFW,	Expansion of existing project	Historical steelhead range	Unknown	Immediate increase in instream flow	High
Replace barriers blocking passage including dams, road culverts and irrigation structures	CTWSRO, USFS, SWCDs, watershed councils	Ongoing	Provide access to upstream habitat	Ongoing, replacing all culverts expected to take 20 years	Immediate	High
Provide screening at 100% of irrigation diversions	ODFW	Ongoing	At point of diversion	Number of screens needs to be determined	Immediate	High
Replace screens that do not meet criteria	ODFW	Ongoing	At point of diversion	Number of screens needs to be determined	Immediate	High

Status of Existing Programs through which Actions are Implemented

Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	Fish Passage/Screening	Whychus Creek – Three Sisters irrigation diversion Whychus Creek – Sokol Diversion Whychus Creek – Baker Ranch Irrigation Pond	No	The program completes a minimum of one project per year, but is dependent upon landowner cooperation and limited funding. Rating of no given because adequate funds to quickly complete screening not available.
PGE, CTWSRO	Pelton Fish Passage Plan	Whychus Creek Deschutes River Metolius River	Uncertain	Program not implemented. 50-year timeframe. Considerable uncertainty regarding smolt passage survival.
CTWSRO, ODFW	Salmon and Steelhead Reintroduction Plan	Whychus Creek Metolius River	Uncertain	Adaptive plan over life of FERC license, considerable uncertainty regarding future success.
ODOT	Culvert replacement or retrofit		Uncertain	See State of Oregon programmatic review -- Appendix F.
CTWSRO	IRMP	Warm Springs River	Yes	Adaptive management plan could use expansion.
CTWSRO, USFS	Culvert replacement	Metolius River 5th field HUC Oak Creek Rm 0.01	USFS Yes	Timeframe to complete installation uncertain and program could use expansion. Only two major culverts left to be replaced in the Metolius—USFS has replaced 8 culverts in last 4 years.
Upper Deschutes Watershed Council	Various passage projects	Lake Creek Whychus Creek	Yes	Projects currently on Whychus Creek and Lake Creek could be expanded to other areas.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

The major issue for this strategy is passage above the Pelton-Round Butte Complex. A new FERC license was issued in June of 2005. A main component of the license is the reintroduction of salmon and steelhead above the PRB. New facilities, evaluation, modifications will need to be implemented. Juvenile out plants, downstream fish passage efficiencies and timelines have been defined in the Salmon and Steelhead Reintroduction and Conservation Plan in draft written by ODFW and CTWS.

The Forest Service Pacific Northwest Region's Aquatic Restoration Strategy (USDA-FS, 2005) provides guidance that will help prioritize culvert replacements for this population.

Strategy 3. Maintain and restore floodplain connectivity and function.

Strategy 3. Maintain and restore floodplain connectivity and function.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Reconnect floodplains to channels	1- Deschutes R. (Eagle Cr to Shitike Cr) 1- Deschutes R. (Trout Cr. to PRB) 1- Warm Springs R. (mouth to RM 31) 1- Shitike Cr. (mouth to RM 5) 1- Beaver Cr. (mouth to RM 26) 1- Mill Cr. (RM 5 to RM 6.5) 2- Quartz Cr. (Mouth to RM 5) 2- Coyote Cr. (Mouth to RM 11) 1- Potential MaSAs in Whychus Cr. 2- Potential MaSAs in Metolius	Degraded floodplain, degraded riparian area, channel structure	Removal of interaction between river and floodplain, grazing, agricultural use, loss of beaver dams	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	Floodplains and channels that are in balance are essential for proper stream function.
Reconnect side channels and off-channel habitats to stream channels	1- Deschutes R. (Eagle Cr to Shitike Cr) 1- Deschutes R. (Trout Cr. to PRB) 1- Warm Springs R. (mouth to RM 31) 1- Shitike Cr. (mouth to RM 5) 1- Beaver Cr. (mouth to RM 26) 2- Quartz Cr. (Mouth to RM 5) 2 - Coyote Cr. (Mouth to RM 11) 1- MaSAs in Whychus Cr. 2- Potential MaSAs in Metolius	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	In 1995, about 68% of all steelhead spawning in the mainstem Deschutes River from the Reregulating Dam to Trout Creek occurred in side channels between islands and channel margins, despite the fact that such channels comprise less than 10% of the channel length in the reach (Zimmerman and Ratliff 2003).
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	1- Beaver Cr. (RM 11 to RM 22)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat	Abundance, productivity	All	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Reconnect floodplain habitats	CTWSRO, ODFW, watershed council, SWCD, USFS	Ongoing	Improved connectivity with channel will be localized; improved water table will increase streamflow and lower water temperatures downstream.	Long term	5-15 years	Moderate
Reconnect side channels and off-channel habitats to stream channels	CTWSRO, ODFW, watershed council, SWCD, USFS	Ongoing	Improved connectivity with channel will be localized; improved water table will increase streamflow and lower water temperatures downstream.	Long term	5-15 years	Moderate
Promote the maintenance and creation of beaver dams to restore the role in natural	CTWSRO, ODFW, USFS	Ongoing	Subbasin-wide	Long term	Within 5 years	Moderate

Strategy 3. Maintain and restore floodplain connectivity and function.						
ecological processes.						
Status of Existing Programs through which Actions are Implemented						
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale		
USFS, BLM, Grasslands	Stream enhancement program (PACFISH/NWFP)	Metolius River 5th field HUCs Whychus Creek 5th Field HUCs. Only when specifically identified that passive restoration is not working.	Yes	The USFS/BLM preferred strategy is passive restoration; managing riparian areas to protect channel-forming processes. Additional opportunities are limited, projects may arise. See USFS/BLM Sufficiency Assessment—Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005).		
Watershed Councils	Watershed restoration	Whychus Creek RM 16.5	Uncertain	Only if specific needs cannot be addressed by passive restoration techniques.		
Soil and Water Conservation Districts	Watershed restoration	Population-wide		Only if specific needs cannot be addressed by passive restoration techniques.		
CTWSRO	IRMP	Warm Springs 5th field HUCs (8) Shitike Creek 5th Field HUC	Yes	Adaptive management plan, program could be expanded. See State of Oregon programmatic review -- Appendix F.		
ODA	Agricultural Water Quality Management Program	Population-wide		See State of Oregon programmatic review -- Appendix F.		
NRCS, SWCD, private landowners	CREP	Beaver Creek (RM 0.25 to RM 3.5 and RM 14 to RM 18) Warm Springs River (RM 0 to RM 3.5 and RM 27.5 to RM 30)	Yes	Could be expanded.		
Upper Deschutes Watershed Council	Various restoration projects	Upper Deschutes subbasin	Uncertain	Program needs additional resources to expand.		
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)						
The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize FS restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.						

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural channel form	1- Deschutes R. (Eagle Cr to Shitike Cr) 1- Deschutes R. ((Trout Cr. to PBR) 1- Warm Springs R. (mouth to RM 31) 1- Shitike Cr. (mouth to RM 5) 1- Beaver Cr. (RM 0.25 to RM 4, RM 14 to RM 15, and RM 18 to RM 26) 2 - Quartz Cr. (Mouth to RM 5)	Degraded channel structure and complexity, floodplain, degraded riparian area	Removal of interaction between river and floodplain, grazing, agricultural use, loss of beaver	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	Habitat complexity has been reduced in Shitike Creek and Warm Springs River by channel simplification and land use practices, resulting in flashy flows that have scoured the channel.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.						
	2 - Coyote Cr. (Mouth to RM 11) 1- MaSAs in Whychus Cr. 2- MaSAs in Metolius 2- Mill Cr. (RM 5 to RM 7.5)		dams			
Increase role and abundance of wood and large organic debris in streambeds	1- Deschutes R. (Eagle Cr to Shitike Cr) 1- Deschutes R. (Trout Cr. to PBR) 1- Metolius R. 1- Warm Springs R. (mouth to RM 37 and RM 41 to RM 42) 1- Shitike Cr. (mouth to RM 5) 1- Beaver Cr. (RM 14 to RM 15 and RM 18 to RM 26) 2- Quartz Cr. 2- Coyote Cr. 1- MaSA in Shitike Cr. 1- MaSAs in Whychus Cr.	Degraded channel structure and complexity, floodplain, degraded riparian area , altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	Removal of large wood (Metolius River) and channelizing streams have increased water velocities and reduced the ability of the stream to hold water for gradual release.
Increase instream habitat through manual placement of structures	2- Metolius R. 1- Shitike Cr. RM 0-5 1- Quartz Cr. RM 1-RM 2 1- Whychus Cr. RM 0.0-RM 32	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	large wood removal	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	Considered an active form of restoration while habitat conditions are restored through more passive efforts.
Stabilize streambanks	1- Deschutes R. (Eagle Cr to Shitike Cr) 1- Deschutes R. (spawning areas below PRB) 1- Warm Springs R. (mouth to RM 31) 1- Shitike Cr. (mouth to RM 5) 1- Beaver Cr. (mouth to RM 26) 2- Quartz Cr. (mouth to headwaters) 2- Coyote Cr. (mouth to headwaters) 1- Potential MaSAs in Whychus Cr. 2- Potential MaSAs in Metolius	Degraded channel structure and complexity, floodplain connectivity, degraded riparian areas, sediment routing, flows	Stream channelization, berming, bank armoring, overgrazing in riparian areas	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural channel form	CTWSRO, ODFW, SWCD, USFS, watershed councils	Ongoing	High dispersal downstream	Long term	5-15 years	High
Increase role and abundance of wood and large organic debris in streambeds	ODFW, USFS, PGE, CTWSRO, watershed councils	Ongoing	Treated area	Long term	Immediate	Moderate
Increase instream habitat through manual placement of structures	ODFW, USFS, CTWSRO	Ongoing	Treated area	Long term	Immediate	Moderate
Stabilize streambanks	CTWSRO, ODFW, SWCD, watershed councils, USFS, ODA	Ongoing	High dispersal downstream	Long term	5-15 years	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
PGE, CTWSRO	Lower Deschutes Gravel Study	Lower Deschutes	Yes	Possibly, based upon study results.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.				
PGE, CTWSRO	Large Wood Management Plan	Lower Deschutes	Yes	Adapt as program is implemented, program needs expansion.
USFS	Stream enhancement program (PACFISH)	Population-wide, only when specifically identified that passive restoration is not working	Yes	The USFS preferred strategy is passive restoration; managing riparian areas to protect channel-forming processes. Programs generally effective. See USFS/BLM Sufficiency Assessment—Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005).
Watershed Councils	Watershed restoration	Population-wide	Uncertain	Only if specific needs cannot be addressed by passive restoration techniques.
SWCDs	Watershed restoration	Population-wide		Only if specific needs cannot be addressed by passive restoration techniques. See State of Oregon programmatic review -- Appendix F.
CTWSRO	IRMP	Reservation	Yes	Adaptive management plan, program could be expanded.
ODA	Agricultural Water Quality Management Program	Population-wide		See State of Oregon programmatic review -- Appendix F.
NRCS, SWCD, private landowners	CREP	Population-wide	Likely	Could be expanded
Upper Deschutes Watershed Council	Various restoration projects	Upper Deschutes subbasin	Uncertain	Could be expanded.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Large wood placement in the lower Deschutes, gravel augmentation studies and evaluation will be conducted by PRBC licensees. The area of study and implementation will occur between the Reregulating Dam and Shitike Creek. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize FS restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.				

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural riparian communities	1- Deschutes R. (Eagle Cr. to Shitike Cr.) 1- Deschutes R. (Trout Cr. to PBR) 2 - Metolius R. 1- Warm Springs R. (mouth to RM 31., Ka-Nee-Ta resort area) 1- Shitike Cr. (mouth to RM 5, Community of Warm Springs, near Hwy 26) 1 - Beaver Cr. (mouth to RM 26) 2- Quartz Cr. (mouth to RM 5) 2 - Coyote Cr. (mouth to RM 11) 1- Potential MaSAs in Whychus Cr. 2- Mill Cr. (RM 5 to RM 6.5)	Bank degradation, degraded riparian communities, LWD recruitment, temperatures, flow, sediment routing, noxious Weeds	Livestock grazing, agricultural conversion, roads, bank armoring, residential development, loss of beaver dams, noxious weeds	Abundance, productivity	All	Many stream systems have experienced a loss of riparian vegetation. Roads are located in many riparian areas within the subbasin (NPCC 2004b).

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
Develop grazing strategies that promote riparian recovery	1- Whychus Cr.- RM 4 to RM16 2- Seekseequa Cr. 5th field HUC 1- Warm Springs R. 5th field HUCs 1- Shitike Creek 5th field HUC 2- Lower Deschutes River RM 74 to RM 100	Bank degradation, degraded riparian communities, flow, sediment routing	Overgrazing	Abundance, productivity	All	Significant opportunity to improve grazing strategies.
Eradicate invasive plant species from riparian areas	Lower Warm Springs River 5th field HUC Mill Creek 6th Field HUC Shitike Creek 5th field HUC Deschutes River RM 87 to Rm 100 Beaver Creek 5th field HUC	Degraded riparian communities	Conversion of natural riparian vegetative communities	Abundance, productivity	All	
Install fencing to exclude livestock from riparian areas	Warm Springs River RM 0.0 – 3.5 Warm Springs River RM 27.5 - 30 Lower Deschutes River RM 73-84 Beaver Creek RM 0.25-3.5 Beaver Creek RM 14-18 Badger Creek RM 0.5-2.5 Skookum Creek RM 0-1.0	Bank degradation, degraded riparian communities, flow, sediment routing	Overgrazing	Abundance, productivity	All	Specific locations will benefit significantly from livestock exclusion.
Install off-stream livestock watering	Badger Creek (RM 2.2) Warm Springs River (RM 28)	Degraded riparian communities, sediment routing	Overgrazing	Abundance, productivity	All	Off-channel water will reduce impacts in channel.
Plant riparian vegetation where appropriate	Beaver Creek Warm Springs River (mouth to Schoolie Creek, Ka-Nee-Ta resort area) Shitike Creek (mouth to RM 5, City of Warm Springs, near Hwy 26) Deschutes River (Eagle Creek to Shitike Creek) Deschutes River (Trout Creek to PBR)	Bank degradation, degraded riparian communities, LWD recruitment, temperatures, flow, sediment routing	Overgrazing, agricultural conversion, confinement in Ka-Nee-Ta area, roads, development	Abundance, productivity	All	Riparian planting can accelerate the rate of recovery.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural riparian communities	CTWSRO, USFS, ODA, SWCDs, ODFW, watershed councils	Ongoing	High dispersal downstream	Long term	5-15 years	High
Develop grazing strategies that promote riparian recovery	CTWSRO, USFS, ODA, SWCDs, BLM	Ongoing	High dispersal downstream	Long term	5-15 years	High
Eradicate invasive plant species from riparian areas	CTWSRO, USFS, ODA, SWCDs, watershed councils, BLM	Ongoing	Localized	Long term	After multiple years of treatment	Moderate
Install fencing to exclude livestock from riparian areas	CTWSRO, ODA, SWCDs, ODFW	Ongoing	High dispersal downstream	Long term	Riparian restoration (0-5 years)	High
Install off-stream livestock watering	ODFW, CTWSRO, USFS, ODA, SWCD	Expansion of existing effort	Private lands	Ongoing	Riparian restoration (0-5 years)	High
Plant riparian vegetation where appropriate	CTWSRO, USFS, ODA, SWCDs, ODFW, watershed councils	Ongoing	High dispersal downstream	Long term	5-15 years	Moderate

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
CTWSRO	Watershed maintenance	Warm Springs River RM 0.0 – 3.5	Likely	Needs to be continued.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.				
		Warm Springs River RM 27.5 - 30 Lower Deschutes River RM 73-84 Beaver Creek RM 0.25-3.5 Beaver Creek RM 14-18 Badger Creek RM 0.5-2.5 Skookum Creek RM 0-1.0		
CTWSRO	IRMP	Warm Springs 5th field HUCs Shitike Creek 5th field HUC	Yes	Adaptive management plan in place, program could be expanded.
SWCDs	Upland improvements, riparian improvements	Private land		Program could be expanded. See State of Oregon programmatic review -- Appendix F.
ODFW	ODFW COID mitigation and enhancement program	Upper Deschutes River, Whychus Creek	No	Limited to small geographical scale. More downstream effects need to be addressed need to be addressed.
USFS	Allotment Management Plan, Forest Management Plans	Metolius 5th field HUCs Whychus 5th field HUCs	Yes	See USFS/BLM Sufficiency Assessment—Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005).
NRCS	EQUIP, CRP, CREP	Upper Deschutes 4th field HUC	Yes	Programs for property owners to enroll riparian and upland.
ODA	Agricultural Water Quality Management Program	Private land		See State of Oregon programmatic review -- Appendix F.
Upper Deschutes Watershed Council	Various restoration projects	Whychus Creek	Yes	Could be expanded.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
The CTWSRO has erected and maintains nearly 70 miles of riparian exclusion fences, constructed water gaps, and off channel watering station for livestock. Constant maintenance of the fence lines must be conducted to keep livestock out and protect the riparian vegetation. Construction of more off channel watering sites or water gaps would help to address part of the issue. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize FS restoration actions for this population, and helps deploy limited active restoration funding where it is most needed. The USFS requires fence maintenance for all grazing allotments. New fencing may be part of adjustments to existing grazing strategies by the USFS/BLM to promote riparian recovery.				

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Implement agricultural water conservation measures	1-Whychus Creek 1-Upper Deschutes River	Altered hydrology, low flows, high temperatures	Water withdrawals, land conversion on uplands, road network	Abundance, productivity	Primarily fry and summer parr	
Improve irrigation conveyance and efficiency	1-Whychus Creek 1-Upper Deschutes River	Low flows, high temperatures	Water withdrawals,	Abundance, productivity	Primarily fry and	Irrigation withdrawals in Whychus Creek dewater sections of the creek

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
			loss during conveyance		summer parr	during summer baseflows.
Lease or purchase water rights and convert to instream	1-Whychus Creek 1-Upper Deschutes River	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily fry and summer parr	Small tributary flows are often intermittent limiting habitat availability in summer. EDT identified streamflows as a major limiting factor in this area.
Monitor/regulate water withdrawals	Population-wide	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily fry and summer parr	
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs	Population-wide	Low flows, high temperatures	Water withdrawals	Abundance, productivity, spatial structure, diversity	All stages	New programs in development

Action Implementation

Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Implement agricultural water conservation measures	SWCD, CTWSRO, landowners	Ongoing	Point of diversion downstream	Long term	Immediate increase in streamflow	High
Improve irrigation conveyance and efficiency	SWCD, USFS, OWRD, CTWSRO, OWEB, landowners	Expands existing program, proposes new projects	High dispersal downstream	Ongoing – Long term	Increased streamflow (0-5 years)	High
Lease or purchase water rights and convert to instream	OWRD, Oregon Water Trust, PGE, DRC, DBLT, others	Ongoing	Point of diversion to mouth of Deschutes	Long term	Immediate increase in instream flow	High
Monitor/regulate water withdrawals	OWRD	Ongoing	Point of diversion to mouth of Deschutes	Long term	Immediate	High
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs	OWRD	Ongoing	Population-wide	2007-2009 except incentive funding ongoing	Long term	Moderate

Status of Existing Programs through which Actions are Implemented

Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
CTWSRO	IRMP, water quality standards	Warm Springs 5th Field HUCS Shitike Creek 5th field HUC Seekseequa Creek 5th field HUC	Yes in some areas, no in others	Program could be expanded to improve effectiveness.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.				
ODFW	Habitat Program, riparian improvements	Upper Deschutes 4th field HUC	Uncertain	Needs expansion.
OWRD	Stream Flow Monitoring and Restoration, Flow Restoration, Lease/Transfer Water Rights, Administration of Water Rights, Water Use Measurement, Water Needs Assessment, Storage Assessment, Conservation Assessment	Upper Deshcutes 4th field HUC		See State of Oregon programmatic review -- Appendix F.
Oregon Water Trust and BOR	Leasing and Purchase of Water Rights	Upper Deschutes 4th field HUC	Uncertain	Program needs expansion.
SWCDs	Improve irrigation efficiency, upland improvements, riparian improvements	Population-wide		See State of Oregon programmatic review -- Appendix F.
ODEQ	Water quality management plans	Upper Deschutes 4th field HUC		See State of Oregon programmatic review -- Appendix F.
USFS, BLM	Water quality restoration plans (WQRP), PACFISH	Upper Deschutes 4th field HUC	Uncertain	WQR Plans identify projects but don't direct implementation of projects. See USFS/BLM Program Sufficiency Assessment -- Appendix E. and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005).
Watershed Councils	Upland improvements, riparian improvements	Whychus Creek, Lake Creek	No	Program needs additional resources.
NRCS	Upland improvements, riparian improvements	Population-wide	Uncertain	Program could be expanded.
DRC	Flow restoration projects	Upper Deschutes River Whychus Creek	No	Currently have projects in Whychus Creek. Needs to be expanded.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
The CTWSRO, ODFW, Watershed Councils, NRCS and Soil and Water Districts have implemented riparian improvements on federal, tribal, state, and private lands to improve base streamflows and other habitat parameters, primarily through construction of riparian corridor fences that exclude livestock grazing and development of off channel watering devices. Public land managers have implemented PACFISH standards for protection and restoration of USFS and BLM lands. Primary constraints on more riparian improvements are personnel and funding. The Deschutes River subbasin has 578 miles of stream protected by instream water rights. Voluntary flow restoration restored 13.4 cfs in 2006, of which 3.2 cfs was permanent. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize FS restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.				

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Manage irrigation return flow to reduce elevated stream temperatures	2- Warm Springs R. 2- Mill Cr. 1- Whychus Cr. 1-Deschutes R.	Altered stream temperatures, degraded water quality	Water withdrawals	Abundance, productivity	Fry dispersal and rearing	
Minimize unnatural factors that lead to fluctuations in dissolved oxygen levels	1- Warm Springs R. (RM 7) 1- Shitike Cr. (RM1.5)	Depleted oxygen Nutrient enrichment Bacteria increase	Point source inputs	Abundance, productivity	Fry dispersal and rearing	Warm temperatures reduce the dissolved oxygen capacity of the water.
Reduce chemical pollution inputs	Agricultural lands throughout population	Chemical pollution	Pesticides, fertilizers, herbicides, vehicle hydrocarbons, etc.	Abundance, productivity		

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
			point source inputs			
Implement Agricultural Water Quality Management Program	Agricultural lands throughout population	Degraded upland processes, altered hydrology, water quality, altered sediment routing	Land conversion and agricultural practices	Abundance, productivity	Fry dispersal and rearing	Recent conservation measures have greatly reduced sediment inputs.
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	1- Deschutes R. Pelton Dam to Trout Cr. 1- Warm Springs MaSAs and MiSAs 1- Shitike Cr. MaSAs and MiSAs 2- Potential MaSAs in Metolius 1- Potential MaSAs in Whychus	Degraded upland processes, floodplains, riparian areas, altered hydrology, altered sediment routing	Degradation and conversion of uplands, floodplains, riparian areas	Abundance, productivity	Spawning, incubation, fry dispersal, rearing, over-wintering	The Deschutes River and several westside tributary reaches are included on the 2002 ODEQ 303(d) list of water quality limited streams. The lower Deschutes River exceeds temperature criteria for salmonid rearing from White River to Pelton Dam. Water temperatures in lower reaches of Warm Springs River and Shitike Creek can exceed 70°F from mid to late summer. EDT identified water temperature during incubation as a major limiting factor in lower Shitike Creek, Beaver Creek, and several other stream reaches (NPCC 2004b). Reduced streamflows negatively affect water quality. Excessive sediment loads can also reduce water quality in the Warm Springs River, primarily from runoff in lower tributaries including Quartz and Coyote creeks.
Continue TMDL monitoring	Population-wide	Degraded water quality, sediment routing	Land use practices, water withdrawals, pesticides, fertilizers, herbicides	Abundance, productivity	All	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Manage irrigation return flow to reduce extreme stream temperatures	SWCDs	Ongoing	High dispersal downstream	Less than 5 years	Immediate	High
Minimize unnatural factors that lead to fluctuations in dissolved oxygen levels	ODEQ, municipalities	Ongoing	Dispersal downstream	Ongoing – Long term	Variable	Moderate
Reduce chemical pollution inputs	ODEQ, WyEast RC&D, others Municipal sewage treatment plants		Dispersal downstream	Ongoing – Long term	Reduce chemical pollution immediately	High
Implement Agricultural Water Quality Management Program	ODA, SWCD		Subbasin-wide	Ongoing – Long term	Long term	High
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	SWCD	Ongoing	Subbasin-wide, high dispersal downstream	Long term	Up to 15 years	High
Continue TMDL monitoring	USFS, ODFW, SWCD, ODEQ	Ongoing	Subbasin-wide	Ongoing	Immediate	High

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
Status of Existing Programs through which Actions are Implemented						
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale		
ODEQ	CWA Section 401	Upper Deschutes 4th field HUC		See State of Oregon programmatic review -- Appendix F.		
CTWSRO	CWA Section 401, Water Quality Standards, Integrated Resource Management Plan	Warm Springs 5th field HUCs Shitike Creek 5th field HUC	Likely	Needs expansion.		
ODA	Agricultural Water Quality Management Program	Middle Deschutes River Whychus Creek		See State of Oregon programmatic review -- Appendix F.		
USFS, BLM	Stream Restoration Program (PacFish/NWFP)	Metolius River/5th field HUCs Whychus Creek5th field HUCs Middle Deschutes River 5th field HUCs	Yes	See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005).		
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)						
ODA's Agricultural Water Quality Management Program is designed to prevent and control water pollution from agricultural activities and soil erosion on non-Federal and non-Tribal Trust or Reservation lands. ODA relies on voluntary measures to protect water quality, but also enforces pollution and streamside vegetation requirements. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize FS restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.						

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Continue to promote no-till and other seeding techniques that reduce erosion where site conditions are suitable	Subbasin-wide	Altered hydrology, sediment routing	Upland land use practices, loss of water storage capacity	Abundance, productivity	All	
Restore native upland plants	Subbasin-wide	Altered hydrology, sediment routing	Upland land use practices, loss of water storage capacity	Abundance, productivity	All	
Upgrade or remove problem forest roads	Forest lands	Altered hydrology, sediment routing	Road network	Abundance, productivity	All	
Utilize appropriate fire suppression techniques, implement mitigation measures	Subbasin-wide	Altered hydrology, sediment	Conversion of vegetative communities	Abundance, productivity	All	Appropriate mitigation methods minimize suppression impacts on habitat.
Demonstration projects to restore forest health and resilience to wildfire	Private and state forest lands	Altered hydrology, sediment, water quality, riparian functions, LWD recruitment	Conversion of vegetative communities	Abundance, productivity	All	Suppression of fires has altered fire regimes and increased threat of high intensity fires.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
Employ BMPs to minimize unnatural rates of erosion	Subbasin-wide	Altered hydrology, sediment routing, water quality	Upland land use practices, erosion, loss of water storage capacity	Abundance, productivity	All	

Action Implementation

Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Continue to promote no-till and other seeding techniques that reduce erosion where site conditions are suitable	SWCD	Existing program	Croplands, MaSAs	Ongoing	Reduce runoff, sediment supply, immediate increase in base flow	High
Restore native upland plants	USFS, BLM, NRCS, SWCDs, watershed councils, CTWSRO, BIA	Ongoing	High dispersal downstream	Juniper control can be quick, other actions such as control of invasive plants may take 20 years or more	0-20 years	High
Upgrade or remove problem forest roads	CTWSRO, USFS, ODOT, ODF	Ongoing	High dispersal downstream	Long term	Immediate for sediment, other parameters 5-15 yrs	High
Utilize appropriate fire suppression techniques, implement mitigation measures	CTWSRO, USFS, BLM	Ongoing	Areas where fires have occurred	Long term	5-15 yrs	High
Demonstration projects to restore forest health and resilience to wildfire	ODF	Ongoing	Private and state forest lands	Long term	Variable 5-20 years	Moderate
Employ BMPs to minimize unnatural rates of erosion	SWCD, USFS, ODA, ODF, BLM, CTWSRO, watershed councils, NRCS, private landowners	Ongoing	High dispersal downstream	Intermediate	5-15 years	High

Status of Existing Programs through which Actions are Implemented

Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
NRCS,SWCD, Private Landowners	CRP, CREP, EQUIP, WHP	Middle Deschutes 5th field HUC Metolius 5th field HUCs Warm Springs 5th field HUCs Lower Deschutes River RM 74-100 Whychus Creek	Likely	Needs expansion.
CTWSRO	Watershed Restoration	Coyote Creek / Quartz Creek 5th field watershed Beaver Creek 5th field watershed Shitike Creek 5th field watershed	No	Program needs additional resources—expand in scope.
ODFW	Watershed Restoration	Whychus Creek Metolius River	Uncertain	Needs expansion.
ODF	Private land protection from fire, Private Forest Program	Private and state forestlands throughout population		See State of Oregon programmatic review -- Appendix F.
ODF	Oregon Forest Practices Act	Private and state forest lands		See State of Oregon programmatic review -- Appendix F.
USFS, BLM	Stream Restoration Program (PacFish/NWFP)	Metolius River 5th field HUCs Whychus Creek 5th field HUCs	Yes	See USFS/BLM Program Sufficiency Assessment -- Appendix E.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.				
		Middle Deschutes River		
CTWSRO	IRMP	Warm Springs 5th field HUCs Shitike Creek 5th field HUC	Yes	Guided by adaptive management plan for next 10 years--may need expansion in future.
CTWSRO, USFS, BLM	Fire suppression mitigation approaches	Population-wide	Likely	See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005).
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize FS restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.				

9.3.4 Habitat Strategies and Actions for Crooked River Steelhead Population

Primary limiting factors: degraded channel structure and complexity and floodplain connectivity, degraded riparian condition, high water temperature, low flows, altered hydrology sediment routing and lack of fish passage.

Primary threats: grazing and agricultural practices, urban development, off highway vehicle use, irrigation withdrawal, dams, lack of floodplain connectivity.

Geographic area designations: Allen Cr-1 (Rm 0 – Rm 4); Crooked MS-1 (Rm 6 – Rm 7); Crooked MS-2 (Rm 7 – Rm 14); Crooked MS-3 (Rm 14 – Rm 30); Crooked MS-4 (Rm 31 – Rm 45); Crooked MS-5 (Rm 45 – Rm 46); Crooked MS-6 (Rm 46 – Rm 51); Crooked MS-7 (Rm 51 – Rm 55); Crooked MS-8 (Rm 55 – Rm 62); Crooked MS-9 (Rm 62 – Rm 70); Crooked R. above Bowman Dam; Little McKay Cr-1 (Rm 0 – Rm 3); McKay Cr-1 (Rm 0 – Rm 5); McKay Cr-2 (Rm 5 – Rm 10); McKay Cr-3 (Rm 10 – Rm 14); McKay Cr-4 (Rm 14 – Rm 16); McKay Cr-5 (Rm 16 – Rm 19); Ochoco Cr-1 (Rm 0 – Rm 5); Ochoco Cr-2 (Rm 5 – Rm 10); Ochoco Cr. above Ochoco Dam.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority, 3-third priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Protect the highest quality habitats through acquisition or conservation easements	1- Crooked MS-1,8,9 1- McKay Cr-1,3 1- Ochoco Cr-2 2- Crooked MS-3,4,5,6 2- McKay Cr-2 2- Ochoco Cr-1 3- Crooked R. (above Bowman Dam) 3- Ochoco Cr. (above Ochoco Dam)	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing	All	Abundance, productivity	All	Additional riparian fencing on McKay and Ochoco creeks would greatly improve riparian conditions and recruitment of woody vegetation.
Adopt and manage Cooperative Agreements	Private and public lands	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing	All	Abundance, productivity	All	Continue stream channel restoration on City of Prineville property and expand up and downstream.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Conserve rare and unique functioning habitats	1- Crooked MS-1,2,9 2- McKay Cr-4,5 2- Little McKay Cr-1 2- Crooked MS-7	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing	All	Abundance, productivity	All	
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes	1- Entire population	All factors	All	Abundance, productivity	All	Apply BMP's and other existing habitat protection laws to the entire population to prevent habitat degradation.
Conduct outreach to resource users and managers	1- Entire population	All factors	All	All	All	Program outputs will be improved as knowledge of ecological processes, hydrological processes, and land use management is expanded.
Special management designated on public lands	1- Crooked MS-1,2,9	All factors	All	All	All	Management of Wild and Scenic River

Action Implementation

Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Protect the highest quality habitats through acquisition or conservation easements	BLM, USFS, Crooked River Watershed Council (CRWC), City of Prineville, Deschutes Basin Land Trust	Ongoing	McKay MASA, Lower Crooked MASA, Lower Ochoco MASA	Immediate	Variable depending on habitat condition	High
Adopt and manage Cooperative Agreements	CRWC, City of Prineville, private landowners, ODFW, Ochoco lumber,	Ongoing	Entire subbasin	Long term	Variable depending on habitat condition	Likely
Conserve rare and unique functioning habitats	BLM, USFS, ODFW	Ongoing	1- Crooked MS-1,2,9 2- McKay Cr-4,5 2- Little McKay Cr-1 2- Crooked MS-7	Immediate	Variable depending on habitat condition	High
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes	SWCD, USFS, ODA, NRCS, CRWC, BLM, counties, private landowners	Ongoing	Entire subbasin	Long term	Degradation stop immediately, habitat recovery 15-25 years depending on status	Unknown, depends upon action taken as a result of being more informed
Conduct outreach to resource users and managers	ODFW, CRWC, BLM, USFS, NOAA Fisheries, SWCD's, OSU extension, CTWSRO, PGE	Ongoing	Entire subbasin	Long term	Variable lag time	Unknown, depends upon action taken as a result of being more informed

Status of Existing Programs through which Actions are Implemented

Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
USFS and BLM	Special Management Area designations PACFISH, Wild and Scenic River Corridors	Crooked MS-1,2,-9 McKay Cr-4, Cr-5 Little McKay Cr-1	Likely	Continual implementation of programs. See USFS/BLM Program Sufficiency Assessment -- Appendix E. Currently no additional opportunities to expand programs

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.				
				on BLM lands.
USDA FSA/SWCD's	CREP/CRP	Agricultural lands throughout population	Likely	Additional programs can be enrolled, and programs are not permanent in duration. See State of Oregon Programmatic review -- Appendix F.
ODA/SWCD's	Agricultural Water Quality Management Program	Agricultural lands throughout population	Uncertain	See State of Oregon Programmatic review -- Appendix F.
Local Government	County planning and zoning, City of Prineville Comprehensive Plan	Private lands throughout population	Uncertain	Riparian protection not adequate. Discharge of partially treated wastewater from city facility into Crooked River.
PGE	Lower Crooke MASA, Lower Ochoco MASA	Upper Population	Uncertain	Newly implemented program, results not yet available.
NGOs	Lease or purchase of land or instream water rights	Private lands throughout population	No	Limited opportunities arise, but programs can be expanded when opportunities become available.
Watershed Councils	CRWC	Population-wide	Uncertain	Water council currently active and successful, however success and future is dependent on ability to continue procuring funds.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Implementation of PACFISH standards and guides for most Forest and BLM programs has been highly successful over most of this population's area, but implementation of PACFISH Standards and Guidelines for FS and BLM grazing management remains challenging in some locations. FSA programs that protect riparian areas and upland watersheds include CRP, which pays landowners not to farm highly erodible soils, and the CREP program that pays landowners for setting riparian corridors side from grazing and farming. The long-term effectiveness of both programs is limited by the relatively short duration of the contracts, which ranges from 10-15 years. ODA's Agricultural Water Quality Management Program is designed to prevent and control water pollution from agricultural activities and soil erosion on non-Federal and non-Tribal Trust or Reservation lands. ODA relies on voluntary measures to protect water quality, but also enforces pollution and streamside vegetation requirements.				

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Replace or remove barriers blocking passage including dams, road culverts, irrigation structures, infiltration galleries	1- Rice Baldwin Dam 1- Stearns Dam 1- Seamus Dam 1- Parga Dam 2- Ochoco Creek (Prineville Country Club) 2- Bowman Dam 2- Ochoco Dam 2- Opal Springs Dam	Impaired fish passage	Dams, culverts, instream structures	Abundance, spatial structure, productivity	Primarily adults and 0+juveniles	Passage has been provided at the Crooked River Central and Peoples Irrigation diversions. It is likely that passage will be provided at Seamus and Parga Dams by 2011. Passage at other dams and diversions will be a greater challenge.
Maintain irrigation diversions and screens	1-Where diversions exist throughout population	Impaired fish passage	Irrigation diversions	Abundance, spatial structure, productivity	Primarily juveniles, but also adults at facilities with ladders.	All known diversions are maintained and generally meet screening criteria.
Provide screening at 100% of irrigation diversions	1-Peoples Irrigation 2-private irrigation diversions	Entrainment in canals	Irrigation diversions	Abundance, spatial structure, productivity	Juveniles	Screening of Peoples irrigation is planned. Significant progress in screening in

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
						recent years, including each of Ochoco Irrigation District's diversions. Most remaining screening issues in McKay Cr.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Remove/replace barriers blocking passage including dams, road culverts and irrigation structures	CRWC, BLM, USFS, ODFW, private landowners	Ongoing	Access between upstream and downstream habitats	Immediate	Immediate	High
Maintain irrigation diversions and screens	ODFW, private landowners, irrigation districts	Ongoing	Diversions subbasin-wide	Based on funding	Immediate	High
Provide screening at 100% of irrigation diversions	ODFW Fish Passage and Screening	Ongoing	Access between upstream and downstream habitats	Immediate as need is identified	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
CRWC, BLM, ODFW, BOR, NRCS, Ochoco Irrigation, private landowners	Fish passage and screening, state funding and federal funding	Rice Baldwin Dam, Stearns Dam, Seamus Dam, Parga Dams, Ochoco Creek, Bowman Dam, Ochoco Dam, Opal Springs Dam.	Likely	Passage has been provided at the Crooked River Central and Peoples Irrigation diversions. It is likely that passage will be provided at Seamus and Parga Dams by 2011. Passage at other dams and diversions will be a greater challenge.
ODFW	Fish Passage/Screening, State program and federal funded	Population-wide	Uncertain	The program completes a minimum of one project per year, but is dependent upon landowner cooperation and limited funding. See State of Oregon programmatic review -- Appendix F.
CTWSRO/ODFW	Salmon and Steelhead Reintroduction Plan	Areas above Pelton complex	No	Adaptive plan over life of FERC license.
ODOT	Culvert replacement or retrofit	Population-wide		See State of Oregon programmatic review -- Appendix F.
USFS and BLM	Culvert replacement	Population-wide	USFS likely with current program.	Needs expansion.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
A comprehensive fish screen inventory needs to be completed throughout the population. The Forest Service Pacific Northwest Region's Aquatic Restoration Strategy (USDA-FS, 2005) provides guidance that will help prioritize culvert replacements for this population. Fish will not be able to pass beyond Crooked MS-1 without passage at Opal Springs Dam, successful construction of a fish ladder is crucial.

Strategy 3. Maintain and restore floodplain connectivity and function.

Strategy 3. Maintain and restore floodplain connectivity and function.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Reconnect floodplains to	1- Crooked MS-4,5,6	Degraded floodplain,	Removal of interaction	Abundance,	Primarily 0 to	Floodplains and channels that are in

Strategy 3. Maintain and restore floodplain connectivity and function.						
channels	1- McKay Cr-1,2,3,4 2- Little McKay Cr-1 2- Crooked MS-3,7,8 2- McKay Cr-5,6 2- Allen Cr-1 2-Ochoco Cr-1,2 3- Crooked R. (above Bowman Dam) 3- Ochoco Cr. (above Ochoco Dam)	degraded riparian area, channel structure	between river and floodplain, grazing, agricultural use, loss of beaver dams	productivity	2-age rearing and 2-age migrants	balance are essential for proper stream function. Improved livestock grazing and agricultural practices necessary for successful restoration. Floodplain connection in Crooked MS-8 is highly desirable, but landowner cooperation is necessary.
Reconnect side channels and off-channel habitats to stream channels	1- Crooked MS-4,5,6 1- McKay Cr-1,2,3,4 2- Little McKay Cr-1 2- Crooked MS-3,7,8 2- McKay Cr-5,6 2- Allen Cr-1 2-Ochoco Cr-1,2 3- Crooked R. (above Bowman Dam) 3- Ochoco Cr. (above Ochoco Dam)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	Off channel habitat important juvenile rearing habitat. Improved livestock grazing and agricultural practices necessary for successful restoration. Floodplain connection in Crooked MS-8 is highly desirable, but landowner cooperation is necessary.
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	1-McKay Cr 1,2,3,4,5 1-Little McKay Cr 1 1-Ochoco Cr 1,2 2-Allen Cr 1 3-Crooked above Bowman 3-Ochoco Cr above Ochoco Dam	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat	Abundance, productivity	All	As riparian areas recovery, beaver recolonization occurs naturally.
Restore wet meadows and wetlands	1- Crooked MS-4,5,6 1- McKay Cr-1,2,3,4 2- Little McKay Cr-1 2- Crooked MS-3,7,8 2- McKay Cr-1,4 2- Allen Cr-1 2-Ochoco Cr-1,2 3- Crooked R. (above Bowman Dam) 3- Ochoco Cr. (above Ochoco Dam)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands and wet meadows	Abundance, productivity	Primarily fry and age 0+	Restoration of wet meadows and wetlands will be by-product of floodplain and side channel restoration; however, specific projects may be required to reach acceptable status.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Reconnect floodplain habitats.	CTWSRO, ODFW, CRWC, BLM, SWCD's, USFS, PGE, ODOT, City of Prineville	Ongoing	High dispersal downstream from site	Long term	5-15 years	Likely, dependent on further landowner cooperation
Reconnect side channels and off-channel habitats to stream	CTWSRO, ODFW, CRWC, SWCD, USFS, BLM, PGE,	Ongoing	High dispersal downstream from site	Long term	5-15 years	Likely, dependent on

Strategy 3. Maintain and restore floodplain connectivity and function.						
channels.	ODOT					further landowner cooperation
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	CTWSRO, ODFW, USFS, BLM	Ongoing	Subbasin-wide	Long term	Within 15 years	Likely
Restore wet meadows and wetlands	CTWSRO, ODFW, CRWC, BLM, SWCD's, USFS, PGE, ODOT, City of Prineville	Ongoing	Subbasin-wide	Long term	Within 15 years	Likely

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
CRWC, City of Prineville	Crooked River stream channel restoration	Crooked MS-5	No	Engineering for project complete, implementation expected summer 2010. Project only restores one stream segment, more restoration necessary in this reach and others. Efforts to re-establish floodplain connectivity in other reaches of the Crooked River were not successful due to channel degraded channel condition, altered hydrology and project design.
CRWC, Ochoco Lumber, ODFW	Ochoco Creek Enhancement, Ochoco Mill Site	Ochoco CR-1	No	Although this project will improve fish habitat within the project boundaries, similar strides are necessary in Ochoco CR-1 and Ochoco CR-2
CRWC, private landowners, ODFW	Middle McKay passage protection, stream restoration	McKay Cr-2,3 Allen Creek Cr-1	Uncertain	Projects will create fish passage and restore natural stream channels. However, landowner cooperation is necessary for project completion and restoration needs to be expanded throughout entire stream and some tributaries.
NRCS,SWCD, USDA FSA, Private Landowners	CREP/CRP	Private lands throughout population	Uncertain	An effective program that could be expanded to more landowners. See State of Oregon programmatic review -- Appendix F.
BLM, Oregon State Parks,	Wild and Scenic Rivers	Crooked MS-1,2,3 (RM 6-17) Crooked MS-9	Yes	See State of Oregon and Federal agencies' programmatic reviews.
ODA/SWCD	Agricultural Water Quality Management Program	Private lands	No	See State of Oregon programmatic review -- Appendix F.
USFS	Stream Restoration Program (PACFISH)	Forest lands only when specifically identified that passive restoration is not working	Likely	The USFS preferred strategy is passive restoration; managing riparian areas to protect channel-forming processes. Program implementation needs to expand in scope. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005).

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
CRP in uplands and riparian protection provide short-term benefits, however longer periods are required to restore stream channel and habitat. Habitat benefits of CRP enrollments are dependent upon agreements between participating agencies and landowners. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.

Strategy 3. Maintain and restore floodplain connectivity and function.
The success of all stream channel and riparian restoration is dependent on cooperation between landowners and government agencies. Proper land management practices must be adopted by landowners and natural resource managers to assure that further habitat degradation does not occur. Channel and floodplain restoration projects in the recovery area will require long-term monitoring agreements between the CRWC and landowners.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority, 3-third priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural channel form, includes berm and levee removal	1- Crooked MS-4,5,6 1- McKay Cr-1,2,3,4, 1- Ochoco Cr 2 2- Little McKay Cr-1 2- Crooked MS-3,7,8 2- McKay Cr-5,6 2- Allen Cr-1 2-Ochoco Cr-1, 3- Crooked R. (above Bowman Dam) 3- Ochoco Cr. (above Ochoco Dam)	Degraded channel structure and complexity, floodplain, degraded riparian area, altered hydrology, degraded water quality, sediment routing	Grazing, agricultural practices, channelization, berms, roads, railroad bank armoring, floodplain, loss of beaver dams	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	Channelization, berm construction, and bank armoring, following floods has isolated the stream from the floodplain in many areas. Large wood and other instream habitat complexity is lacking. Efforts to re-establish floodplain connectivity in other reaches of the Crooked River were not successful due to channel degraded channel condition, altered hydrology and project design.
Increase role and abundance of wood and large organic debris in streambeds	1- McKay CR-1,2,3,4,5 1- Little McKay Cr-1 1- Ochoco CR-1,2 2- Crooked MS- 3,4,5,6,7,8,9 2- Allen Cr-1 3- Crooked R. (above Bowman Dam) 3- Ochoco Cr. (above Ochoco Dam)	Degraded channel structure and complexity, floodplain, degraded riparian area , altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	Limited opportunity to recruit and maintanin large woody debris in mainstem Crooked River. Agricultural practices have nearly eliminate woody vegetation from riparian areas and woody vegetation rehabilitation is necessary for entire Crooked River, McKay CR-1,2,3,4 and Ochoco CR-1 and 2. Bowman and Ochoco Dams prevents LWD recruitment from above the dam.
Increase instream habitat through manual placement of structures	1- McKay Cr-1,2,3,4,5 1- Little McKay Cr-1 1- Ochoco Cr 1,2 2- Allen Cr-1 2- Crooked MS- 3,4,5,6,7,8	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	Large wood removal	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	Considered an active form of restoration while habitat conditions are restored through more passive efforts
Stabilize streambanks with passive restoration processes	1- Crooked MS-4,5,6 1- McKay Cr-1,2,,4.5 1- Little McKay Cr-1 2- Crooked MS-3,7,8 2- McKay Cr-3 2- Allen Cr-1	Degraded channel structure and complexity, floodplain connectivity, degraded riparian areas, sediment routing, flows	Stream channelization, berming, bank armoring, overgrazing in riparian areas	Abundance, productivity	Primarily 0 to 2-age rearing and 2-age migrants	Passive restoration will not be adequate in lower Crooked River valley. Passive restoration should be considered above Bowman and Ochoco Dams to prepare for steelhead recovery in coming decades.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.						
	2-Ochoco Cr-1,2 3- Ochoco Cr. (above Ochoco Dam) 3- Crooked R. (above Bowman Dam)					

Action Implementation

Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural channel form, includes berm and levee removal	CTWSRO, ODFW, SWCD, USFS, BLM, CRWC, City of Prineville	Ongoing	High dispersal downstream	Long term	5-15 years	Likely
Increase role and abundance of wood and large organic debris in streambeds	ODFW, USFS, BLM, PGE, CTWSRO, CRWC	Ongoing	Localized to treatment area	Long term	Immediate	High
Increase instream habitat through manual placement of structures	ODFW, USFS, BLM, CTWSRO, CRWC, private landowners	Ongoing	Limited application throughout population	Long term	Immediate	High
Stabilize streambanks	CTWSRO, ODFW, SWCD, CRWC, USFS, BLM, ODA, City of Prineville	Ongoing	High dispersal downstream	Long term	5-15 years	High

Status of Existing Programs through which Actions are Implemented

Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
NRCS,SWCD, USDA FSA, Private Landowners	CREP/CRP	Riparian and upland areas throughout population	Uncertain	An effective program for both upland and riparian protection, but could be expanded to additional private lands. See State of Oregon programmatic review -- Appendix F.
BLM Prineville District	Various range and upland restoration projects.	BLM lands	Likely	Most lands currently meeting BLM Standards and Guidelines continued monitoring is needed to unsure long-term compliance.
BLM, Oregon State Parks, CTWSRO	Wild and Scenic Rivers	Crooked MS-1,2,3, 9 (RM 6-17, 62-70) Crooked MS-9	Likely	See State of Oregon programmatic review -- Appendix F. See USFS/BLM Program Sufficiency Assessment -- Appendix E.
ODA/SWCD	Agricultural Water Quality Management Program	Throughout population	No	See State of Oregon programmatic review -- Appendix F.
USFS	Stream Restoration Program (PACFISH)	Forest lands only when specifically identified that passive restoration is not working	Likely	The USFS preferred strategy is passive restoration; managing riparian areas to protect channel-forming processes. Needs to be expanded to more streams in Trout Creek Subbasin. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (UDSA-FS, 2005).
CRWC	Various restoration projects	Entire Crooked River Subbasin	Uncertain	Project capacity currently at a maximum, expansion of council personnel could improve recovery effort.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

CRP in uplands and riparian protection provide short-term benefits, however longer periods are required to restore stream channel and habitat. Habitat benefits of CRP enrollments are dependent upon agreements between participating agencies and landowners. Riparian fencing must be maintained to assure that the riparian vegetation can re-establish and eventually provide a source of LWD.

The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.
Channel and floodplain restoration projects in the recovery area will require long-term monitoring agreements between the CRWC and landowners.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority, 3-third priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural riparian communities including vegetative planting	1- Crooked MS-3,4,5,6,7,8 1- McKay Cr-1,2,3,4,5 1- Ochoco Cr-1,2 1- Allen Cr-1 2- Crooked MS-1,2,9 2- Little McKay Cr-1 3- Crooked R. (above Bowman Dam) 3- Ochoco Cr. (above Ochoco Dam)	Bank degradation, degraded riparian communities, LWD recruitment, temperatures, flow, sediment routing	Livestock grazing, agricultural conversion, roads, bank armoring, residential development, loss of beaver dams	Abundance, productivity	All	Past grazing practices throughout the subbasin have caused riparian degradation. Current practices, though improved, continue to limit recovery. Heavy off road vehilcle use has lead to severe riparian degradation in McKay Cr-5. Riparian vegetation contributes little to LWD recruitment and canopy cover. Streambank erosion and loss of riparian vegetation has led to undesirable width-to-depth ratios throughout the watershed
Develop grazing strategies that promote riparian recovery	1- Crooked MS-3,4,5,6,7,8 1- McKay Cr-1,2,3,4,5 1- Ochoco Cr-1,2 1- Allen Cr-1 2- Little McKay Cr-1 3- Crooked R. (above Bowman Dam) 3- Ochoco Cr. (above Ochoco Dam)	Bank degradation, degraded riparian communities, LWD recruitment, temperatures, flow, sediment routing	Overgrazing	Abundance, productivity	All	Significant opportunity to improve grazing strategies.
Eradicate invasive plant species from riparian areas	Where opportunities exist throughout the subbasin	Degraded riparian communities	Conversion of natural riparian vegetative communities	Abundance, productivity	All	
Install/maintain fencing to exclude livestock from riparian areas	1- Crooked MS-3,4,5,6,7,8 1- McKay Cr-1,2,3,4,5 1- Ochoco Cr -2 2- Allen Cr-1 2- Little McKay Cr-1 2- Ochoco Cr-2 3- Crooked R. (above Bowman Dam) 3- Ochoco Cr. (above Ochoco Dam)	Bank degradation, degraded riparian communities, LWD recruitment, temperatures, flow, sediment routing	Overgrazing	Abundance, productivity	All	Several locations will benefit from livestock exclusion.
Install off-stream livestock watering	Throughout entire subbasin	Degraded riparian communities, sediment routing	Overgrazing	Abundance, productivity	All	
Plant riparian vegetation where appropriate	1- Crooked MS-3,4,5,6,7,8 1- McKay Cr-1,2,3,4,5 1- Ochoco Cr-1,2	Bank degradation, degraded riparian communities, LWD recruitment, temperatures, flow, sediment routing	Overgrazing, agricultural conversion, roads,	Abundance, productivity	All	Natural vegetation restoration generally occurs without planting, some planting occurs along with

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
	1- Allen Cr-1 2- Crooked MS-1,2,9 2- Little McKay Cr-1 3- Crooked R. (above Bowman Dam) 3- Ochoco Cr. (above Ochoco Dam)		urban development			fencing projects and CREP projects.

Action Implementation

Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural riparian communities including vegetative planting	USFS, SWCD's, ODFW, CRWC, BLM, OWEB, private landowners	Ongoing	High dispersal downstream	Long term	Riparian restoration (10-25 years)	Likely
Develop grazing strategies that promote riparian recovery	USFS, ODA, SWCD's, BLM, CRWC, private landowners	Ongoing	High dispersal downstream	Long term	Riparian restoration (10-25 years)	Likely
Eradicate invasive plant species from riparian areas	CTWSRO, USFS, ODA, SWCD's, CRWC, BLM, private landowners	Ongoing		Immediate	Riparian restoration (10-25 years)	Uncertain
Install/maintain fencing to exclude livestock from riparian areas	NRCS, , ODA, SWCD's, ODFW, USFS, BLM, private landowners	Ongoing	High dispersal downstream	Immediate	Riparian restoration (10-25 years)	Likely
Install off-stream livestock watering	USFS, ODA, SWCD, CRWC, private landowners	Expansion of existing effort	Private lands	Ongoing	Riparian restoration (10-25 years)	Likely
Plant riparian vegetation where appropriate	USFS, SWCD's, ODFW, CRWC, BLM, OWEB, private landowners	Ongoing	High dispersal downstream	Long term	Riparian restoration (10-25 years)	Likely

Status of Existing Programs through which Actions are Implemented

Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
BLM, Oregon State Parks, CTWSRO	Wild and Scenic Rivers	Crooked MS-1,2,3 (RM 6-17) Crooked MS-9	Likely	See State of Oregon programmatic review -- Appendix F. See USFS/BLM Program Sufficiency Assessment -- Appendix E.
USFS	Stream Restoration Program (PACFISH)	Forest lands	Likely	Needs to be expanded to more streams in Trout Creek Subbasin. See USFS/BLM Program Sufficiency Assessment -- Appendix E and Regional Aquatic Restoration Strategy. See discussion in Gaps commentary below.
NRCS,SWCD, USDA FSA, Private Landowners	CREP	Throughout population	Uncertain	An effective program for both riparian protection and restoration, but could be expanded to additional private lands.
ODA	Agricultural Water Quality Management Program	Throughout population		See State of Oregon programmatic review -- Appendix F.
CRWC/OWEB	Various restoration projects	Throughout population	Uncertain	Effective program for developing restoration/protection projects and supplying outreach information on resource management. Participation could be expanded.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

The Forest Service Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize stream enhancement actions for this population, and helps deploy limited active restoration funds where it is most needed.

Public land managers have implemented PACFISH standards for protection and restoration of USFS and BLM lands. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS,

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.
2005) helps prioritize stream enhancement actions for this population, and helps deploy limited active restoration funding where it is most needed. The USFS/BLM requires fence maintenance for all grazing allotments. New fencing may be part of adjustments to existing grazing strategies by the USFS/BLM to promote riparian recovery.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Implement agricultural water conservation measures	1- Crooked MS-3,4,5,6,7 1- McKay Cr-1,2,3 1- Allen Cr-1 1- Ochoco Cr-1,2 2- Crooked R. (above Bowman Dam) 2- Ochoco Cr. (above Ochoco Dam)	Altered hydrology, low flows, high temperatures	Water withdrawals, land conversion on uplands, road network	Abundance, productivity	Primarily fry and summer parr	Major flows of Crooked River and its tributaries diverted for irrigation purposes. Conserved flows from the Crooked River above Bowman Dam and Ochoco Creek above Ochoco Dam would benefit downstream fish populations. Flow gauges at diversions could be used to regulate irrigation allocations.
Improve irrigation conveyance and efficiency	1- Crooked MS-3,4,5,6,7 1- McKay Cr-1,2,3 1- Allen Cr-1 1- Ochoco Cr-1,2 2- Crooked R. (above Bowman Dam) 2- Ochoco Cr. (above Ochoco Dam)	Low flows, high temperatures	Water withdrawals, loss during conveyance	Abundance, productivity	Primarily fry and summer parr	Conversion of flood to sprinkler irrigation, piping, irrigation efficiency improvement, and diversion gauging would increase flows.
Lease or purchase water rights and convert to instream	1- Reallocation of Prineville Reservoir 1- Where available	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily fry and summer parr	
Monitor/regulate water withdrawals	Population-wide	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily fry and summer parr	Most water withdrawals are not monitored for compliance.
Water retention structures	Population-wide	Altered hydrology, low flows	Degradation on uplands	Abundance, productivity	Primarily fry and summer parr	Many water retention structures would not be necessary if riparian areas were left intact and uplands were properly managed thereby increasing the water retention abilities of the soil.
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	Population-wide	Altered hydrology, low flows, high temperatures, impaired natural functions and processes on uplands, floodplains, riparian areas	Degradation and conversion of uplands, floodplains, riparian areas	Abundance, productivity	Primarily fry and summer parr	Juniper encroachment and consequential reduction of native grasses, shrubs, and forbs has reduced retention of precipitation in uplands. Flow fluctuations are now larger than they were historically. High flows have scoured channels reducing habitat diversity.
Assess existing and future water needs, complete statewide inventory of above	Population-wide	Low flows, high temperatures	Water withdrawals	Abundance, productivity, spatial	All stages	New programs in development

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs				structure, diversity		

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Implement agricultural water conservation measures	SWCD, , BOR, irrigation districts, landowners, OWRD	Expands existing program, new projects	Croplands throughout subbasin	Based on funding	Immediate increase in streamflow; habitat diversity, floodplain connection (0-5 yrs)	Likely
Improve irrigation conveyance and efficiency	SWCD, USFS, OWRD, OWEB, landowners, CRWC	Expands existing program, proposes new projects	High dispersal downstream	Ongoing	Increased streamflow (0-15 years)	Likely
Lease or purchase water rights and convert to instream	OWRD, Oregon Water Trust, PGE, DRC, BOR	Ongoing	Point of diversions to mouth of Crooked	Long term	Immediate increase in instream flow	Uncertain
Monitor/regulate water withdrawals	OWRD	Ongoing	Point of diversions to mouth of Crooked	Long term		Likely
Water retention structures	SWCD's	Ongoing	Uplands	Intermediate	0-15 years	Uncertain
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	SWCD, USFS, OWRD, OWEB, ODFW, CTWSRO, landowners	Ongoing	Subbasin-wide	Intermediate	Up to 15 years	Uncertain
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs	OWRD	Ongoing	Population-wide	2007-2009 except incentive funding ongoing	Long term	Likely

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
BLM	Various projects related to rangeland improvements in uplands	BLM lands	Uncertain	Effective programs. Long-term monitoring of effectiveness is needed. See USFS/BLM Program Sufficiency Assessment--Appendix E.
NRCS,SWCD, FSA, Private Landowners	CRP, CREP	Riparian and upland areas within population	No	An effective program for both upland and riparian protection, but could be expanded to additional private lands.
OWRD	Streamflow Monitoring and Restoration, Flow Restoration, Lease/Transfer Water Rights, Administration of Water Rights, Water Use	Specific locations determined by opportunities		See State of Oregon programmatic review -- Appendix F.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.				
	Measurement, Water Needs Assessment, Storage Assessment, Conservation Assessment			
Oregon Water Trust	Lease water rights and return instream	Specific locations determined by opportunities	Uncertain	Program works well, could be expanded with more willing landowners. Need assurance that instream leases remain instream.
SWCD, NRCS	Various irrigation efficiency improvements, CRP, CREP	Specific locations determined by opportunities	Uncertain	Needs expansion.
ODA/SWCD	Agricultural Water Quality Management Program	Population-wide		See State of Oregon programmatic review -- Appendix F.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Many landowners have adopted modern irrigation techniques; however downstream irrigators generally take unused water. Monitoring of irrigation withdrawals with flow gauges is essential before the benefits of conservative water management are realized. However, irrigation waters should not be returned to streams if they will compromise the water quality of essential habitats. The BOR, as required in the Columbia River Biological Opinion, is required to identify and assist with passage improvement design and flow restoration.				

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Manage irrigation return flow and wastewater effluent to improve water quality	1- Crooked MS-1,2,3,4,5,6,7 1- McKay Cr-1,2,3 1- Ochoco Cr-1,2 2- Allen Cr-1 2- Crooked R. (above Bowman Dam) 2- Ochoco Cr. (above Ochoco Dam)	Altered stream temperatures, degraded water quality	Land use practices, water withdrawals, pesticides, fertilizers, herbicides, raw sewage	Abundance, productivity	Fry dispersal and rearing	Returns contain multiple pollutants, excessive nutrients, and have increased temperatures leading poor downstream water quality and reduced dissolved oxygen capacity,
Implement Agricultural Water Quality Management Program	Agricultural lands throughout population	Degraded upland processes, altered hydrology, water quality, altered sediment routing	Land conversion and agricultural practices	Abundance, productivity	Fry dispersal and rearing	
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	Population-wide	Degraded upland processes, floodplains, riparian areas, altered hydrology, altered sediment routing	Degradation and conversion of uplands, floodplains, riparian areas	Abundance, productivity	Eggs, fry, juveniles, adults	There are opportunities to improve irrigation methods and reduce runoff from agricultural fields reducing nutrient loading and pollution of streams.
Continue TMDL monitoring	Population-wide	Degraded water quality, sediment routing	Land use practices, water withdrawals, pesticides, fertilizers, herbicides	Abundance, productivity	All	
Permit and enforce actions that could affect water quality	Population-wide	Water quality	Land use practices	Abundance, productivity, diversity	All	Directed actions at known sources of pollution should be addressed through BMP's and restoration projects.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Action Implementation

Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Manage irrigation return flow to reduce extreme stream temperatures	SWCD's, Irrigation Districts	Ongoing	High dispersal downstream	Less than 5 years	Immediate	Likely
Implement Agricultural Water Quality Management Plan	ODA, SWCD		Subbasin-wide	Ongoing	Variable	Likely
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	SWCD	Ongoing	Subbasin-wide, high dispersal downstream	Intermediate	Up to 15 years	Uncertain
Continue TMDL monitoring	USFS, SWCD, ODEQ, CRWC	Ongoing	Subbasin-wide	Ongoing	Immediate	High
Permit and enforce actions that could affect water quality	ODA, SWCD, Municipalities, CDs, USFS, BLM, Irrigation Districts, private landowners, ODEQ	Ongoing	High dispersal downstream	Ongoing	Immediate	Uncertain, degree of implementation is unknown

Status of Existing Programs through which Actions are Implemented

Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
BLM	Various projects related to rangeland improvements in uplands	BLM lands	Uncertain	Effective programs. See USFS/BLM Program Sufficiency Assessment -- Appendix E.
FSA, NRCS,SWCD, Private Landowners	CRP, CREP	Riparian and upland areas throughout population	Uncertain	An effective program for both upland and riparian protection, but could be expanded to additional private lands. See State of Oregon programmatic review -- Appendix F for SWCD.
ODA/SWCD	Agricultural Water Quality Management Program	Throughout population	Uncertain	See State of Oregon programmatic review -- Appendix F.
USFS	Stream Restoration Program (PACFISH)	USFS lands	Uncertain	Needs expansion. See USFS/BLM Program Sufficiency Assessment -- Appendix E and Regional Aquatic Restoration Strategy.
ODEQ	Water Quality	Subbasin-wide	Likely	See State of Oregon programmatic review – Appendix F
ODEQ/EPA	Pesticides/Toxics	Subbasin-wide	Likely	See State of Oregon programmatic review – Appendix F, for ODEQ
Municipalities	Public Works	Crooked MS- 3,4,5,6	No	Treatments of sewage returns unacceptable

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize stream enhancement actions for this population, and helps deploy limited active restoration funding for riparian planting where it is most needed.

Implementation of PACFISH standards and guides for Forest and BLM programs, in conjunction with Forest Plan Management Area allocations, has been highly successful for passive upland restoration over most of this population's area.

The TMDLs set loading capacity to achieve water quality standards. To address high summer water temperatures, near stream vegetation disturbance, channel widening and low flows are the existing sources of increased solar radiation loading. Achievement of the TMDL targets is dependent of determination of system potential vegetation. During TMDL development, the best professional judgment of the team described the potential streamside shade-producing vegetation broadly, as continuous tree-belts on each side of the river.

While permit processes implemented by the US Army Corps of Engineers are thorough and actions authorized are protective of aquatic resources, the program lacks personnel resources to insure that terms and conditions of permitted actions are followed. In addition, this agency lacks resources to adequately monitor waterways for non-permitted actions or act upon non-permitted situations reported by other agencies or private parties. See State of Oregon programmatic review -- Appendix F for ODSL.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority, 3- third priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Remove junipers	1-Crooked MS-3,4,5,6,7,8 1-McKay Cr-3,4,5 1-Allen Cr-1 1- Ochoco Cr-2 2- Crooked above (Bowman Dam) 2- Ochoco (above Ochoco dam)	Altered hydrology	Loss of water storage capacity	Abundance, productivity	All	
Restore native upland plants and remove noxious weeds	1-Crooked MS-3,4,5,6,7,8,9 1-McKay Cr-1,2,3,4,5 1-Allen Cr-1 1- Ochoco Cr-2 2- Ochoco Cr-1 3- Crooked above (Bowman Dam) 3- Ochoco (above Ochoco dam)	Altered hydrology, sediment routing	Upland land use practices, loss of water storage capacity	Abundance, productivity	All	
Upgrade or remove problem forest roads	1- McKay Cr-4,5 1- Little McKay Cr-1	Altered hydrology, sediment routing	Road network	Abundance, productivity	All	
Promote reforestation and fuels management	1- McKay Cr-4,5 1- Little McKay Cr-1	Altered hydrology, sediment	Conversion of vegetative communities	Abundance, productivity	All	
Demonstration projects to restore forest health and resilience to wildfire	Private forest lands	Altered hydrology, sediment, water quality, riparian functions, LWD recruitment	Conversion of vegetative communities	Abundance, productivity	All	Suppression of fires has altered fire regimes and increased threat of high intensity fires.
Employ BMPs to minimize unnatural rates of erosion	Subbasin-wide	Altered hydrology, sediment routing, water quality	Upland land use practices, erosion, loss of water storage capacity	Abundance, productivity	All	
Apply BMPs to forest practices including fuels management and fire suppression mitigation, livestock grazing, road management and agricultural practices	Subbasin-wide	Altered hydrology, sediment routing	Forestry, roads, overgrazing, Agricultural practices, noxious weeds	Abundance, productivity	All	Upland management practices affect the hydrologic function of the watershed by causing rapid runoff rather than infiltration. BMP's should be implemented to insure that the watershed functions to its potential, given the anthropogenic influence in the watershed.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Remove junipers	SWCD's, NRCS	Ongoing	Uplands	Immediate	0-20 years	Uncertain, control must be followed by appropriate

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
						management strategies
Restore native upland plants	USFS, BLM, NRCS, SWCD's, watershed councils, CTWSRO, BIA	Ongoing	High dispersal downstream	Juniper control can be quick, other actions such as control of invasive plants may take 20 years or more	0-20 years	Uncertain
Upgrade or remove problem forest roads	CTWSRO, USFS, ODOT, ODF	Ongoing	High dispersal downstream	Long term	Immediate for sediment, other parameters 5-15 yrs	Likely
Promote reforestation and fuels management	CTWSRO, USFS, watershed councils, SWCD's, counties	Ongoing	Forestlands	Long term	0-10 yrs	Likely
Demonstration projects to restore forest health and resilience to wildfire	ODF	Ongoing	Private and state forest lands	Long term	Variable 5-20 years	Moderate
Employ BMPs to minimize unnatural rates of erosion	SWCD, USFS, ODA, ODF, BLM, CTWSRO, watershed councils, NRCS, private landowners	Ongoing	High dispersal downstream	Intermediate	5-15 years	Likely
Employ BMPs to forest practices including fuels management and fire suppression mitigation, livestock grazing, road management and agricultural practices	SWCD, USFS, ODA, CTUIR, private landowners	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, dependent on implementation of water quality management plans and other plans.	0-20 years, depending on treatments applied	Uncertain, dependent on voluntary landowner participation

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
NRCS,SWCD, Private Landowners	CRP, CREP, Environmental Quality Incentive Program (EQUIP)	Private upland and riparian lands	Uncertain	An effective program for both upland and riparian protection, but could be expanded to additional private lands. Continued implementation of program dependent on funding. See State of Oregon programmatic review -- Appendix F for SWCD.
SWCD's	Voluntary Watershed Restoration	Private agricultural lands		Dependent on funding, and landowner interest. See State of Oregon programmatic review -- Appendix F.
BLM	Various projects related to rangeland improvements in uplands.	BLM lands	Uncertain	Effective programs that could be expanded to additional lands.
CTWSRO	IRMP	Reservation Lands	Likely	Adaptive plan could be expanded.
USFS	Stream Restoration Program (PACFISH), Vegetation Management Programs, Range Management Programs	USFS forest lands	Uncertain	Effectiveness of program unproven. May need expanded monitoring. See USFS/BLM Program Sufficiency Assessment -- Appendix E and Regional Aquatic Restoration Strategy. See discussion in Gaps commentary below.
ODF	Private land protection from fire, Private Forest Program	Private and state forestlands throughout population		See State of Oregon programmatic review -- Appendix F.
ODF	Oregon Forest Practices Act	Private and state forest lands		See State of Oregon programmatic review -- Appendix F.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
Many benefits to steelhead have been seen in upland and riparian management plans since the 1987 Farm Bill. CRP in uplands and riparian protection provide short-term benefits, however longer periods are required to restore stream channel and habitat. Habitat benefits of CRP enrollments are dependent upon agreements between participating agencies and landowners. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize active watershed restoration for this population, and helps deploy limited active watershed restoration funding where it is most needed. Implementation of PACFISH standards and guides for Forest and BLM programs, in conjunction with Forest Plan Management Area allocations, has been highly successful for passive upland restoration over most of this population's area.

9.3.5 Habitat Strategies and Actions for Lower Mainstem John Day River Steelhead Population

Primary limiting factors: degraded channel structure and complexity (habitat quantity and diversity), altered sediment routing, water temperature, and altered hydrology. Impaired fish passage is also a high priority limiting factor in Bridge, Butte, Kahler, Muddy, Rock, and Thirtymile creeks.

Primary threats: agricultural and grazing practices, removal of overstory trees and bank vegetation from the riparian corridor, water withdrawals, wetland draining and conversion, and stream channelization and diking.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Protect high quality habitats through acquisition or conservation easements	Mountain Cr. (2); Pine Cr. (1); Cottonwood Cr. (1); Bridge Cr (1). Reaches are either designated roadless areas, Wilderness Study Areas, or designated Wilderness Areas within the watershed. John Day River, Parrish Cr to Tumwater Falls (a Wild and Scenic River) (2); Butte Cr, lower 8 miles (2)	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing	Many threats including livestock overgrazing of riparian area, channelization, stream bank armoring, agricultural practices (fertilizers, herbicides, sediments, changes in plant communities), water withdrawals, loss of beaver dams	Abundance, productivity	All	Protection of high quality habitats is the most cost effective way of ensuring fish have good quality habitat. It is much less expensive over the long term to protect high quality habitat than it is to degrade the habitat and then try to restore it. Many objectives are likely to be met just by habitat protection and the associated natural recovery of upland and/or riparian areas. Land acquisitions, easements, and cooperative agreements may also facilitate the implementation of active restoration projects.
Adopt and manage Cooperative Agreements	For those stream reaches already under either CREP or ODFW cooperative agreements on Alder (2), Pine Hollow (1), Rock (Gilliam Co) (2), Mountain (1), Cottonwood (1), Squaw (2) and Butte (1) crs	Same as above	Same as above	Abundance, productivity	All	
Designate additional wilderness and wild and scenic status	Convert Wilderness Study Areas on public lands to Wilderness at Spring Basin (1), Pat's Cabin (1), Sutton Mountain (2), North Pole Ridge (2), Thirtymile (1), and Lower John Day mainstem (2)	Same as above	Land use practices	Abundance, productivity	All	
Special management designations in forest and BLM	Bridge Cr, adjacent to the Sutton Mt. WSA (1), and on Ochoco National Forest (2)	Same as above	Livestock grazing of riparian area, changes in	Abundance, productivity	All	These special designations include Riparian Habitat Conservation

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
plans			plant communities			Areas and Anadromous Fish Emphasis
Protect access to key habitats	None identified at this time, although ODFW periodically reviews proposals that could block passage into spawning and rearing habitat.	Passage barriers, altered hydrology, channel structure		Abundance, productivity, distribution	All	Thoroughly review projects that may block fish passage. Current ODFW policy is to grant exemptions from fish passage requirements only if mitigation meets or exceeds the loss of habitat. Exemptions must be approved by the Fish and Wildlife Commission
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes	Population-wide	All	Same as above	Abundance, productivity	All	
Conduct outreach to resource users and managers	Population-wide	All				

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Protect the highest quality habitats through acquisition or conservation easements	CTUIR, TNC, RMEF, John Day Basin Trust, SWCDs	Ongoing	Water quality improvement have high dispersal downstream, stream corridor and function improvements would be confined to the specific site	Existing conservation agreements are complete. Full implementation of conservation measures will take 5-15 years or more	5-15 years with passive restoration approaches	High, based on previous cooperative agreements
Adopt and manage Cooperative Agreements	ODFW, SWCDs, FSA	Ongoing	Water quality improvement have high dispersal downstream, stream corridor and function improvements would be confined to the specific site	Agreements are for 10-15 years	Immediate	High, although not in perpetuity
Designate additional wilderness and wild and scenic status	USFS, Oregon State Parks	Ongoing as identified	Water quality and flow improvements would have high dispersal downstream, stream corridor and function improvements confined to the specific site	unknown	5-15 years	Unknown, subject to availability of areas that meet criteria
Special management designations in forest and BLM plans	USFS, BLM	Ongoing as identified	Same as above	Many complete, potentially subject to change in Forest Plan revisions	Immediate	High, although subject to change from Forest Plan or mgmt plan revision
Protect access to key habitats	None identified at this time, although ODFW periodically reviews proposals that could block passage into spawning and rearing habitat.					

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	NRCS, SWCDs, USFS, ODFW, ODF, DSL, BLM, ODOT, CTWSRO, ODA, FSA, private landowners	ongoing	Population-wide	Long term	5-15 years	High
Conduct outreach to resource users and managers	ODFW, NOAA Fisheries, USFWS, USFS, BLM, CTWSRO, Watershed Councils, SWCDs	ongoing	Population-wide	Long term	Variable lag time	Unknown, depends upon action taken as a result of being more informed

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
USFS and BLM	Wilderness Areas, Wilderness Study Areas, Wild and Scenic River corridors, Special Management Area designations, PACFISH	Bridge Cr, Cottonwood Cr, Pat's Cabin, North Pole Ridge, Lower John Day, Spring Basin, Thirtymile, and Sutton Mountain for Wilderness, all streams within National Forest and BLM lands for PACFISH	Yes	See USFS/BLM Program Sufficiency Assessment—Appendix E. Additional areas may be considered for addition to special management area protected status on FS lands. BLM has no opportunities to expand any of these programs.
ODFW	Cooperative Agreements	Alder, Cottonwood, Squaw and Mountain crs	Uncertain	The agreements are for only 10-15 years and need extended.
FSA	CREP	Rock, Pinehollow, and Butte crs	Uncertain	The agreements are for only 10 or 15 years and need extended.
NGOs	Lease or purchase of lands or instream water rights		Yes	Important to secure critical habitat and/or water rights.
ODA	Agricultural Water Quality Management Program	The entire lower subbasin		See State of Oregon programmatic review -- Appendix F.
CTWSRO	Watershed Restoration	Pine Cr	Likely	Could expand program.
ODF	Oregon Forest Practices Act	All private and state owned lands		See State of Oregon programmatic review -- Appendix F.
Local Government	City and County Planning and Zoning	Private land and population-wide	Varies by county, Grant County currently has 100' riparian setbacks.	Although large scale development is not presently occurring throughout the John Day subbasin, it will likely occur within the next 30 years.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

The John Day River has 248.6 miles designated as Federal Wild and Scenic River and 317 miles designated as State Wild and Scenic, including the John Day River from Tumwater Falls (RM 10) to Service Cr (RM 157). State designated reaches include the John Day mainstem from Tumwater Falls (RM 10) to Parrish Cr (RM 170). Although wild and scenic designation does not preclude development, it requires development to be consistent with protecting the Outstandingly Remarkable Values (ORV's) for which the river was designated, requires review of any activity that may affect ORV's within the ¼ mile river corridor, and protects the free flowing condition of the river. Designation as W&S essentially precludes construction of any major dam. A Management Plan adopted by BLM and Oregon State Parks Department in 2001 for the designated rivers segments identifies specific management actions including development of livestock grazing management plans for each allotment. Grazing management plans for most of the allotments within the corridor are complete; all BLM grazing plans are complete.

Existing forest plans include special management designations for RHCAs. Adding additional wilderness areas and wild and scenic river segments would require designation by Congress. The forest plans and BLM plans have been amended by PACFISH, which requires 300-foot buffers on any fish bearing stream for tree removal, as well as specific guidelines for livestock grazing and riparian vegetation use. Compliance with the 300-foot buffer for timber harvest operations has been very good. In areas where trees were harvested before the rules went into effect, it will take decades for them to grow big enough to function as large wood and contribute to LWD. Forest practices rules for private and state owned forest lands have guidelines for protection of riparian function, although they are not nearly as restrictive as those on federal lands.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.
Designating additional RMAs or adding to the current restrictions within RHCAs will be revisited during the Forest Plan Revision process that is currently underway. Cooperative and conservation agreements on private land are tools for protecting high quality habitats. ODFW has used cooperative agreements over the last 21 years to protect riparian corridors that have been fenced to exclude livestock grazing. Unfortunately those agreements are for only 15 years and there have not been funds or personnel needed to extend them for longer time periods. CTWSRO owns mitigation property near Clarno on the mainstem John Day River. It encompasses 33,557-acres and includes approximately 20 miles of steelhead spawning and rearing habitat. All CTWSRO properties will be in conservation status perpetually. FSA programs that protect riparian areas and upland watersheds include the CRP, which pays landowners not to farm highly erodible soils, and the CREP program, which pays landowners for setting riparian corridors aside from grazing and farming. The long term effectiveness of both programs is limited by the relatively short duration of the contracts which ranges from 10 to 15 years. NRCS programs that protect riparian areas and upland watersheds include the Conservation Reserve Program (CRP) and the Conservation Reserve Enhancement Program (CREP). The CRP program pays landowners not to farm highly erodible soils and the CREP program pays landowners for setting riparian corridors aside from grazing and farming. The long term effectiveness of both programs is limited by the relatively short duration of the contracts which ranges from 10 to 15 years.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.

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Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Remove or minimize use of push up dams	Rock (1); Upper Rock (1), Middle Rock (1), Lone Rock (1), Thirtymile (1), Butte (1), Big Muddy (2), and Rock/Mountain crs (2)	Impaired fish passage	Push up dams	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	Push up irrigation dams are located throughout the entire subbasin and are common in the Rock/Mountain Cr drainages. Annual maintenance and construction of push up dams contributes to onsite and downstream channel stability, loss of pools and other structure, and increased sediment loads.
Remove or replace barriers blocking passage such as dams, road culverts and irrigation structures	Rock (1), Upper Rock (1), Middle Rock (1), Lone Rock (1), Thirtymile (1), Butte (1), Kahler (1), Big Muddy (2), and Rock/Mountain crs (2)	Impaired fish passage	Dams, culverts, instream structures	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	Concrete diversions, in-channel stock ponds, and road culverts are located throughout the entire subbasin. Concrete structures are located primarily in the Rock Cr (Lower John Day) drainage although there are a number of structures scattered throughout other parts of the subbasin, including Cherry Cr. Passage problems at culverts are widespread throughout all subbasins.
Provide screening at 100% of irrigation diversions	Rock Cr (Gilliam Co.) (1), Keeton Cr. (Wheeler Co.) (2), Bridge Cr. (Wheeler Co.) (1), Lower John Day mainstem pumping sites (2)	Impaired fish passage	Irrigation diversions	Abundance, productivity, spatial structure	Emergent fry	Adequately screened diversions provide immediate benefits.
Replace screens that do not meet criteria	Rock Cr (Gilliam Co.) (1), Keeton Cr. (Wheeler Co.) (2), Bridge Cr. (Wheeler Co.) (1), Lower John Day mainstem pumping sites (2)	Impaired fish passage	Irrigation diversions	Abundance, productivity, spatial structure	Emergent fry	Screening of irrigation diversions began in 1950s and most were screened by mid-1970s. Many screens now need to be replaced to address new criteria to reduce entrainment of emergent fry and bull trout.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Remove or minimize use of push up dams	SWCD	Ongoing	Provide access to upstream habitat	Ongoing, but all push up dams not expected to be corrected for at least 15 years	Immediate	High, if comply with fish passage design criteria
Remove or replace barriers blocking passage such as dams, road culverts and irrigation structures	USFS, watershed councils, SWCDs, ODOT	Ongoing	Access to upstream habitat	Ongoing, replacing all culverts blocking fish passage expected to take 50 years	Immediate	High, if comply with fish passage design criteria. BLM has no culvert barriers to adult fish. Monitoring needed to determine if upstream passage for juveniles is an issue.
Provide screening at 100% of irrigation diversions	ODFW, SWCDs	Ongoing	At point of diversion	Approximately 16 diversions need to be screened, should take 5-10 years	Immediate	High if comply with fish passage design criteria
Replace screens that do not meet criteria	ODFW	Ongoing	At point of diversion	Approximately 10 screens need to be replaced, should take 5-10 years	Immediate	High if comply with fish passage design criteria

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, likely, uncertain, no)**	**Sufficiency Rationale**
Soil and Water Conservation Districts	Irrigation dam improvements, culvert replacement or retrofits	Unscreened or poorly screened diversions throughout population		The Soil and Water Districts are constrained by the construction window of opportunity. The counties could expand the program but are constrained by funding and personnel. See State of Oregon programmatic review -- Appendix F.
ODFW	Fish Passage/Screening state program and federally funded	Unscreened or poorly screened diversions throughout population	No	The program completes a minimum of one project per year, but is dependent upon landowner cooperation and limited funding.
USFS	Culvert replacement	Throughout population on Federal land	Uncertain	Program progressing slowly, culverts replaced are sufficient. BLM has no culvert barriers to adult fish. Monitoring needed to determine if upstream passage for juveniles is an issue.
Watershed Councils	Road Crossing Passage improvements, passage improvements	Throughout population	Uncertain	Programs need additional resources.
ODOT	Culvert replacement or retrofit	Throughout population		See State of Oregon programmatic review -- Appendix F.
BOR	John Day Basin Program		Yes	
CTWSRO	John Day Basin Program		No	The tribe contracts with Soil and Water Districts to assist with consultation, permits, and monitoring program.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

The mainstem passage problems for the Lower Mainstem John Day population have been addressed, but there are many tributaries where adult passage is blocked and more areas where juvenile passage problems occur. Irrigation dams, stock ponds, and road culverts are the primary causes of passage issues. Soil and Water Districts are correcting passage at irrigation diversions and improperly installed culverts, but are constrained by funding and by personnel needed for construction oversight. An inventory of road crossings on state and county roads in 1999 indicated 23 culverts on state owned roads and 43 culverts on county owned roads did not meet fish passage criteria in the Lower Mainstem John Day River population. Appendix G presents an inventory of known passage problems associated with culverts on state, county, or Federal roads. Some of those culverts have been replaced with structures that do meet the fish passage criteria, but much work remains. Watershed councils and ODOT, who are the principal entities working on culverts

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.
are constrained primarily by funding. An inventory of road crossings on federal lands indicates juvenile passage problems are pervasive, particularly on National Forests, with approximately 22 culverts not meeting passage criteria on National Forest land. The US Forest Service and BLM are constrained primarily by funding and the personnel needed for NEPA analysis. At the current rate of culvert replacements, it will take over 50 years to correct all passage problems on National Forests in all five John Day populations. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize FS restoration actions for this population, and helps deploy limited active restoration funding where it is most needed. Another constraint is that existing state laws do not require passage improvements at existing barriers unless there is a major change in the structure, such as reconstruction or significant modifications, so landowner cooperation is critical for improving passage throughout the subbasin.
US Bureau of Reclamation is required in the Columbia River Biological Opinion to identify and assist with passage improvement design and flow restoration.
Currently, the ODFW Fish Passage and Screening program replaces about 20 irrigation diversion screens per year in the John Day subbasin. With over 120 diversions in the John Day subbasin that either do not meet current screening criteria or are unscreened, it would take at least 6 years to replace them all. Of the 120 diversions, 26 need screens or screens replaced in this population. Currently, highest priority is given to diversions that are unscreened with lower priority given to diversions that have screens, but do not meet the criteria. The program is constrained primarily by funding and personnel. Current law does not require water users to screen diversions less than 30 cubic feet per second and virtually all diversions in the John Day are less than 30 cfs, so landowner cooperation is essential to success of the program.

Strategy 3. Maintain and restore floodplain connectivity and function.

Strategy 3. Maintain and restore floodplain connectivity and function.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Reconnect floodplains to channels	Rock (2), Upper Rock (1), Middle Rock (2), Lone Rock (1), Thirtymile (1), Butte (1), Bridge (1) Kahler (1), Mountain (1), Pinehollow (1), Grass Valley (2), and Hay (2) crs	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	Primarily eggs, fry and 0+	
Restore wet meadows	Thirtymile (1), Butte (1), Bridge (1), Kahler (1), Mountain (1), Rock (2), Upper Rock (2), Middle Rock (2), Lone Rock (2), Pinehollow (2), Grass Valley (2), and Hay (2) crs	Degraded floodplain, altered hydrology	Removal of wetlands	Abundance, productivity	Primarily eggs, fry and 0+	
Reconnect side channels and off-channel habitats to stream channels	Upper Rock (1), Rock (2), Middle Rock (2), Lone Rock (2), Thirtymile (2), Butte (1), Bridge (1), Kahler (2), Mountain (1), Pinehollow (2), Grass Valley (2), and Hay (2) crs	Degraded floodplain, altered hydrology	Removal of side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	Primarily eggs, fry and 0+	There has been a loss of off-channel and side-channel habitats that once provided habitat for spawning and rearing, and refugia from high flows.
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes	Rock (2), Upper Rock (1), Middle Rock (2), Lone Rock (1), Thirtymile (2), Butte (1), Bridge (1), Kahler (1), Mountain (1), Pinehollow (1), Grass Valley (2), and Hay (2) crs	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat	Abundance, productivity	Primarily eggs, fry and 0+	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Reconnect floodplain habitats	ODFW, watershed council, SWCD, USFS, BLM	Ongoing	For the treated stream reach	Short term, once identified	Physical response will be immediate, biological response may take 5-10 years	High
Restore wet meadows	TNC, USFS, CTWSRO	Ongoing and	Benefits of improved channel	Intermediate	5-15 years	Moderate

Strategy 3. Maintain and restore floodplain connectivity and function.						
		planned	morphology localized, improved water table and resulting increased streamflow and lower water temperatures have high dispersal downstream			
Reconnect side channels and off-channel habitats to stream channels	ODFW, watershed council, SWCD, USFS, BLM, CTUIR	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Long term, because of widespread need	5-15 years, depending upon frequency and duration of channel altering flows	Moderate, depending upon how extensive the project is and frequency and duration of channel altering flows
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes	ODFW, CTWSRO, USFS, BLM	ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Long term, due to acceptance by landowners and widespread need	Within 5 years once the dams are built	Moderate-high, dependent upon acceptance by landowners

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program	None completed to date	No	If specific needs cannot be addressed by passive restoration techniques, program underfunded
USFS, BLM	Stream enhancement program	Population-wide on Federal land, only when specifically identified that passive restoration is not working	Likely	The USFS/BLM preferred strategy is passive restoration; managing riparian areas to protect channel-forming processes. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005).
Watershed Councils	Watershed restoration	Population-wide	Dependent upon need and funding	Only if specific needs cannot be addressed by passive restoration techniques
Soil and Water Conservation Districts	Watershed restoration	Population-wide		See State of Oregon programmatic review -- Appendix F.
Nature Conservancy and other NGOs	Restoration projects	Population-wide	Uncertain	Yes
ODA	Agricultural Water Quality Management Program	Population-wide		See State of Oregon programmatic review -- Appendix F.
CTWSRO, CTUIR	Watershed restoration	Pine Cr	Uncertain	Program could be expanded.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize FS restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.				

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.

Strategy. Restore degraded and maintain properly functioning channel structure and complexity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural channel form	Rock (1), Upper Rock (2), Middle Rock (1),	Degraded channel	Stream channelization,	Abundance,	Primarily	Passive restoration techniques, such as

	Lone Rock (2), Thirtymile (2), Butte (2), Bridge (2), Kahler (2), Mountain (2), Pinehollow (1), Grass Valley (2), and Hay (2) crs	structure and complexity, habitat diversity, sediment routing, water temperature, flows	bank armoring, large wood removal, beaver removal, removal of riparian vegetation, livestock overgrazing in riparian areas	productivity	eggs, fry and 0+	riparian fencing, are the preferred method for improving channel structure and stability. More active restoration techniques may be appropriate in these reaches.
Place stable wood and other large organic debris in streambeds and in floodplains	Rock (2), Upper Rock (1), Middle Rock (2), Lone Rock (2), Thirtymile (1), Butte (1), Bridge (1), Kahler (1), Mountain (1), Pinehollow (2), Grass Valley (2), and Hay (2) crs	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	Large wood removal channelization	Abundance, productivity	Primarily eggs, fry and 0+	More active restoration techniques, such as rootwad placement or channel reconfiguration, may be appropriate in these reaches.
Stabilize streambanks	Rock (1), Upper Rock (2), Middle Rock (1), Lone Rock (2), Thirtymile (1), Butte (2), Bridge (2), Kahler (2), Mountain (2), Pinehollow (1), Grass Valley (2), and Hay (1) crs	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	Stream channelization, berming, bank armoring, overgrazing in riparian areas	Abundance, productivity	Primarily eggs, fry and 0+	Some bank erosion is inevitable and beneficial. However, where erosion is actively taking place due to unnatural processes, stabilization may be needed to reduce fine sediments

Action Implementation

Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural channel form	ODFW, SWCDs, USFS, BLM, watershed councils	Ongoing and planned	For the treated stream reach	Short term, once identified	Physical response will be immediate, biological response may take 5-10 years	High
Place stable wood and other large organic debris in streambeds and in floodplains	ODFW, USFS, watershed councils, BLM, SWCDs	As needed	For the immediate stream reach	Once identified, short term	Immediate	High
Stabilize streambanks	ODFW, USFS, watershed councils, BLM, SWCDs	Ongoing	For the treated stream reach, physical benefits dispersed downstream	Passive stabilization techniques are referred and take longer to implement	With passive restoration the response may take 15 years	Moderate to high, depending upon the extent of the treatments

Status of Existing Programs through which Actions are Implemented

Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program	Only used where passive restoration has not been successful. To date, no structural work has been identified	Uncertain	If specific needs cannot be addressed by passive restoration techniques then program needs expansion.
USFS, BLM	Stream enhancement program	Only used where passive restoration has not been successful. To date, no structural work has been identified	Uncertain	The USFS/BLM preferred strategy is passive restoration; managing riparian areas to protect channel-forming processes. May need expansion in some areas. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005).
Watershed Councils	Watershed restoration	Only used where passive restoration has not been successful. To date, no structural work has been identified	Dependent upon need and funding	If specific needs cannot be addressed by passive restoration techniques needs expansion.
Soil and Water Conservation Districts	Watershed restoration	Only used where passive restoration has not been successful. To date, no structural work has been identified		See State of Oregon programmatic review -- Appendix F.
CTWSRO	Watershed restoration	Only used where passive restoration has not been successful. To date, no structural work has been identified	Dependent upon need and funding	If specific needs cannot be addressed by passive restoration techniques needs expansion.

NGOs	Watershed restoration	Only used where passive restoration has not been successful. To date, no structural work has been identified	Dependent upon need and funding	If specific needs cannot be addressed by passive restoration techniques needs expansion.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Instream activities have not been identified as a high priority by the recovery planning team or the management action planning team except when identified as a need for specific sites. The planning team prefers that more passive approaches, such as riparian and upland improvements be emphasized. Typically, instream activities that would improve floodplain function and channel migration processes would include placement of rootwads, whole trees, or boulder clusters to improved habitat complexity and habitat diversity where those parameters are deficient and not expected to improve with passive restoration. Another structural activity would be to construct boulder or log weirs to raise the water table, but only where a passive approach has not worked. Currently little instream structure placement has been identified for this population. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize FS restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.				

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural riparian vegetative communities including vegetative planting	Lower John Day River mainstem below Cottonwood Bridge and above Service Cr (2); Rock Cr (2); Upper Rock (2); Middle Rock (2); Lone Rock (1); MaSAs (Gilliam Co) (2); Grass Valley Canyon (2); some reaches of Mountain Cr (Wheeler Co) (1); portions of Parrish Cr (1), Cherry Cr (1); some reaches of Kahler Cr (1), Ferry Cr (2), upper Hay Cr (2); portions of Bridge Cr (1), Thirtymile Cr (1), Horseshoe Cr (2), Johnson Cr(2), Butte Cr (1), Franks Cr (2), and upper reaches of Pine Hollow Canyon Cr (1)	Degraded riparian area, channel structure and complexity, floodplain degradation, altered hydrology, sediment, water quality	Livestock overgrazing of riparian area, channelization, stream bank armoring, cutting of trees in riparian areas, changes in plant communities (including invasive plants), loss of beaver dams	Abundance, productivity	Primarily fry and 0+	Primary methods of riparian enhancement include riparian corridor fences to exclude livestock, changes in grazing management that promote riparian recovery, and planting of native shrubs.
Develop grazing strategies that promote riparian recovery	Lower John Day River mainstem below Cottonwood Bridge and above Service Cr (2); Rock Cr (2), Upper Rock (1), Middle Rock (2), Lone Rock (1); MaSAs (Gilliam Co) (2), Grass Valley Canyon (2); some reaches of Mountain Cr (Wheeler Co) (1); portions of Parrish Cr (1), Cherry Cr (1); some reaches of Kahler Cr (1), Ferry Cr (2), upper Hay Cr (2); portions of Bridge Cr (1), Thirtymile Cr (1), Horseshoe Cr (2), Johnson Cr (2), portions of Butte Cr (1), Franks Cr (2), and upper reaches of Pine Hollow Canyon Cr (1)	Degraded riparian area, channel structure and complexity, floodplain degradation, altered hydrology, sediment, water quality	Livestock overgrazing of riparian area	Abundance, productivity	Primarily fry and 0+	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural riparian vegetative communities including vegetative planting	ODFW, Watershed Councils, SWCDs, USFS, BLM, CTUIR	Ongoing	Riparian function will be limited to specific reach; water quality benefits will have high	Long term because of widespread need	5-15 years, (see above)	High, based upon experience with existing grazing management

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
			dispersal downstream from site			and riparian recovery projects
Develop grazing strategies that promote riparian recovery	NRCS, AFS, USFS, BLM, SWCDs, ODFW, Watershed Councils, CTUIR	Ongoing	Riparian function will be limited to specific reach; water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years, depending upon grazing plan adopted. Riparian corridor fencing and removal of riparian grazing has the fastest recovery rate.	High, based upon experience with existing grazing management and riparian recovery projects

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program	Alder, Squaw, Cottonwood, and Mountain crs	No	Program could be expanded.
SWCDs	Upland improvements, riparian improvements	Service, lower Rock, Lone Rock, Pinehollow, Grass Valley, Hay, Alder, Butte	Yes in some areas, no in others	Expansion would approve effectiveness.
Watershed Councils	Upland improvements, riparian improvements	Service, lower Rock, Lone Rock, Pinehollow, Grass Valley, Hay, Alder, Butte	No	Expansion in scope needed.
USFS, BLM	Upland improvements, riparian improvements	Lower John Day mainstem from Kimberly to Tumwater Falls, Cottonwood, Bridge, Thirtymile, Ferry, Hay, Squaw	Likely	Expansion in scope needed. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005).
NRCS	Upland improvements, riparian improvements	Pinehollow, Grass Valley, Ferry, Hay, Thirtymile, Butte	Yes	Program currently meeting objectives.
ODA	Agricultural Water Quality Management Program	All		See State of Oregon programmatic review -- Appendix F.
CTWSRO	Watershed restoration	Pine Cr	Uncertain	Needs expansion.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

In the last 20+ years ODFW, Watershed Councils, NRCS and Soil and Water Districts have implemented hundreds of miles of riparian improvements on private lands, primarily through construction of riparian corridor fences that exclude livestock grazing and development of off channel watering devices. Public land managers have implemented PACFISH standards for protection and restoration of USFS and BLM lands. Even though hundreds of miles of riparian improvements have been completed there are many more miles of stream occupied by steelhead within the Lower Mainstem John Day population that need improvement. At the current rate of implementation it could take 50 years to complete restoration actions. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize FS restoration actions for this population, and helps deploy limited active restoration funding where it is most needed. Bank stabilization using some rock is still infrequently occurring after high water events in the lower John Day River, primarily along irrigated pastures and on Rock Cr (Gilliam County). These bank stabilization projects have historically relied on riprap and large rock, however in recent years the high economic and ecological cost of bank armoring with riprap and of channelization has been recognized, so the emphasis has shifted toward a more passive approach for stabilization, primarily through riparian vegetation improvements. Overgrazing of riparian areas by livestock continues in some reaches; however it is not as widespread as historically. Interest by private landowners and public land managers in riparian improvement remains high.

Other projects that have been well accepted and will improve riparian condition are restoring historical cover types by removing juniper, reintroducing fire, enrollment into CREP, and control of invasive/noxious plants. Primary constraints on implementing additional projects for more riparian improvements are funding and personnel needed for planning, promotion, education of landowners, and implementation.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters	Life Stages	Discussion

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
				Addressed	Affected	
Implement agricultural water conservation measures	Rock (1), Bridge (1), Butte (2), Cherry (2), Big Muddy (2), Cottonwood (2), Rock/Mountain (1), Alder (2), lower Parrish (1), and Kahler (1)crs	Altered hydrology, low flows, high temperatures	Water withdrawals, land conversion on uplands, road network	Abundance, productivity	Eggs, fry and 0+	Rock, Bridge, Butte, Cherry, Big Muddy, Cottonwood, Rock/Mountain, Alder, lower Parrish, and Kahler crs are all affected by irrigation withdrawals.
Improve irrigation conveyance and efficiency	Rock (1), Bridge (1), Butte (2), Cherry (2), Big Muddy (2), Cottonwood (2), Rock/Mountain (1), Alder (2), lower Parrish (1), and Kahler (1) crs.	Low flows, high temperatures	Water withdrawals, loss during conveyance	Abundance, productivity	Eggs, fry and 0+	Rock Cr is intermittent for the lower 29 miles due to extensive pumping for irrigation and several of its tributaries are dry during summer months in lower reaches.
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes	Grass Valley Canyon (2), Pinehollow Canyon (1), Rock (1), Bridge (1), Butte (1), Cherry (1), Big Muddy (2), Cottonwood (1), Rock/Mountain (1), Alder (2), Johnson (2), Horseshoe (2), Ferry (2), Hay (1), Thirtymile (1), Service (2), Parrish (1), and Kahler (1) crs	Low flows, high temperatures	Channel incision, loss of water table	Abundance, productivity	Fry and 0+	
Lease or acquire water rights and convert to instream water rights	Rock (1), Bridge (2), Butte (2), Cherry (2), Big Muddy (2), Cottonwood (2), Rock/Mountain (1), Alder (2), lower Parrish (1), and Kahler (1)crs	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Eggs, fry and 0+	
Monitor/regulate water withdrawals	Population-wide	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Eggs, fry and 0+	Annual fluctuations in flow levels are intensified by irrigation withdrawals.
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	Population-wide	Altered hydrology, low flows, high temperatures, impaired natural functions and processes on uplands, floodplains, riparian areas	Degradation and conversion of uplands, floodplains, riparian areas	Abundance, productivity	Eggs, fry and 0+	Changes in the upland plant community due to fire suppression, invasive plants, and conversion of bunch grass prairies to wheat fields have resulted in lower precipitation infiltration rates, which results in higher peak flows and lower low flows. Some tributaries are now dry where they join the John Day River. Removal of large wood and channelizing streams also increases water velocities and reduces the ability of the stream to hold water for gradual release. Restoring watershed function in Pinehollow Canyon will likely result in longer duration of surface flows.
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs	Population-wide	Low flows, high temperatures	Water withdrawals	Abundance, productivity, spatial structure, diversity	All stages	New programs in development

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Implement agricultural water conservation measures.	SWCD, OWRD, watershed councils, NRCS	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and dependent upon landowner willingness to participate and availability of projects	Immediate	High, if the saved water is protected from being appropriated to a downstream user in areas with instream water rights.
Improve irrigation conveyance and efficiency.	SWCD, OWEB, OWRD, watershed councils, NRCS, landowners	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and dependent upon landowner willingness to participate and availability of projects	Immediate	High, if the saved water is protected from being appropriated to a downstream user in areas with instream water rights.
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	SWCD, ODFW, CTWSRO, USFS	Ongoing	High dispersal downstream	Long term	Immediate increase in instream flow, 5-15 years for full functional role	High
Lease or acquire water rights and convert to instream water rights.	OWRD, FSA, OWEB, Oregon Water Trust, others	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and highly dependent upon landowner willingness to lease.	Immediate	High, if the leased water is protected from being appropriated to a downstream user in areas with instream water rights. FSA pays higher rates for CREP enrollment when water rights are leased for instream use.
Monitor/regulate water withdrawals	OWRD	Ongoing	Point of diversion downstream to mouth of John Day River	Long term, dependent upon OWRD enforcing the requirement to measure water usage	Immediate	High if water user reporting requirement and installation of measuring devices on diversions is implemented.
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	SWCD, USFS, OWRD, OWEB, ODFW, CTWSRO, landowners	Ongoing	Population-wide	Intermediate	Up to 15 years	High
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs	OWRD	Ongoing	Population-wide	2007-2009 except incentive funding ongoing	Long term	Moderate
Status of Existing Programs through which Actions are Implemented						
Agency/Organization	Program Name	Geographic Locations		Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale	
ODFW	BPA Habitat Program, riparian improvements	Alder, Cottonwood, Squaw, Rock/Mountain		No	Yes	

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.				
OWRD	Streamflow Monitoring and Restoration, Flow Restoration, Lease/Transfer Water Rights, Administration of Water Rights, Water Use Measurement, Water Needs Assessment, Storage Assessment, Conservation Assessment	Population-wide		See State of Oregon programmatic review -- Appendix F.
Oregon Water Trust, BOR	Leasing and Purchase of Water Rights	Lower John Day River near Twickenham, Pine Cr	Uncertain	Dependent on availability and funding.
Soil and Water Conservation Districts	Improve irrigation efficiency, upland improvements, riparian improvements	Butte, Pinehollow, Lower Mainstem John Day River below Service Cr		Could be expanded in some areas. See State of Oregon programmatic review -- Appendix F.
Watershed Councils	Upland improvements, riparian improvements	Most of Gilliam, Sherman, and parts of Wasco counties in dryland wheat country, juniper treatments in Wheeler County	No	Wheat field terracing, conversion to no-till, construction of sediment retention basins—could all be expanded in rate of implementation.
NRCS	Upland improvements, riparian improvements	Most of Gilliam, Sherman, and parts of Wasco counties in dryland wheat country, juniper treatments in Wheeler County	No	Wheat field terracing, conversion to no-till, construction of sediment retention basins, could all be expanded in rate of implementation.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Many landowners have converted from flood to sprinkler or gated pipe irrigation, which makes more efficient use of the water and grows more palatable forage, but there has not been an effective mechanism to protect saved water from being used by another irrigator downstream. Water measuring devices are just beginning to be required on irrigation withdrawals and while progress is being made there is considerable resistance from irrigators. Extensive work by Watershed Councils and NRCS in the Lower John Day has concentrated on preventing erosion of valuable topsoil by terracing wheat fields, building small sediment retention basins, enrollment of highly erodible soils into the CRP program, and using no-till planting techniques, all of which increases precipitation infiltration rates and reduces the rate of runoff. Other projects that will improve flow are restoring historical cover types by removing juniper, reintroducing fire, enrollment into CRP, and control of invasive/noxious plants. Primary constraints on implementing additional projects are funding, instream water rights that are junior to most irrigation rights, and water laws that sometimes conflict with conservation practices. Approximately 76 miles of stream in the lower John Day River are protected with either existing or pending instream water rights. The instream water rights do not preclude further appropriation of water until flows in the affected reach drop down to the instream water rights as adopted by OWRD. Voluntary efforts restored 25.5 cfs instream in 2006. US Bureau of Reclamation, as required in the Columbia River Biological Opinion, is required to identify and assist with passage improvement design and flow restoration. They have partnered with Oregon Water Trust on several water leases with one recent permanent acquisition of 10 cfs in the Middle Fork that will be left instream after July 20.				

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Increase riparian shading	Thirtymile (1), Rock (2), Butte (1), Service (2), Kahler (1), Parrish (1), Upper Rock (1), and Lone Rock (1) crs; upper Butte (1), Cottonwood (1), Squaw (2), Horseshoe (2), Johnson (2), Bridge (2), Ferry (2), Pinehollow (1), Grass Valley (2), Mountain (1), Kahler (1), Parrish (1), Cherry (1), Hay (1), Alder(1), and Shoefly (2)crs	High water temperatures	Degraded riparian forests	Abundance, productivity	Eggs, fry, 0+, adults	Elevated water temperature is the most pervasive water quality problem for the Lower John Day River population, with 13 stream reaches listed as water quality limited. Additional reaches would probably be listed if water temperature data were available.
Reduce chemical pollution inputs	None currently identified	Chemical pollution	Pesticides, fertilizers, herbicides, vehicle hydrocarbons, etc.	Abundance, productivity	Eggs, fry, 0+, adults	

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
Apply BMPs to animal feeding operations	Lower Rock Cr (1)	Degraded water quality	Animal feed operations	Abundance, productivity	Eggs, fry, 0+, adults	
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	Population-wide	Degraded upland processes, floodplains, riparian areas, altered hydrology, altered sediment routing	Degradation and conversion of uplands, floodplains, riparian areas	Abundance, productivity	Eggs, fry, 0+, adults	Using efficient irrigation methods reduces the amount of surface water returning to the stream, and should result in fewer nutrients from pastures reaching the John Day River. Reducing nutrient loads will contribute to increased water quality by reducing biological oxygen demand and algae blooms.
Continue TMDL monitoring	Population-wide	Degraded water quality, sediment routing	Land use practices, water withdrawals, pesticides, fertilizers, herbicides	Abundance, productivity	Eggs, fry, 0+, adults	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Increase riparian shading	ODFW, Watershed Councils, SWCDs, USFS, BLM	Ongoing	water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years	High
Reduce chemical pollution inputs	ODEQ, others	Ongoing		Ongoing	Reduce chemical pollution immediately	High
Apply BMPs to animal feeding operations	ODA	Ongoing	Water quality improvement would have high dispersal downstream	Some treatments could be done immediately. There are few animal feeding operations within the subbasin, only one of which has been identified as a problem	5-15 years	High, once a treatment has been agreed upon
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	SWCD	Ongoing	Subbasin-wide, high dispersal downstream	Intermediate	Up to 15 years	High
Continue TMDL monitoring	USFS, ODFW, SWCD, ODEQ	Ongoing	Subbasin-wide	Ongoing	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
FSA	CREP, CRP	Gilliam, Sherman and portions of Wasco counties for CRP, Butte, lower Rock, Pinehollow, and Grass Valley tributaries for CREP	No	Program needs expansion, effective where applied.
ODA	Confined animal feeding operations (CAFO), Agricultural Water Quality Management Program	Rock Cr		See State of Oregon programmatic review -- Appendix F.
ODEQ, ODA, SWCD, USFS	Sedimentation Monitoring (TMDL Development and Implementation)	Population-wide		See State of Oregon programmatic review -- Appendix F. See USFS/BLM Program Sufficiency Assessment—Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005).

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
Extensive grain fields in the Lower John Day River area have contributed to relatively high sediment loads in the lower river and tributaries. NRCS and FSA programs in this area (primarily CRP and terracing)) have been used extensively by landowners on the most erodible soils, but the removal of perennial grasses to plant annual crops still contributes unnatural levels of sediment. Other sources of sediment include relatively high road densities on forested lands. Low streamflows during the hottest part of the year exacerbate the already warm water temperatures. Opportunities for increasing streamflow through leasing of water rights, which often results in cooler water over a longer stream reach, are being pursued by Oregon Water Trust and US Bureau of Reclamation. Constraints for future projects include acceptance by landowners and a secure, long term funding source. ODA's Agricultural Water Quality Management Program is designed to prevent and control water pollution from agricultural activities and soil erosion on non-Federal and non-Tribal Trust or Reservation lands. ODA relies on voluntary measures to protect water quality, but also enforces pollution and streamside vegetation requirements. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize FS restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.
Reducing water temperatures through the use of improved riparian vegetation and more efficient methods of irrigation may take several years to provide measurable results. Many projects that improve water quality by reducing irrigation return water have been completed.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Continue to promote no-till farming and other seeding techniques that reduce erosion where site conditions are suitable	Rock (1), Grass Valley (1), Ferry(1), Thirtymile (2), Pinehollow (2), Jackknife (2) crs,	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices, loss of water storage capacity	Productivity	Eggs, fry, and 0+	No till seeding has been used in much of Sherman and Gilliam counties, however, other economically viable alternatives that reduce erosion are desirable.
Restore native upland plant communities	Thirtymile (1), Rock (2), Butte (1), Service (2) , Kahler (2), Parrish (2), Upper Rock (2), and Lone Rock (1) crs, Pinehollow (1), Ferry(1), Horseshoe (2), Service (2), Squaw (2), Bridge (1),	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices, loss of water storage capacity	Productivity	Eggs, fry, and 0+	Upland improvements such as restoring native plant communities and controlling invasive weed species will improve precipitation infiltration rates and ultimately improve watershed health, including the hydrograph.
Upgrade or remove problem forest roads	Thirtymile (1), Upper Rock (2), Alder (2), Parrish (2)	Altered hydrology, sediment routing	Road network	Productivity	Eggs, fry, and 0+	
Initiate upland improvement demonstration projects	Thirtymile (2), Rock (2), Butte (2), Service (1), Kahler (1), Parrish (1), Upper Rock (1), and Lone Rock (2) crs	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices	Productivity	Eggs, fry, and 0+	
Manage vegetation, including juniper removal	Thirtymile (2), Rock (2), Butte (1), Service (2), Kahler (1), Parrish (1), Upper Rock (2), and Lone Rock (2) crs	Altered hydrology, sediment routing	Invasive plants	Productivity	Eggs, fry, and 0+	
Demonstration projects to restore forest health and resilience to wildfire	Private and state forest lands	Altered hydrology, sediment, water quality, riparian functions, LWD recruitment	Conversion of vegetative communities	Abundance, productivity	All	Suppression of fires has altered fire regimes and increased threat of high intensity fires.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
Employ BMPs to forest practices including fuels management and fire suppression mitigation, livestock grazing, road management and agricultural practices	Thirtymile (1), Rock (2), Butte (1), Service (2), Kahler (2), Parrish (1), Upper Rock (1), and Lone Rock (2) crs	Altered hydrology, sediment routing	Upland land use practices	Productivity	Eggs, fry, and 0+	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Continue to promote no-till farming and other seeding techniques that reduce erosion where site conditions are suitable	SWCD, NRCS	Ongoing	High dispersal downstream	Long Term	5-15 years	Moderate to high depending upon the rate of participation by landowners
Restore native upland plant communities	SWCD, USFS, BLM	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Long term	5-30 years	Moderate to high depending upon how severely impacted the sites are and how successful prescribed treatments are
Upgrade or remove problem forest roads	USFS, ODF	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, many forest roads have legacy issues with regard to sediment transport and routing of runoff. Decommissioning may take many years	5-15 years	Moderate, although funding on public lands and landowner cooperation on private lands will determine rate of treatment
Initiate upland improvement demonstration projects	ODFW, NOAA Fisheries, USFWS, USFS, BLM, CTWSRO, Watershed Councils, SWCDs	Ongoing	Entire subbasin	Long term	Variable lag time	Unknown, depends upon action taken as a result of being more informed
Manage vegetation, including juniper removal	USFS, BLM, NRCS, SWCDs, Watershed Councils	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Juniper control can be done relatively quickly, other strategies such as control of invasive plants may take more than 20 years	5-30 years	Moderate
Demonstration projects to restore forest health and resilience to wildfire	ODF	Ongoing	Private and state forest lands	Long term	Variable 5-20 years	Moderate
Employ BMPs to forest practices including fuels management and fire suppression mitigation, livestock grazing, road management and agricultural practices	SWCD, VSFS, ODA, CTWSRO, private landowners	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, dependent on implementation of Agricultural Water Quality Management Plans	0-20 years, depending upon treatments applied	Moderate, dependent upon voluntary landowner participation

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.				
Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
NRCS, Farm Service Agency	CRP	Lower and Middle Rock, Thirtymile, Grass Valley, Pinehollow, Ferry, and Butte crs	No	Program needs expansion, effective where applied.
SWCDs	Juniper control	Butte, Service, Bridge crs	Uncertain	More effective if expanded.
ODFW	Green Forage		Uncertain	Very small program, could be expanded.
USFS, BLM	Individual Forest or Area Management Plans, PACFISH	Bridge, Cottonwood, Lower John Day, Butte, Hay, Rock/Mountain, Upper Rock, and Kahler crs	Yes, but dependent on consistent implementation	See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005).
ODA	Agricultural Water Quality Management Program	Population-wide		See State of Oregon programmatic review -- Appendix F.
ODF	Private land protection from fire, Private Forest Program	Private and state forestlands throughout population		See State of Oregon programmatic review -- Appendix F.
ODF	Oregon Forest Practices Act	Private and state forest lands		See State of Oregon programmatic review -- Appendix F.
CTWSRO	Watershed Restoration	Pine Cr	Yes, where implemented	More acreage needs to be treated.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Programs initiated by the NRCS, SWCDs and ODFW are relatively small, with the CRP program the largest and best funded. CRP has been in existence for 20 years and has been one of the better farm subsidy programs for watershed restoration. The CRP program has focused on the Lower John Day River (primarily below Thirtymile Cr) where dry land grain crops are grown and where significant acres of highly erodible soil exist. Juniper control programs have focused on areas where extensive juniper encroachment has occurred. Juniper control can be completed using several different methods, including controlled burns, cutting with chainsaws, or by removing with bulldozers or trackhoes. Although controlled burns are probably the most effective at controlling the spread of juniper, they are the most difficult to implement because of the threat of the fire getting out of control and costs. Another drawback to controlled burns is that livestock grazing should be excluded from burned areas for at least two growing seasons after the burn to ensure full recovery of desirable perennial grasses. There are opportunities to expand the juniper control program but the lack of a pasture to put livestock into for two years after burning has limited its acceptance. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize FS restoration actions for this population, and helps deploy limited active restoration funding where it is most needed. The ODFW Green Forage program provides a wildlife seed mixture of native grasses and desirable forage to landowners who have recently completed juniper clearing projects, logging projects or other ground disturbing activities. The primary purposes are to provide additional forage for deer and elk and to reduce deer and elk damage complaints; however it also has benefits to watershed health by providing grasses that provide perennial ground cover. The limitations to all the programs are funding and, to a lesser extent, acceptance by landowners.				

9.3.6 Habitat Strategies and Actions for North Fork John Day River Steelhead Population

Primary limiting factors: Degraded channel structure and complexity (habitat quantity, diversity and channel stability), altered sediment routing, water temperature, altered hydrology, degraded floodplain function and connectivity.

Primary threats: riparian disturbance, stream channelization and relocation, grazing, forest practices, road building, irrigation withdrawals, mining, and dredging.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Protect high quality habitats through acquisition or conservation easements	Tributaries of the North Fork John Day River within the NF John Day Wilderness (1); North Fork John Day River, from Big Cr upstream to headwaters (1); Granite Cr (2); South Fork Desolation Cr (1); upper Clear Cr (1); upper Hidaway Cr. (2)	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing	Many threats including livestock overgrazing of riparian area, mining, channelization, stream bank armoring, agricultural practices (fertilizers, herbicides, sediments, changes in plant communities), water withdrawals, loss of beaver dams	Abundance, productivity	All	Protection of high quality habitats is the most cost effective way of ensuring high quality habitat. It is much less expensive over the long term to protect high quality habitat than it is to degrade the habitat and then try to restore it. Land acquisitions, easements, and cooperative agreements facilitate protection.
Adopt and manage Cooperative Agreements	Cottonwood (1); Deer (1), and Rudio crs (2); North Fork John Day River, below Wall Cr (2)	Same as above	Same as above	Abundance, productivity	All	
Special management designations in forest and BLM plans	Recently acquired BLM parcels on the North Fork John Day River, between Monument and Camas Cr (1); areas identified in existing Forest Plans (2)	Same as above	Livestock overgrazing of some riparian areas, changes in plant communities	Abundance, productivity	All	
Designate additional wilderness and wild and scenic status	Those areas identified in the Umatilla National Forest Plan Revision and in the BLM Management Plan currently being developed (2)	Same as above	Livestock overgrazing of riparian area, changes in plant communities	Abundance, productivity	All	
Protect access to key habitats	The lower reaches of Hideaway (1), Cable (1), Desolation (1), Owens (2), Camas (2), Meadowbrook (2), Rudio (2), and Cottonwood (1) crs	Passage barriers, altered hydrology, channel structure		Abundance, productivity, distribution		Current state law requires ODFW to review any new or substantially modified structure with regard to fish passage. Potential still exists for access to be blocked by warm water temperatures and flow alterations. Channel structure may be severely modified by higher than natural flows.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	Population-wide	All	Same as above	Abundance, productivity	All	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Protect the highest quality habitats through acquisition or conservation easements	CTUIR, TNC, RMEF, John Day Basin Trust, SWCDs	Ongoing	Water quality improvement have high dispersal downstream, stream corridor and function improvements would be confined to the specific site	Existing conservation agreements are complete. Full implementation of conservation measures will take 5-15 years or more	5-15 years with passive restoration approaches	High, based on previous cooperative agreements
Adopt and manage Cooperative Agreements	ODFW, SWCDs, FSA	Ongoing	Same as above	Agreements are for 10-15 years	Long term	High, although not in perpetuity
Special management designations in forest and BLM plans	USFS, BLM	Ongoing as identified	Same as above	Many complete, potentially subject to change in Forest Plan revisions	Immediate and long term	High, although subject to change from Forest Plan or management plan revision
Designate additional wilderness and wild and scenic status	UDFS, BLM Oregon State Parks	Ongoing as identified	Water quality and flow improvements would have high dispersal downstream, stream corridor and function improvements confined to the specific site	Unknown	5-15 years	Unknown, subject to availability of areas that meet criteria
Protect access to key habitats	SWCDs, Watershed Councils, BLM, USFS	Ongoing	Immediate area only	Long term	5-15 years	High
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	NRCS, SWCDs, USFS, ODFW, ODF, DSL, BLM, ODOT, CTWSRO, ODA, FSA, private landowners	Ongoing	Population-wide	Long term	5-15 years	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
USFS, BLM	Wilderness Areas, Wilderness Study Areas, Wild and Scenic River corridors, Special Management Area designations, PACFISH	FS and BLM lands for PACFISH, North Fork Wilderness, North Fork Wild and Scenic Corridor	Yes, PACFISH standards are good, but implementation is inconsistent between forests. See discussion below.	See USFS/BLM Program Sufficiency Assessment -- Appendix E.
ODFW	Cooperative Agreements	Privately owned lands, Camas, Cottonwood/Fox, Granite creeks	No	The agreements are for only 10-15 years and need to be for longer timeframes.
FSA	CREP	Privately owned lands, primarily on Cottonwood/Fox Creek	No	The agreements are for only 10-15 years and need to be for longer timeframes.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.				
NGOs	Lease or purchase of lands	Cottonwood Creek conservation easement	Yes	Important to secure critical habitat and/or water rights.
ODA	Agricultural Water Quality Management Program	Private lands throughout the North Fork watershed		See State of Oregon programmatic review -- Appendix F.
CTUIR	Watershed Restoration	Camas and Desolation creeks	Uncertain	Needs expansion.
ODF	Oregon Forest Practices Act	Private and state owned lands		See State of Oregon programmatic review -- Appendix F.
Local Government	City and County Planning and Zoning	Private lands	Uncertain	Needs expansion.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
The North Fork John Day River from Camas Cr (RM 57) to the headwaters (RM 112) is designated as a Federal Wild and Scenic River. The North Fork John Day from near Monument (RM 20) to the North Fork wilderness boundary (RM 76.5) is designated a State Wild and Scenic River. A wild and scenic designation requires development to be consistent with protecting the ORVs for which the river was designated, requires review of any activity that may affect ORVs within the ¼ mile river corridor, and protects the free flowing condition of the river. Designation as W&S essentially precludes construction of any major dam. A Management Plan was adopted by BLM and Oregon State Parks Department in 2001 for the designated rivers segments. Implementation of all the actions identified in the plan will likely take many years, however grazing management plans for most of the allotments within corridor are complete. All BLM allotments have grazing plans, except recently acquired lands. Wilderness areas within the boundaries of the North Fork population include the North Fork John Day Wilderness (85,000 acres). The primary rationale for designating the North Fork Wilderness was for protection of anadromous fish habitat. Adding additional wilderness areas and wild and scenic river segments would require designation by Congress. Implementation of PACFISH standards and guides for Forest and BLM programs, including grazing management, has been highly successful over most of this population's area, but implementation of PACFISH Standards and Guides for FS grazing management programs remains challenging in a few locations. Cooperative and conservation agreements on private land are tools for protecting high quality habitats. ODFW has used cooperative agreements over the last 21 years to protect riparian corridors that have been fenced to exclude livestock grazing. Unfortunately those agreements are for only 15 years and there have not been funds or personnel needed to extend them for longer time periods. In the North Fork subbasin, a perpetual conservation agreement to prevent subdividing a 10,000 acre parcel is in place on Gilmore and Straight crs and includes approximately 3.3 miles of steelhead spawning and rearing habitat. See discussion for Strategy 1, Lower Mainstem John Day River population.				

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Remove or minimize use of push up dams	Cottonwood Cr/Fox drainage (1)	Impaired fish passage	Push up dams	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	Push up dams are common in the Cottonwood Cr drainage. Passage problems at culverts are widespread throughout all subbasins. Annual maintenance and construction of push up dams contributes to onsite and downstream channel stability, loss of pools and other structure, and increased sediment loads.
Remove or replace barriers blocking passage such as dams, road culverts and irrigation structures	For irrigation related passage issues: Cottonwood Cr/Fox drainage (1) For culverts: SF Trail, Meadowbrook (1), Upper Granite (2) crs	Impaired fish passage	Dams, culverts, instream structures	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	Push up irrigation dams, concrete diversions, in-channel stock ponds, and road culverts are located throughout the entire subbasin.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
Construct ladders over existing permanent concrete or earth fill dams, or remove the barrier	None currently identified	Impaired fish passage	Dams	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	A comprehensive barrier assessment has not been completed for all private lands, so there may be a few barriers that are not currently identified
Provide screening at 100% of irrigation diversions	Cottonwood/Fox Cr (1).	Impaired fish passage	Irrigation diversions	Abundance, productivity, spatial structure	Emergent fry, juveniles, and smolts	All unknown existing screens meet criteria

Action Implementation

Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Remove or minimize use of push up dams	SWCD	Ongoing	Provide access to upstream habitat	Ongoing, but all push up dams not expected to be corrected for at least 15 years. A comprehensive barrier assessment has not bee completed.	Immediate	High, if comply with fish passage design criteria
Remove or replace barriers blocking passage such as dams, road culverts and irrigation structures	USFS, watershed councils, SWCDs, ODOT	Ongoing	Access to upstream habitat	Ongoing, replacing all culverts blocking fish passage expected to take 50 years (see Appendix G)	Immediate	High, if comply with fish passage design criteria
Construct ladders over existing permanent concrete or earth fill dams	ODFW, SWCDs	Ongoing	Provide access to upstream habitat	Ongoing, providing passage at all diversion and pond barriers will take many years. A comprehensive barrier assessment has not bee completed.	Immediate	High if comply with fish passage design criteria
Provide screening at 100% of irrigation diversions	ODFW, SWCDs	Ongoing	At point of diversion	Approximately 3 diversions need to be screened	Immediate	High if comply with fish screening design criteria

Status of Existing Programs through which Actions are Implemented

Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
Soil and Water Conservation Districts	Irrigation dam improvements, culvert replacement or retrofits	Unscreened or poorly screened diversions throughout populations	Likely	The Grant Soil and Water District is constrained by the construction window of opportunity. Other counties could expand the program but are constrained by funding and personnel. See State of Oregon programmatic review – Appendix F.
ODFW	Fish Passage/Screening	Unscreened or poorly screened diversions throughout populations	No	The program completes a minimum of one project per year, but is dependent upon landowner cooperation and limited funding. Rate of implementation needs accelerated.
USFS	Culvert replacement	Federally owned lands, Meadowbrook Creek	Uncertain	Based on total number of identified problem culverts on federal lands, will take about 50 years at current rate to complete culvert replacements. See comments below in Gaps section.
Watershed Councils	Road Crossing Passage improvements, passage improvements	Privately owned lands, primarily in North Fork John Day and tributaries below and including Wall Creek	No	Rate of implementation slow, technology sufficient to deal with threats.
ODOT	Culvert replacement or retrofit	State and Federal highway systems	Uncertain	See State of Oregon programmatic review – Appendix F.
BOR	John Day Basin Program	Privately owned lands as identified by SWCDs and Watershed Councils	Yes	Program rate sufficient.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.				
CTWSRO, CTUIR	John Day Basin Program	Privately owned lands, primarily in Camas, Desolation, and lower NF tributaries	No	The tribes contract with Soil and Water Districts to assist with consultation, permits, and monitoring; additional efforts needed to address problems in a timely manner.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

Most of the mainstem passage problems have been addressed, but there are many tributaries where adult passage is blocked and more areas where juvenile passage problems occur. Irrigation dams, stock ponds, and road culverts are the primary causes of passage issues. Soil and Water Districts are correcting passage at irrigation diversions and improperly installed culverts, but are constrained by funding and by personnel needed for construction oversight. Watershed councils and ODOT, who are the principal entities working on culverts are constrained primarily by funding. An inventory of road crossings on federal lands indicates juvenile passage problems are pervasive, particularly on National Forests, with approximately 200 culverts not meeting passage criteria in this population. The BLM has no adult barriers at culverts. Monitoring is needed to determine if upstream passage for juveniles is an issue. The US Forest Service and BLM are constrained primarily by funding and the personnel needed for NEPA analysis. At the current rate of culvert replacements, it will take over 50 years to correct all passage problems on National Forests. Another constraint is that existing state laws do not require passage improvements at existing barriers unless there is a major change in the structure, such as reconstruction or significant modifications, so landowner cooperation is critical for improving passage throughout the subbasin.

The Malheur, Wallowa Whitman, Umatilla and Ochoco National Forests have culvert inventories for their lands. The Forest Service Pacific Northwest Region's Aquatic Restoration Strategy (USDA-FS, 2005), provides guidance that will help prioritize culvert replacements for this population. ODFW has an inventory of culverts on state and county-owned roads. Appendix G presents an inventory of culverts with known passage problems on state, county, and USFS owned roads. The inventory shows there are three culverts on state owned roads and one culvert on county owned roads that do not meet fish passage criteria within the North Fork population boundary. There has not been an inventory of road culverts on private lands.

US Bureau of Reclamation, as required in the Columbia River Biological Opinion, is required to identify and assist with passage improvement design and flow restoration.

See discussion for ODFW Fish Passage and Screening program in Strategy 2, Lower Mainstem John Day River population.

Strategy 3. Maintain and restore floodplain connectivity and function.

Strategy 3. Maintain and restore floodplain connectivity and function.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Reconnect floodplains to channels	Camas Cr, from Wilkins Cr to Cable Cr (2), Owens Cr (1), Clear Cr below Ruby Cr (2), Beaver Cr below Olive Cr (1), Bull Run Cr (1), Crane Cr above Forest Rd 73 (2), lower Boulder Cr (Granite Cr trib) (2), Cottonwood Cr below EF Cottonwood (1)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	Primarily fry and 0+	
Reconnect side channels and off-channel habitats to stream channels and reconnect surface flow/restore fish passage in tributaries.	Camas Cr from Wilkins Cr to Cable Cr (2), Owens Cr (1), Clear Cr below Ruby Cr (1), Beaver Cr below Olive Cr (2), Bull Run Cr (1), Crane Cr above Forest Rd 73 (2), lower Boulder Cr (Granite Cr trib) (2), Cottonwood Cr below EF Cottonwood (1)	Degraded floodplain, altered hydrology	Removal of side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity, spatial structure	Primarily fry and 0+	There has been a loss of off-channel and side-channel habitats that once provided habitat for spawning and rearing, and refugia from high flows.
Restore wet meadows	Cottonwood/Fox, Granite (1), Owens (2), Camas from Wilkins Cr to Cable Cr (2), Upper Wilson Cr (1)	Degraded floodplain, altered hydrology	Removal of wetlands	Abundance, productivity	Primarily fry and 0+	
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	Camas Cr from Wilkins Cr to Cable Cr (1), Owens Cr (1), Clear Cr below Ruby Cr (2), Rudio (1), Wall (1), Wilson (2), Beaver Cr below Olive Cr (2), Bull Run Cr (2), Boulder Cr (2), Crane Cr above Forest Rd 73 (2), lower Boulder Cr (Granite Cr trib) (2), Cottonwood (1), Fox Cr (1)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat	Abundance, productivity, spatial structure	Primarily fry and 0+	

Strategy 3. Maintain and restore floodplain connectivity and function.						
Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Reconnect floodplain to channel	ODFW, watershed council, SWCD, USFS, BLM	Ongoing	For the treated stream reach	Short term, once identified	Physical response will be immediate; biological response up to 5-10 years	High
Reconnect side channels and off-channel habitats to stream channels	ODFW, watershed council, SWCD, USFS, BLM, CTUIR	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Long term, because of widespread need	5-15 years, depending upon frequency and duration of channel altering flows	Moderate, depending upon how extensive project is and frequency/duration of channel altering flows
Restore wet meadows	TNC, USFS, CTWSRO	Ongoing and planned	Benefits of improved channel morphology localized, improved water table and resulting increased streamflow and lower water temperatures have high dispersal downstream	Intermediate	5-15 years	Moderate
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	ODFW, CTWSRO, USFS, BLM	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Long term, due to acceptance by landowners and widespread need	Within 15 years once the beavers are well established	Moderate-high, dependent upon acceptance by landowners

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, likely, uncertain, no)**	**Sufficiency Rationale**
ODFW	BPA Habitat Program	Cottonwood/Fox Creek, other privately owned lands when specifically identified	No	If specific needs cannot be addressed by passive restoration techniques then active measures taken. Program has limited resources.
USFS, BLM	Stream enhancement program	Granite Creek, NF John Day between Big and Desolation creeks for USFS and blocks of BLM on NF and tributaries between Camas Creek and Monument, but only when specifically identified that passive restoration is not working	Yes in some areas, no in others due to limited funding	The USFS/BLM preferred strategy is passive restoration; managing riparian areas to protect channel-forming processes. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005). See discussion in Gaps commentary below.
Watershed Councils	Watershed restoration	Private lands between Camas Creek and Kimberly	Uncertain	Dependent on future funding.
Soil and Water Conservation Districts	Watershed restoration	Private lands between Camas Creek and Kimberly		See State of Oregon programmatic review – Appendix F.
Nature Conservancy and other NGOs	Restoration projects	None currently identified, but may be opportunities in the future	Yes	Sufficiency yes when opportunities arise.
CTUIR	Watershed restoration	Camas Creek, Desolation Creek, and other privately owned lands	Uncertain	Program could be expanded.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.				

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.

Strategic Actions and Impacts on Limiting Factors, Threats, and Population

Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural channel form	Camas Cr, from Wilkins Cr to Cable Cr (1), Owens Cr (2), Clear Cr below Ruby Cr (1), Beaver Cr below Olive Cr (1), Bull Run Cr (1), Crane Cr above Forest Rd 73 (2), lower Boulder Cr (Granite Cr trib) (2), Cottonwood Cr below EF Cottonwood (1).	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature, flows	Stream channelization, bank armoring, large wood removal, beaver removal, removal of riparian vegetation, livestock overgrazing in riparian areas	Abundance, productivity	Primarily fry and 0+	Passive restoration techniques, such as riparian fencing, are the preferred method for improving channel structure and stability. More active restoration techniques may be appropriate in these reaches.
Place stable wood and other large organic debris in streambeds and in floodplains	Camas Cr (2), Owens Cr (2), Clear Cr (1) below Ruby Cr, Beaver Cr (1) below Olive Cr, Bull Run Cr (1), Crane Cr (2) above Forest Rd 73, lower Boulder Cr (1) (Granite Cr trib), Cottonwood/Fox Cr (1), Desolation Cr (2), Rudio (2)	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	Large wood removal, channelization	Abundance, productivity	Primarily fry and 0+	More active restoration techniques, such as rootwad placement or channel reconfiguration, may be appropriate in these reaches when passive restoration techniques have not been successful
Stabilize streambanks	Camas Cr (1) from Wilkins Cr to Cable Cr, Owens Cr (2), Cottonwood Cr below EF Cottonwood (1).	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	Stream channelization, berming, bank armoring, overgrazing in riparian areas	Abundance, productivity	Primarily eggs, fry and 0+	Some bank erosion is inevitable and beneficial. However, where erosion is actively taking place due to unnatural processes, stabilization may be needed to reduce fine sediments

Action Implementation

Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural channel form	ODFW, SWCDs, USFS, BLM, watershed councils	Ongoing and planned	For the treated stream reach	Short term, once identified	Physical response will be immediate, biological response may take 5-10 years	High
Place stable wood and other large organic debris in streambeds and in floodplains	ODFW, USFS, watershed councils, BLM, SWCDs	As needed	For the immediate stream reach	Short term, once identified	Immediate	High
Stabilize streambanks	ODFW, USFS, watershed councils, BLM, SWCDs	Ongoing	For the treated stream reach, physical benefits dispersed downstream	Passive stabilization techniques are preferred and take longer to implement	With passive restoration the response may take 15 years	Medium to high, depending upon the extent of the treatments

Status of Existing Programs through which Actions are Implemented

Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program	Cottonwood/Fox, Granite, Rudio, and Deer creeks, NF below Monument, but only when specifically identified that passive restoration is not working	No	Program has limited resources.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.				
USFS, BLM	Stream enhancement program	NF between Camas and Big Creek for USFS and BLM blocks between Kimberly and Camas Creek, but only when specifically identified that passive restoration is not working	Yes in some areas, no in others due to limited funding.	The USFS/BLM preferred strategy is passive restoration; managing riparian areas to protect channel-forming processes. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005). See discussion in Gaps commentary below.
Watershed Councils	Watershed restoration	NF between Wall Creek and Kimberly, Rudio, Cottonwood/Fox, and Deer creeks. Only when specifically identified that passive restoration is not working	Uncertain	Depends on availability of funds.
Soil and Water Conservation Districts	Watershed restoration	Granite Creek, NF John Day between Wall Creek and Kimberly. Only when specifically identified that passive restoration is not working		See State of Oregon programmatic review – Appendix F.
CTWSRO, CTUIR	Watershed restoration	Granite, Camas, and Desolation, Creeks. Only when specifically identified that passive restoration is not working	Uncertain	Funding future uncertain.
NGOs	Watershed restoration	None currently identified. Only when specifically identified that passive restoration is not working	Uncertain	No current activities.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Instream activities have not been identified as a high priority by the recovery planning team or the subbasin plan team except when identified as a need for specific sites. The planning team prefers that more passive approaches, such as riparian and upland improvements be emphasized. Typically, instream activities that would improve floodplain function and channel migration processes would include placement of rootwads, whole trees, or boulder clusters to improved habitat complexity and habitat diversity where those parameters are deficient and not expected to improve with passive restoration. Another structural activity would be to construct boulder or log weirs to raise the water table, but only where a passive approach has not worked. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.				

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural riparian vegetative communities including vegetative planting	Rudio (2), Cottonwood below Fox Cr (1), Deerhorn (2), Jericho (2), Camas above Wilkins Cr (1), and Desolation from the mouth to Park Cr (2)	Degraded riparian area, channel structure and complexity, floodplain degradation, altered hydrology, sediment, water quality	Overgrazing of riparian area, channelization, stream bank armoring, tree harvest in riparian areas, changes in plant communities (including invasive plants), loss of beaver dams	Abundance, productivity	Primarily fry and 0+	Primary methods of riparian enhancement include riparian corridor fences to exclude livestock, changes in grazing management that promote riparian recovery, and planting of native shrubs.
Develop grazing strategies that promote riparian recovery	Rudio (2), Cottonwood below Fox Cr (1), Deerhorn (2), Jericho (2), Camas above Wilkins Cr (1), and Desolation from the mouth to Park Cr. (2), recently acquired BLM parcels on the North Fork John Day River, between Monument and Camas Cr (1)	Same as above	Livestock overgrazing of riparian area	Abundance, productivity	Primarily fry and 0+	

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Restore natural riparian vegetative communities including vegetative planting	ODFW, Watershed Councils, SWCDs, USFS, BLM, CTUIR	Ongoing	Riparian function will be limited to specific reach; water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years (see above)	High, based upon experience with existing grazing management and riparian recovery projects
Develop grazing strategies that promote riparian recovery	NRCS, AFS, USFS, BLM, SWCDs, ODFW, Watershed Councils, CTUIR	Ongoing	Riparian function will be limited to specific reach; water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years, depending upon grazing plan adopted. Riparian corridor fencing and removal of riparian grazing has the fastest recovery rate.	High, based upon experience with existing grazing management and riparian recovery projects

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, likely, uncertain, no)**	**Sufficiency Rationale**
ODFW	BPA Habitat Program	Cottonwood/Fox, Camas, and Granite creeks	No	Insufficient resources.
SWCDs	Upland improvements, riparian improvements	Private lands on Rudio, and Cottonwood creeks, NF John Day between Monument and Kimberly		May need additional resources. See State of Oregon programmatic review – Appendix F.
Watershed Councils	Upland improvements, riparian improvements	Private lands on Rudio, and Cottonwood creeks, NF John Day between Monument and Kimberly	No	Need additional resources.
USFS and BLM	Upland improvements, riparian improvements	NF John Day between Wall and Camas Creek for BLM and NF John Day and tributaries above and including Camas Creek for USFS	Uncertain	See USFS/BLM Program Sufficiency Assessment -- Appendix E and Regional Aquatic Restoration Strategy. See discussion in Gaps commentary below.
NRCS	Upland improvements, riparian improvements	Private lands on NF John Day below Wall Creek	Yes	Deemed sufficient.
ODA	Agricultural Water Quality Management Program	Private lands within the NF watershed		See State of Oregon programmatic review -- Appendix F.
CTUIR	Watershed restoration	Camas, Desolation, and Deer creeks on private land.	Uncertain	Limited by resources.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
See discussion for Strategy 5, Lower Mainstem John Day River population. Implementation of PACFISH standards and guides has been highly successful over most of this population's area, but implementation of PACFISH Standards and Guides for FS grazing management programs remains challenging in a few locations. Forest Services's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize stream enhancement actions for this population, and helps deploy limited active restoration funding where it is most needed.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Implement agricultural water conservation measures	Cottonwood/Fox (1), lower Rudio Cr (1), Mainstem North Fork below Wall Cr (2)	Altered hydrology, low flows, high temperatures	Water withdrawals, land conversion on uplands, road network	Abundance, productivity	Fry and 0+	Cottonwood/Fox and lower Rudio Crs are the tributaries most affected by irrigation withdrawals. The mainstem North Fork below Wall Cr has numerous irrigation withdrawals, but warm water temperatures preclude steelhead from using for year long rearing.
Improve irrigation conveyance and efficiency	Cottonwood/Fox (1), lower Rudio Cr (1), Mainstem North Fork below Wall Cr (2)	Low flows, high temperatures	Water withdrawals, loss during conveyance	Abundance, productivity	Fry and 0+	
Increase pool habitat (beaver ponds)	Cottonwood/Fox (1), Rudio (1), Granite (2), Olive (2), Clear (2), Owens (1), Desolation (2), Wilson (1), and Wall(1) crs, Camas Cr above Wilkins Cr (1)	Low flows, high temperatures	Water withdrawals, loss during conveyance	Abundance, productivity	Fry and 0+	
Floodplain aquifer recharge	Camas Cr above Wilkins Cr (1)	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Fry and 0+	
Lease or acquire water rights and convert to instream	Cottonwood/Fox (1), lower Rudio Cr (2), Mainstem North Fork below Wall Cr (2)	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Fry and 0+	
Monitor/regulate water withdrawals	Population-wide	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Fry and 0+	Annual fluctuations in flow levels are intensified by irrigation withdrawals
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	Population-wide	Altered hydrology, low flows, high temperatures, impaired natural functions and processes on uplands, floodplains, riparian areas	Degradation and conversion of uplands, floodplains, riparian areas	Abundance, productivity	Fry and 0+	Changes in the upland plant community due to fire suppression, invasive plants, and conversion of bunch grass prairies to wheat fields have resulted in lower precipitation infiltration rates, which results in higher peak flows and lower low flows. Some tributaries are now dry where they join the John Day River. Removal of large wood and channelizing streams also increases water velocities and reduces the ability of the stream to hold water for gradual release.
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide	Population-wide	Low flows, high temperatures	Water withdrawals	Abundance, productivity, spatial structure, diversity	All stages	New programs in development

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
incentive funding to develop strategies to meet long-term needs						
Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Implement agricultural water conservation measures	SWCD, watershed councils, NRCS	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and dependent upon landowner willingness to participate and availability of projects	Immediate	High, if the saved water is protected from being appropriated to a downstream user in areas with instream water rights
Improve irrigation conveyance and efficiency	SWCD, OWEB, watershed councils, NRCS, landowners	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and dependent upon landowner willingness to participate and availability of projects	Immediate	High, if the saved water is protected from being appropriated to a downstream user in areas with instream water rights
Increase pool habitat (beaver ponds)	SWCD, ODFW, CTWSRO, USFS	Ongoing	High dispersal downstream	unknown	Immediate increase in instream flow	High
Floodplain aquifer recharge	CTWSRO, SWCDs	Planned, some ongoing	Potentially high dispersal from recharge project site downstream for many miles	Long term, although opportunities for pilot projects is dependent upon willing landowner	Immediate	High, if the additional water is protected from being appropriated to a downstream user in areas with instream water rights
Lease or acquire water rights and convert to instream	OWRD, FSA, OWEB, Oregon Water Trust, others	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and highly dependent upon landowner willingness to lease.	Immediate	High, if the leased water is protected from being appropriated to a downstream user in areas with instream water rights. FSA pays higher rates for CREP enrollment when water rights are leased for instream use.
Monitor/regulate water withdrawals	OWRD	Ongoing	Point of diversion downstream to mouth of John Day River	Long term, dependent upon OWRD enforcing the requirement to measure water usage	Immediate	High if water user reporting requirement and installation of measuring devices on diversions is implemented
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	SWCD, USFS, BLM, OWRD, OWEB, ODFW, CTWSRO, landowners	Ongoing	MaSAs	Intermediate	Up to 15 years	High
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs	OWRD	Ongoing	Population-wide	2007-2009 except incentive funding ongoing	Long term	Moderate

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.				
Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program, riparian improvements	Private lands on Cottonwood/Fox, Rudio, Camas, and Granite creeks	No	Program has limited resources.
OWRD	Streamflow Monitoring and Restoration, Flow Restoration, Lease/Transfer Water Rights, Administration of Water Rights, Water Use Measurement, Water Needs Assessment, Storage Assessment, Conservation Assessment	Cottonwood/Fox, Rudio, NF John Day below Wall Creek and other streams with water withdrawals		See State of Oregon programmatic review -- Appendix F.
Oregon Water Trust and BOR	Leasing and Purchase of Water Rights	No existing sites identified	Uncertain	Depends on opportunities and funding.
Soil and Water Conservation Districts	Improve irrigation efficiency, upland improvements, riparian improvements	Cottonwood/Fox, Rudio, Deer and Granite creeks, and NF John Day below Wall Creek		See State of Oregon programmatic review – Appendix F.
Watershed Councils	Upland improvements, riparian improvements	Cottonwood/Fox, Rudio, Deer and Granite creeks, and NF John Day below Wall Creek	No	Program has limited resources and needs expansion.
NRCS	Upland improvements, riparian improvements	Cottonwood/Fox, Rudio, Deer and Granite creeks, and NF John Day below Wall Creek	No	Program needs expansion.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Approximately 170 miles of stream in the North Fork are protected with either existing or pending instream water rights. The instream water rights do not preclude further appropriation of water until flows in the affected reach drop down to the instream water rights as adopted by OWRD. Voluntary efforts restored 1.2 cfs instream in 2006. See discussion for Strategy 6, Lower Mainstem John Day River population.				

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Increase riparian shading	North Fork John Day River below Camas Cr (2), Camas Cr. (1), Lower Cottonwood Cr. (1), Rudio Cr. (1), Owens Cr. (1), lower reaches of Wall (2), Desolation(2), and Wilson (2) Crks.	High water temperatures	Degraded riparian forests	Abundance, productivity	Eggs, fry, juveniles, adults	Elevated water temperature is a pervasive water quality problem for the North Fork John Day River population, with 39 stream reaches listed as water quality limited. Additional reaches would probably be listed if water temperature data were available. Camas, Owens and Cottonwood crs and lower reaches of Wall, Desolation, and Wilson crs are relatively good producers of steelhead that are listed as water quality limited due to elevated water temperatures.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
Manage return flow to reduce extreme stream temperatures	lower North Fork John Day River (2) Camas Cr. (1), Cottonwood Cr. (1), Rudio Cr. (1), Owens Cr. (2)	High water temperatures	Water withdrawals	Abundance, productivity	Eggs, fry, juveniles, adults	
Address contamination from mine related discharge	Granite Cr and tributaries (1)	Chemical contaminants	Heavy metal and mine waste pollution	Abundance, productivity	Eggs, fry, juveniles, adults	
Reduce chemical pollution inputs	None currently identified	Chemical pollution	Pesticides, fertilizers, herbicides, vehicle hydrocarbons, etc.	Abundance, productivity	Eggs, fry, juveniles, adults	
Apply BMPs to animal feeding operations	None currently identified	Degraded water quality	Animal feed operations	Abundance, productivity	Eggs, fry, juveniles, adults	
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	Population-wide	Degraded upland processes, floodplains, riparian areas, altered hydrology, altered sediment routing	Degradation and conversion of uplands, floodplains, riparian areas	Abundance, productivity	Eggs, fry, juveniles, adults	While irrigation is not common in the North Fork, there are some opportunities to use more efficient irrigation methods, which reduces the amount of surface water returning to the stream, and result in fewer nutrients from pastures reaching the North Fork John Day River and its tributaries. Reducing nutrient loads will contribute to increased water quality by reducing biological oxygen demand and algae blooms.
Continue TMDL monitoring	Population-wide	Degraded water quality, sediment routing	Land use practices, water withdrawals, pesticides, fertilizers, herbicides	Abundance, productivity	Eggs, fry, juveniles, adults	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Increase riparian shading	ODFW, Watershed Councils, SWCDs, USFS, BLM, CTUIR	Ongoing	water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years	High
Manage return flow to reduce extreme stream temperatures	SWCDs, watershed councils	Ongoing	Water quality improvement would have high dispersal downstream	Less than 5 years, once the project has been identified	Immediate	High, reduced temperatures has been well documented
Address contamination from mine related discharge	ODEQ, USFS	Ongoing	Primarily in contaminated reaches, with intermediate dispersal downstream	Long term, although actual treatment may take only a matter of days.	Immediate in the specific stream reach.	High, although contingent upon adequate maintenance
Reduce chemical pollution inputs	ODEQ, others	Ongoing		Ongoing	Reduce chemical pollution immediately	High
Apply BMPs to animal feeding operations	ODA	Ongoing	Water quality improvement would have high dispersal downstream	Some treatments could be done immediately. There are few animal feeding operations within the subbasin, only one of which has been identified as a problem	5-15 years	High, once a treatment has been agreed upon

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
Restore natural functions and processes through actions identified in strategies 1,3,4,5,8	SWCD, USFS, BLM	Ongoing	Subbasin-wide, high dispersal downstream	Intermediate	Up to 15 years	High
Continue TMDL monitoring	USFS, ODFW, SWCD, ODEQ	Ongoing	Subbasin-wide	Ongoing	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
FSA	CREP, CRP	Cottonwood/Fox, Rudio, and Camas creeks, NF John Day below Wall Creek	No	Program needs expanded.
ODFW	Riparian Enhancement Program	Cottonwood/Fox, Rudio, and Camas creeks.	No	Constrained by funding and personnel.
ODEQ	Mine Waste Program	Granite Creek		See State of Oregon programmatic review -- Appendix F.
ODA	Confined animal feeding operations (CAFO), AgWQM	None currently identified	Likely	See State of Oregon programmatic review -- Appendix F.
ODEQ, ODA, SWCD, USFS	Sedimentation Monitoring (TMDL Development and Implementation)	Watershed-wide		See State of Oregon programmatic review -- Appendix F. See USFS/BLM Program Sufficiency Assessment -- Appendix E and Regional Aquatic Restoration Strategy. See discussion in Gaps commentary below.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

Heavy metal and other contaminants coming from historical and ongoing mining activity in the Granite Cr drainage has resulted in elevated levels of these contaminants found in sediments. ODFW biologists have observed dead fish and adult fish with gill lesions in the streams of this watershed. Although the cause of this mortality is not certain, elevated iron and heavy metal concentrations may be a contributing factor. Although recent surveys conducted by the UNF and U.S. Environmental Protection Agency (EPA) indicated that mercury was not present in high enough concentrations known to cause these types of effects, conditions at abandoned mine sites and abatement ponds may change yearly, increasing the amount of heavy metals released (NMFS 2004/0008). Low stream flows during the hottest part of the year exacerbate the already warm water temperatures. Opportunities for increasing streamflow through leasing of water rights, which often results in cooler water over a longer stream reach, are being pursued by Oregon Water Trust and US Bureau of Reclamation. Constraints for future projects include acceptance by landowners and a secure, long term funding source. Forest Services's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize stream enhancement actions for this population, and helps deploy limited active restoration funding for riparian planting where it is most needed.

Reducing water temperatures through the use of improved riparian vegetation and more efficient methods of irrigation may take several years to provide measurable results. Many projects that improve water quality by reducing irrigation return water have been completed.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore native upland plant communities	Cottonwood/Fox Cr (1), upper Rudio Cr (1), Deer Cr (1), Wilson Cr (2), Wall Cr (2).	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices, loss of water storage capacity	Abundance, productivity	Eggs, fry, and 0+	Upland improvements such as restoring native plant communities and controlling invasive weed species will improve precipitation infiltration rates and ultimately improve watershed health, including the hydrograph.
Upgrade or remove problem forest roads	Upper North Fork John Day River and tributaries above and including Trail Cr (1), Wilson Cr (2),	Same as above	Road network	Abundance, productivity	Eggs, fry, and 0+	

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
	Upper Camas Cr tributaries (2), Clear Cr and tributaries (1), Granite Cr (2)					
Initiate upland improvement demonstration projects	Population-wide	Same as above	Upland land use practices	Abundance, productivity	Eggs, fry, and 0+	
Manage vegetation, including juniper removal	Cottonwood/Fox Cr (1), upper Rudio Cr (2), Deer Cr (2), Wall Cr (1), Wilson Cr (2)	Altered hydrology, sediment routing	Invasive plants	Abundance, productivity	Eggs, fry, and 0+	
Demonstration projects to restore forest health and resilience to wildfire	Private and state forest lands	Altered hydrology, sediment, water quality, riparian functions, LWD recruitment	Conversion of vegetative communities	Abundance, productivity	All	Suppression of fires has altered fire regimes and increased threat of high intensity fires.
Employ BMPs to forest practices including fuels management and fire suppression mitigation, livestock grazing, road management and agricultural practices	Population-wide	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices	Abundance, productivity	Eggs, fry, and 0+	Suppression of fires over the last 80 years has contributed to higher than normal tree densities and increased threat of high intensity fires. High intensity fires have greater potential for damaging watershed function than lower intensity fires. There are areas on National Forest lands that have degraded conditions due to fire suppression, but they are difficult to quantify.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore native upland plant communities	SWCD, USFS, BLM	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Long term		
Upgrade or remove problem forest roads	USFS, ODF, ODOT	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, many forest roads have legacy issues with regard to sediment transport and routing of runoff. Decommissioning may take many years	5-15 years	Moderate, although funding on public lands and landowner cooperation on private lands will determine rate of treatment
Initiate upland improvement demonstration projects	ODFW, NOAA Fisheries, USFWS, USFS, BLM, CTWSRO, Watershed Councils, SWCDs	Ongoing	Entire subbasin	Long term	Variable lag time	unknown, depends upon action taken as a result of being more informed
Manage vegetation, including juniper removal	USFS, BLM, NRCS, SWCDs, Watershed Councils	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Juniper control can be done quickly, other strategies such as control of invasive plants may take more than 20 years	5-30 years	Moderate
Demonstration projects to restore forest health and resilience to wildfire	ODF	Ongoing	Private and state forest lands	Long term	Variable 5-20 years	Moderate
Employ BMPs to forest practices including fuels management and fire suppression mitigation, livestock grazing, road	SWCD, USFS, BLM, ODA, CTWSRO, private landowners	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, dependent on implementation of Agricultural Water Quality Management Plans	0-20,years, depending upon treatments applied	Moderate, dependent upon voluntary landowner participation

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
management and agricultural practices						
Status of Existing Programs through which Actions are Implemented						
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale		
NRCS, Farm Service Agency	CRP	Rudio, Lower Cottonwood, NF John Day below Wall Creek	No	Needs expansion.		
SWCDs	Juniper control	Rudio and Cottonwood creeks	No	Needs expansion.		
ODFW	Green Forage	Rudio and Cottonwood creeks	No	Very small program.		
USFS, BLM	Forest Plan, Resource Management Plan, PACFISH	All FS/BLM lands throughout watershed	Likely	See USFS/BLM Program Sufficiency Assessment -- Appendix E and Regional Aquatic Restoration Strategy. See discussion in Gaps commentary below.		
ODF	Private land protection from fire, Private Forest Program	Private and state forestlands throughout population		See State of Oregon programmatic review -- Appendix F.		
ODF	Oregon Forest Practices Act	Private and state forest lands		See State of Oregon programmatic review -- Appendix F.		
ODA	Agricultural Water Quality Management Program	Private lands throughout the watershed		See State of Oregon programmatic review -- Appendix F.		
CTUIR	Watershed Restoration	Camas and Desolation creeks on private lands	Uncertain	Limited resources.		
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)						
See discussion for Strategy 8, Lower Mainstem John Day River population. Implementation of PACFISH standards and guides (BMPs) to Forest and BLM programs, has been highly successful for passive upland restoration over most of this population's area. Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize active watershed restoration for this population, and helps deploy limited active watershed restoration funding where it is most needed.						

9.3.7 Habitat Strategies and Actions for Middle Fork John Day River Steelhead Population

Primary limiting factors: degraded channel structure and complexity (habitat quantity and diversity), degraded floodplain function and connectivity, altered sediment routing, altered hydrology, and water temperature.

Primary threats: riparian disturbance, stream channelization and relocation, grazing, forest practices, road building, passage barriers, irrigation withdrawals, mining, and dredging.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Protect high quality habitats through acquisition or conservation easements	Upper reaches of Big, Big Boulder, and Granite Boulder crs that originate in the Vinegar Hill-Indian Rock Scenic Area (1); Other areas with high potential for protection once they are restored include the Middle Fork mainstem from Ragged Cr to the upper end of Phipps Meadow (2), and streams that drain the north side of Dixie Butte -- Davis (2), Butte (2), Placer Gulch (2), and Greenhorn (2) crs.	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing,	Many threats including livestock overgrazing of riparian area, channelization, stream bank armoring, agricultural practices (fertilizers, herbicides, sediments, changes in plant communities), water withdrawals, loss of beaver dams	Abundance, productivity	All	Protecting base streamflows from further appropriations is a very important function of protecting existing high quality habitats. Protection of high quality habitats is the most cost effective way of ensuring fish have good quality habitat. Land acquisitions, easements, and cooperative agreements may also facilitate the implementation of active restoration projects.
Adopt and manage Cooperative Agreements	Middle Fork between Placer Gulch and Caribou Cr (1); through Phipps Meadow (1), from Ragged to Tincup Cr (1), from Paradise Canyon to below Lick Cr.(2), Granite Cr (2)	Same as above	Same as above	Abundance, productivity	All	
Special management designations in forest and BLM plans	Riparian Habitat Conservation Areas identified in existing Forest Plans	Same as above	Same as above	Abundance, productivity	All	
Designate additional wilderness and wild and scenic status	Public lands identified in the Forest Plan Revision process	Same as above	Same as above	Abundance, productivity	All	
Protect and conserve rare and unique functioning habitats	Phipps Meadow (1)	Same as above	Same as above	Abundance, productivity	All	It is much less expensive over the long term to protect high quality habitat than it is to degrade the habitat and then try to restore it.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Protect access to key habitats	None identified at this time, although ODFW periodically reviews proposals that could block passage into spawning and rearing habitat.	Passage barriers, altered hydrology, channel structure	High water temperatures, low flow, channelization	Abundance, productivity, distribution	All	Thoroughly review projects that may block fish passage. Current ODFW policy is to grant exemptions from fish passage requirements only if mitigation meets or exceeds the loss of habitat. Exemptions must be approved by the Fish and Wildlife Commission.
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	Population-wide	All	Same as in first cell above	Abundance, productivity	All	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Protect the highest quality habitats through acquisition or conservation easements	CTUIR, TNC, RMEF, John Day Basin Trust, SWCDs	Ongoing	Water quality improvement have high dispersal downstream, stream corridor and function improvements would be confined to the specific site	Existing conservation agreements are complete. Full implementation of conservation measures will take 5-15 years or more	5-15 years with passive restoration approaches	High, based on previous cooperative agreements
Protect and conserve rare and unique functioning habitats	Land trusts, CTWSRO, ODFW, SWCD, NGOs, USFS	Ongoing	Same as above	Existing conservation agreements are complete. Full implementation of conservation measures will take 5-15 years or more	5-15 years with passive restoration approaches	High, based on previous cooperative agreements
Adopt and manage Cooperative Agreements	ODFW, SWCDs, FSA	Ongoing	Same as above	Agreements are for 10 to 15 years	Immediate	High, although not in perpetuity
Special management designations in forest and BLM plans	USFS, BLM	Ongoing as identified	Same as above	Subject to Forest Plan Revision timeframe for designation	Immediate	High, although subject to change from Forest Plan or mgmt plan revision
Designate additional wilderness and wild and scenic status	Public lands identified in the Forest Plan Revision process	Same as above	Same as above	Intermediate, depending on socio-political acceptance	5-15 years	High if designated
Protect access to key habitats	ODFW, USFS, BLM, Watershed Councils, SWCDs	Ongoing	Same as above	Immediate	Immediate	High
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	NRCS, SWCDs, USFS, ODFW,ODF, DSL, BLM, ODOT, CTWSRO, ODA, FSA, private landowners	Ongoing	Population-wide	Long term	5-15 years	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
USFS/ BLM	Wilderness Areas, Wilderness Study Areas, Wild and Scenic River corridors, Special Management designations, PACFISH	Indian Rock/Vinegar Hill Scenic Area and buffers on FS and BLM lands	Yes, PACFISH standards are good, but implementation is inconsistent between forests. See discussion below.	See USFS/BLM Program Sufficiency Assessment -- Appendix E.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.				
ODFW	Cooperative Agreements	Middle Fork private lands with cooperative agreements, Camp Creek and Phipps Meadows	No	The agreements are for only 10-15 years and need to be longer.
FSA	CREP	Middle Fork on Oxbow and Forrest Ranch properties owned by CTWRSO	No	The agreements are for only 10 or 15 years and need to be longer.
NGOs	Lease or purchase of lands or instream water rights	Conservation easement on Middle Fork John Day RPB property and The Nature Conservancy Middle Fork Preserve	Yes	Important to secure critical habitat and/or water rights as additional opportunities arise.
ODA	Agricultural Water Quality Management Program	Private lands		See State of Oregon programmatic review -- Appendix F.
CTWSRO	Watershed Restoration	Oxbow and Forrest Ranch properties and other private lands	Likely	Could be expanded to include other areas.
ODF	Oregon Forest Practices Act	Private and state owned timber lands		See State of Oregon programmatic review -- Appendix F.
Local Government	City and County Planning and Zoning	Private lands	Uncertain	

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

The John Day River has 317 miles designated as State Wild and Scenic. State designated reaches include the Middle Fork John Day River from its mouth to Crawford Cr Bridge (RM 71). The Indian Rock Vinegar Hill Scenic Area in the Malheur and Umatilla National Forests is managed primarily for its scenic value, which offers good protection for watershed and fish habitat parameters. Adding additional wilderness areas and wild and scenic river segments would require designation by Congress.

Cooperative and conservation agreements on private land are tools for protecting high quality habitats. ODFW has used cooperative agreements over the last 21 years to protect riparian corridors that have been fenced to exclude livestock grazing. Unfortunately those agreements are for only 15 years and there have not been funds or personnel needed to extend them for longer time periods. Over 120 miles of stream throughout the subbasin have been protected under this program. Additional opportunities will be limited by availability of funds and by willingness of landowners to sign conservation easements and/or agreements.

Conservation agreements and acquisitions by conservation organizations are another recently used tool that can protect high quality habitat. The Middle Fork John Day River has five parcels with conservation easements or conservation organizations as the owners. A perpetual riparian conservation agreement restricting development and grazing is currently in place on a 310 acre private parcel in the Middle Fork near river mile 40. Another conservation property is the Nature Conservancy Dunstan Preserve (approx. 1,200 acres) near RM 50. It is managed primarily for fish benefits. The Oxbow Conservation Area (1,022 acres) and the Forrest Conservation Area (approx 867 acres) both owned by the Confederated Tribes of the Warm Springs Reservation of Oregon are managed as mitigation for the loss of fish and wildlife habitat associated with hydroelectric development on the Columbia River. Another privately owned parcel has a perpetual water lease agreement to prevent water withdrawals after July 20, which will result in approximately 10 cfs being left in the stream, primarily for the benefit of salmon and steelhead.

Implementation of PACFISH standards and guides for most Forest and BLM programs has been highly successful over most of this population's area, but implementation of PACFISH Standards and Guides for FS grazing management programs remains challenging in some locations.

See discussion for Strategy 1, Lower Mainstem John Day River population.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Remove or minimize use of push up dams	Long Cr and tributaries (1)	Impaired fish passage	Push up dams	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	Annual maintenance and construction of push up dams contributes to onsite and downstream channel stability, loss of pools and other structure, and increased sediment loads.
Remove or replace barriers blocking passage such as dams, road culverts and irrigation structures	Irrigation or water storage related issues: Long Cr and tributaries (1) Culverts: Camp (2), Long (1), Vinegar (2), Butte (1), Crawford (2), Granite Boulder (1), and Little Boulder (1) crs	Impaired fish passage	Dams, culverts, instream structures	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	Push up irrigation dams, concrete diversions, in-channel stock ponds, and road culverts are located throughout the entire subbasin. Passage problems at culverts are widespread throughout all subbasins.
Construct ladders over existing permanent concrete or earth fill dams (complete barrier inventory)	None identified	Impaired fish passage	Dams	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	A comprehensive survey of all barriers has not been completed, BOR has completed an aerial survey, but has not field verified the potential barriers identified in the aerial survey.
Replace screens that do not meet criteria	Beaver (2), Big, Butte (2), Granite Boulder (2), Long (1), MF John Day (1)	Impaired fish passage	Irrigation diversions	Abundance, productivity, spatial structure	Emergent fry	All known diversions in the Middle Fork are currently screened. Most screens within the Middle Fork population boundaries have been replaced to address new criteria to reduce entrainment of emergent fry and bull trout. Priority areas identified where additional upgrades needed.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Remove or minimize use of push up dams (complete comprehensive survey)	SWCD	Ongoing	Provide access to upstream habitat	Ongoing, but all push up dams not expected to be corrected for at least 15 years. A comprehensive survey has not been completed.	Immediate	High, if comply with fish passage design criteria
Remove or replace barriers blocking passage -- dams, road culverts and irrigation structures	USFS, BLM, watershed councils, SWCDs, ODOT	Ongoing	Access to upstream habitat	Ongoing, replacing all culverts blocking fish passage expected to take 50 years. See Appendix G.	Immediate	High, if comply with fish passage design criteria
Construct ladders over existing permanent concrete or earth fill dams	ODFW, SWCDs	Ongoing	Provide access to upstream habitat	Ongoing, providing passage at all diversion and pond barriers will take many years.	Immediate	High if comply with fish passage design criteria
Replace screens that do not meet criteria	ODFW	Ongoing	At point of diversion	Approximately 14 diversions need to be replaced, should take - years	Immediate	High if comply with fish passage design criteria

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.				
Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
Soil and Water Conservation Districts	Irrigation dam improvements, culvert replacement or retrofits	Middle Fork John Day, Big Boulder Creek, and other private lands		The Grant Soil and Water District is constrained by the construction window of opportunity. Other counties could expand the program but are constrained by funding and personnel. See State of Oregon programmatic review -- Appendix F.
ODFW	Fish Passage/Screening	Private lands throughout the MF watershed, Bridge Creek	No	The program completes a minimum of one project per year, but is dependent upon landowner cooperation and limited funding.
USFS	Culvert replacement	Federal lands, and specifically Granite Boulder and Beaver creeks. See Appendix G for list of the 223 culverts needing replacement.	No	Limited resources result in slow progress and long timeline for completion.
Watershed Councils	Road Crossing Passage improvements, passage improvements	Butte and Bridge creeks, others as identified in Appendix G.	No	Needs additional resources.
ODOT	Culvert replacement or retrofit	Bridge Creek, Summit Creek, Clear Creek		See State of Oregon programmatic review -- Appendix F.
BOR	John Day Basin Program	Private lands throughout the MF watershed as identified by SWCD or Watershed Council.	Yes	Program sufficient.
CTWSRO	John Day Basin Program	Oxbow and Forrest Ranch properties and other private lands as later identified.	No	The tribe contracts with Soil and Water Districts to assist with consultation, permits, and monitoring. Additional resources needed.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Most of the mainstem passage problems have been addressed, but there are many tributaries where adult passage is blocked and more areas where juvenile passage problems occur. Irrigation dams, stock ponds, and road culverts are the primary causes of passage issues. Soil and Water Districts are correcting passage at irrigation diversions and improperly installed culverts, but are constrained by funding and by personnel needed for construction oversight. An inventory of road crossings on state and county roads in 1999 indicated 14 culverts on state owned roads and 4 culverts on county owned roads did not meet fish passage criteria within the Middle Fork population boundary. Appendix G presents an inventory of culverts with known passage problems on state, county, and USFS owned roads. Some culverts have been replaced with structures that do meet the fish passage criteria, but much work remains. Watershed councils and ODOT, who are the principal entities working on culverts are constrained primarily by funding. An inventory of road crossings on federal lands indicates juvenile passage problems are pervasive, particularly on National Forests, with approximately 223 culverts not meeting passage criteria in this population. The US Forest Service and BLM are constrained primarily by funding and the personnel needed for NEPA analysis. At the current rate of culvert replacements, it will take over 50 years to correct all passage problems on National Forests, however, the Forest Service Pacific Northwest Region's Aquatic Restoration Strategy (USDA-FS, 2005), provides guidance that will help prioritize culvert replacements for this population. The BLM has no adult barriers at culverts. Monitoring is needed to determine if upstream passage for juveniles is an issue. Another constraint is that existing state laws do not require passage improvements at existing barriers unless there is a major change in the structure, such as reconstruction or significant modifications, so landowner cooperation is critical for improving passage throughout the subbasin. See discussion for Strategy 2, Lower Mainstem John Day River population.				

Strategy 3. Maintain and restore floodplain connectivity and function.

Strategy 3. Maintain and restore floodplain connectivity and function.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Reconnect floodplains to channels	Upper mainstem Middle Fork from Big Cr upstream to Idaho Cr (1), Lower Vinegar (2), Vincent (2), and	Degraded floodplain, altered hydrology,	Removal of wetlands, side channels, off-stream	Abundance, productivity	Primarily, fry and 0+	

Strategy 3. Maintain and restore floodplain connectivity and function.						
	Long (1) crs	altered sediment routing, degraded water quality	habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams			
Reconnect side channels and off-channel habitats to stream channels	Upper mainstem Middle Fork from Big Cr upstream to Idaho Cr (1), Lower Vinegar (2), Vincent (2), and Long (1) crs	Degraded floodplain, altered hydrology	Removal of side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity, spatial structure	Primarily, fry and 0+	There has been a loss of off-channel and side-channel habitats that once provided habitat for spawning and rearing, and refugia from high flows.
Restore wet meadows	Long Cr (2), Phipps Meadow (1), Middle Fork between Ragged Cr and Phipps Meadow (1), Flood Meadow (2), Keeney Meadow (2), Camp Cr (1) Coxie Meadow (2)	Degraded floodplain, altered hydrology	Removal of wetlands	Abundance, productivity	Primarily, fry and 0+	
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes	Upper mainstem Middle Fork from Big Cr upstream to Idaho Cr (2), Lower Vinegar (2), Vincent (2), and Long crs (1), Camp Cr (1), Placer Gulch (1), Davis Cr (1), Indian Cr (2)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat	Abundance, productivity, spatial structure	Primarily, fry and 0+	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Reconnect floodplain to channel	ODFW, watershed council, SWCD, USFS, BLM	Ongoing	For the treated stream reach	Short term, once identified	Physical response will be immediate, biological response may take 5-10 years	High
Reconnect side channels and off-channel habitats to stream channels	ODFW, watershed council, SWCD, USFS, BLM, CTUIR	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Long term, because of widespread need	5-15 years, depending upon frequency and duration of channel altering flows	Moderate, depending upon how extensive the project is and frequency and duration of channel altering flows
Restore wet meadows	TNC, USFS, CTWSRO	Ongoing and planned	Benefits of improved channel morphology localized, improved water table and resulting increased stream flow and lower water temperatures have high dispersal downstream	Intermediate	5-15 years	Moderate
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes	ODFW, CTWSRO, USFS, BLM	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Long term, due to acceptance by landowners and widespread need	Within 5 years once the dams are built	Moderate-high, dependent upon acceptance by landowners

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program	Private lands throughout the MF watershed, Phipps Meadow, Rush Creek, and Eightmile Creek	No	Program limited primarily by funding.

Strategy 3. Maintain and restore floodplain connectivity and function.				
USFS/BLM	Stream enhancement program	Federal lands, Middle Fork John Day, Summit Creek. Only when specifically identified that passive restoration is not working.	Yes in some areas, no in others due to limited funding	The USFS preferred strategy is passive restoration; managing riparian areas to protect channel-forming processes. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005). See discussion in Gaps commentary below.
Watershed Councils	Watershed restoration	Private lands throughout the MF Watershed, Rush Creek has been specifically identified	Uncertain	Active restoration only if specific needs cannot be addressed by passive restoration techniques, need additional resources.
Soil and Water Conservation Districts	Watershed restoration	Private lands throughout the MF Watershed		See State of Oregon programmatic review -- Appendix F.
Nature Conservancy and other NGOs	Restoration projects	TNC Middle Fork Preserve and conservation easement on RPB property	Yes where applied	Program could expand to other priority areas.
CTWRSO	Watershed restoration	Oxbow and Forrest Ranch properties	Likely	Program could expand.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Instream activities have not been identified as a high priority by the recovery planning team or the subbasin plan team except when identified as a need for specific sites. The planning team prefers that more passive approaches, such as riparian and upland improvements be emphasized. Typically, instream activities would include placement of rootwads, whole trees, or boulder clusters to improved habitat complexity and habitat diversity where those parameters are deficient and not expected to improve with passive restoration. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.				

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural channel form	Upper mainstem Middle Fork from Big Cr upstream to Idaho Cr (1), Lower Vinegar (2), Vincent (2), and Long (2) crs Channel reconfiguration work needed: mouth of Granite Boulder Cr to Ragged Cr (1), between Big Boulder Cr and Camp Cr (1), between Elk Cr and Bear Cr (2), and near the mouth of Mosquito Cr (1); Rush Cr (2)	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature, flows	Stream channelization, bank armoring, large wood removal, beaver removal, removal of riparian vegetation, livestock overgrazing in riparian areas	Abundance, productivity	Primarily, fry and 0+	Passive restoration techniques, such as riparian fencing, are the preferred method for improving channel structure and stability. More active restoration techniques may be appropriate in these reaches. Historical dredge mining in several reaches of the mainstem Middle Fork between Caribou Cr and Mosquito Cr has simplified the stream channel. The North Fork Watershed Council is working with a landowner to restore channel sinuosity on Rush Cr.
Place stable wood and other large organic debris in	Upper mainstem Middle Fork from Big Cr upstream to Idaho Cr (1), Lower Vinegar (2),	Degraded channel structure and complexity,	large wood removal channelization	Abundance, productivity	Primarily, fry and 0+	More active restoration techniques, such as rootwad placement or channel

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.						
streambeds and in floodplains	Vincent (2), and Long (2) crs; Big Boulder Cr (1), Rush Cr (2)	habitat diversity, sediment routing, water temperature				reconfiguration, may be appropriate in these reaches.
Stabilize streambanks	Upper mainstem Middle Fork from Big Cr upstream to Idaho Cr (1),Lower Vinegar (2), Vincent (2), and Long (2) crs	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	Stream channelization, berming, bank armoring, overgrazing in riparian areas	Abundance, productivity	Primarily eggs, fry and 0+	Some bank erosion is inevitable and beneficial. However, where erosion is actively taking place due to unnatural processes, stabilization may be needed to reduce fine sediments

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural channel form	ODFW, SWCDs, USFS, BLM, watershed councils	Ongoing and planned	For the treated stream reach	Short term, once identified	Physical response will be immediate, biological response may take 5-10 years	High
Place stable wood and other large organic debris in streambeds and in floodplains	ODFW, USFS, watershed councils, BLM, SWCDs	As needed	For the immediate stream reach	Once identified, short term	Immediate	High
Stabilize streambanks	ODFW, USFS, watershed councils, BLM, SWCDs	Ongoing	For the treated stream reach, physical benefits dispersed downstream	Passive stabilization techniques are preferred and take longer to implement	With passive restoration the response may take 15 years	Medium to high, depending upon the extent of the treatments

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program	Big Boulder Creek and those specifically identified as deficient in habitat diversity	No	Program could expand, approach sufficient.
USFS, BLM	Stream enhancement program	Those streams specifically identified as deficient in habitat diversity	Yes in some areas, no in others due to limited funding	See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005). See discussion in Gaps commentary below.
Watershed Councils	Watershed restoration	Those streams specifically identified as deficient in habitat diversity	Uncertain	Restricted by resources, approach sufficient.
Soil and Water Conservation Districts	Watershed restoration	Those streams specifically identified as deficient in habitat diversity		See State of Oregon programmatic review -- Appendix F.
CTWSRO	Watershed restoration	Big Boulder Creek and those specifically identified as deficient in habitat diversity	Uncertain	Scope of program limits success, approach sufficient.
NGOs	Watershed restoration	TNC Middle Fork Preserve and RPB conservation easement property	Uncertain	

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
Instream activities have not been identified as a high priority by the recovery planning team or the subbasin plan team except when identified as a need for specific sites. The planning team prefers that more passive approaches, such as riparian and upland improvements be emphasized. Typically, instream activities that would improve floodplain function and channel migration processes would include placement of rootwads, whole trees, or boulder clusters to improved habitat complexity and habitat diversity where those parameters are deficient and not expected to improve with passive restoration. Another structural activity would be to construct boulder or log weirs to raise the water table, but only where a passive approach has not worked.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.
The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural riparian vegetative communities including vegetative planting	Mainstem Middle Fork John Day between Crawford and Bridge crs (1), between Horse and Camp crs (1), below Highway 395 (2); and Long (1), Slide (2), Eightmile (2), Sixmile (2), Twelvemile (2), Granite (2), Camp (!), and Crawford (2) crs	Degraded riparian area, channel structure and complexity, floodplain degradation, altered hydrology, sediment, water quality	Overgrazing of riparian area, channelization, stream bank armoring, tree harvest in riparian areas, changes in plant communities (including invasive plants), loss of beaver dams	Abundance, productivity	Primarily fry and 0+	Primary methods of riparian enhancement include riparian corridor fences to exclude livestock, changes in grazing management that promote riparian recovery, and planting of native shrubs.
Develop grazing strategies that promote riparian recovery	Mainstem Middle Fork John Day between Crawford and Bridge crs (1), between Horse and Camp crs (1), below Highway 395 (2); and Long (1), Slide (2), Eightmile (2), Sixmile (2), Twelvemile (2), Granite (2), Camp (!), and Crawford (2) crs	Same as above	Livestock overgrazing of riparian area	Abundance, productivity	Primarily fry and 0+	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural riparian vegetative communities including vegetative planting	ODFW, Watershed Councils, SWCDs, USFS, BLM, CTUIR	Ongoing	Riparian function will be limited to specific reach; water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years, (see above)	High, based upon experience with existing grazing management and riparian recovery projects
Develop grazing strategies that promote riparian recovery	NRCS, AFS, USFS, BLM, SWCDs, ODFW, Watershed Councils, CTUIR	Ongoing	Riparian function will be limited to specific reach; water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years, depending upon grazing plan adopted. Riparian corridor fencing and removal of riparian grazing has the fastest recovery rate.	High, based upon experience with existing grazing management and riparian recovery projects

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program	Big Boulder Creek, MF John Day,	No	Program limited by funding.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.				
		Phipps Meadow		
SWCDs	Upland improvements, riparian improvements	Private lands throughout the watershed		Could be expanded.
Watershed Councils	Upland improvements, riparian improvements	Eightmile and Rush Creek, and others as later identified	No	Limited by resources, approach sufficient.
USFS/BLM	Upland improvements, riparian improvements	Federal lands, Long Creek specifically identified	Uncertain	Funding is limited. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005). See discussion in Gaps commentary below.
NRCS	Upland improvements, riparian improvements	Private lands as identified by SWCD and Watershed Council	Yes	Program sufficient.
ODA	Agricultural Water Quality Management Program	Private lands, specifically Granite Creek		See State of Oregon programmatic review -- Appendix F.
CTWRSO	Watershed restoration	Oxbow and Forrest Ranch properties	Likely where implemented	Program could be implemented on broader scale.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
See discussion for Strategy 5, Lower Mainstem John Day River population. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed. Implementation of PACFISH standards and guides for most Forest and BLM programs has been highly successful over most of this population's area, but implementation of PACFISH Standards and Guides for FS grazing management program remains challenging in some locations.				

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Implement agricultural water conservation measures	Long Cr and its tributaries (1); Mainstem Middle Fork, Coyote Cr. to Camp Cr. (2)	Altered hydrology, low flows, high temperatures	Water withdrawals, land conversion on uplands, road network	Abundance, productivity	Fry and 0+	Most other sections of the Middle Fork with consumptive water rights are now under conservation agreements.
Improve irrigation conveyance and efficiency	Long Cr and its tributaries (1); Mainstem Middle Fork, Coyote Cr. to Camp Cr. (2)	Low flows, high temperatures	Water withdrawals, loss during conveyance	Abundance, productivity	Fry and 0+	
Increase pool habitat (beaver ponds)	Long Cr and its tributaries (1), Camp (1), Crawford (1), Deerhorn (2), Davis (2), Placer Gulch (2), Granite (1), Rush (2), Twelvemile (2), Slide (1), Sixmile(2), Squaw (1), Idaho (1), Lick (2), Mainstem Middle Fork, Coyote Cr. to Camp Cr. (2)	Altered hydrology, low flows, high temperatures	Loss of wet meadows	Abundance, productivity	All freshwater life stages	
Floodplain aquifer recharge	Granite Boulder Cr (1)	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Fry and 0+	Pilot project with CTWSRO.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
Lease or acquire water rights and convert to instream	Long Cr. and its tributaries (2); Mainstem Middle Fork, Coyote Cr. to Camp Cr. (1)	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Fry and 0+	
Monitor/regulate water withdrawals	Population-wide	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Fry and 0+	Annual fluctuations in flow levels are intensified by irrigation withdrawals.
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs	Population-wide	Low flows, high temperatures	Water withdrawals	Abundance, productivity, spatial structure, diversity	All stages	New programs in development

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Implement agricultural water conservation measures	SWCD, watershed councils, NRCS	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and dependent upon landowner willingness to participate and availability of projects	Immediate	High, if the saved water is protected from being appropriated to a downstream user in areas with instream water rights.
Improve irrigation conveyance and efficiency	SWCD, OWEB, watershed councils, NRCS, landowners	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and dependent upon landowner willingness to participate and availability of projects	Immediate	High, if the saved water is protected from being appropriated to a downstream user in areas with instream water rights.
Increase pool habitat (beaver ponds)	SWCD, ODFW, CTWSRO, USFS	Ongoing	High dispersal downstream	Unknown	Immediate increase in instream flow	High
Floodplain aquifer recharge	CTWSRO, SWCDs	Planned, some ongoing	Potentially high dispersal from recharge project site downstream for many miles	Long term, although opportunities for pilot projects is dependent upon willing landowner	Immediate	High, if the additional water is protected from being appropriated to a downstream user in areas with instream water rights.
Lease or acquire water rights and convert to instream	OWRD, FSA, OWEB, Oregon Water Trust, others	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and highly dependent upon landowner willingness to lease.	Immediate	High, if the leased water is protected from being appropriated to a downstream user in areas with instream water rights. FSA pays higher rates for CREP enrollment when water rights are leased for instream use.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
Monitor/regulate water withdrawals	OWRD	Ongoing	Point of diversion downstream to mouth of John Day River	Long term, dependent upon OWRD enforcing the requirement to measure water usage	Immediate	High if water user reporting requirement and installation of measuring devices on diversions is implemented.
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs	OWRD	Ongoing	Population-wide	2007-2009 except incentive funding ongoing	Long term	Moderate

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program, riparian improvements	Camp Creek, Phipps Meadow, Oxbow property	No	Limited by funding, approach sufficient.
OWRD	Streamflow Monitoring and Restoration, Flow Restoration, Lease/Transfer Water Rights, Administration of Water Rights, Water Use Measurement, Water Needs Assessment, Storage Assessment, Conservation Assessment	Where irrigation withdrawals occur throughout the MF John Day watershed		See State of Oregon programmatic review -- Appendix F.
Oregon Water Trust and BOR	Leasing and Purchase of Water Rights	Middle Fork John Day, Vinegar and Clear creeks	No	Program limited by funding.
Soil and Water Conservation Districts	Improve irrigation efficiency, upland improvements, riparian improvements	Middle Fork John Day, Vinegar and Clear creeks		See State of Oregon programmatic review -- Appendix F.
Watershed Councils	Upland improvements, riparian improvements	Rush and Eightmile creeks	No	Limited resources.
NRCS	Upland improvements, riparian improvements	Those identified by SWCD and Watershed Council	No	Limited resources.
CTWSRO	Watershed restoration	Oxbow and Forrest Ranch properties	Likely in areas of implementation	Program could expand.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

Approximately 66 miles of stream in the Middle Fork are protected with either existing or pending instream water rights. The instream water rights do not preclude further appropriation of water until flows in the affected reach drop down to the instream water rights as adopted by OWRD. Voluntary efforts restored 5.7 cfs instream in 2006.

The Oregon Water Trust has made good progress at restoring flows in the Middle Fork with a total of over 20 cfs of water being converted to instream flow and water leases for another approximately 11 cfs on various streams throughout the subbasin.

See Strategy 6, Lower Mainstem John Day River population for further discussion.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Increase riparian shading	Mainstem: between Crawford and Caribou crs (1), between Tincup and Ragged crs (1), between Balance and Camp crs (1), below Highway 395 (2); Long Cr and tributaries (1); Indian Cr (2), Twelvemile (2), Sixmile (2) and Slide (2) crs	High water temperatures	Degraded riparian forests	Abundance, productivity	Fry and 0+	Elevated water temperatures are the result of reduced riparian vegetation and loss of floodplain function (wet meadow storage). Elevated water temperature is a pervasive water quality problem for the Middle Fork John Day River population, with 21 stream reaches listed as water quality limited. Additional reaches would probably be listed is water temperature data were available.
Manage return flow to reduce extreme stream temperatures	Mainstem: between Highway 7 and Caribou Cr (1), and between Horse and Camp crs (2); Long Cr (1)	High water temperatures	Water withdrawals	Abundance, productivity	Fry and 0+	
Reduce chemical pollution and nutrient inputs	None identified at this time	Chemical pollution	Pesticides, fertilizers, herbicides, vehicle hydrocarbons, etc.	Abundance, productivity	Fry and 0+	Using more efficient irrigation methods should result in fewer nutrients from pastures reaching the John Day River. Although the Middle Fork has been extensively impacted by historical mining activity, there are no known contamination issues.
Apply BMPs to animal feeding operations	Granite Cr (1)	Degraded water quality	Animal feed operations	Abundance, productivity	Fry and 0+	
Continue TMDL monitoring	For sediment: Mainstem Middle Fork above Camp Cr (2), Long Cr and tributaries (1), Butte Cr (2), Indian Cr (2), and Slide Cr (2). For temperature: Mainstem: between Highway 7 and Caribou Cr (1), below Camp Cr (2); Long Cr (1); Indian Cr (2)	Degraded water quality, sediment routing	Land use practices, water withdrawals, pesticides, fertilizers, herbicides	Abundance, productivity	Eggs, fry, juveniles, adults	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Increase riparian shading	ODFW, Watershed Councils, SWCDs, USFS, BLM, CTUIR	Ongoing	water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years	High
Manage return flow to reduce extreme stream temperatures	SWCDs, watershed councils	Ongoing	Water quality improvement would have high dispersal downstream	Less than 5 years, once the project has been identified	Immediate	High, reduced temperatures has been well documented

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
Reduce chemical pollution and nutrient inputs	ODEQ, others	Ongoing	High dispersal downstream	Ongoing	Reduce chemical pollution immediately	High
Apply BMPs to animal feeding operations	ODA	Ongoing	Water quality improvement would have high dispersal downstream	Some treatments could be done immediately. There are few animal feeding operations within the subbasin, only one of which has been identified as a problem	5-15 years	High, once a treatment has been agreed upon
Continue TMDL monitoring	USFS, ODFW, SWCD, ODEQ	Ongoing	Subbasin-wide	Ongoing	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
FSA	CREP, CRP	Middle Fork John Day, Granite Creek	No	Yes
ODEQ	Mine Waste Program	None currently identified, although extensive mining activity occurred on Middle Fork and tributaries		See State of Oregon programmatic review -- Appendix F.
ODA	Confined animal feeding operations (CAFO), AgWQM	Granite Creek, others as later identified		See State of Oregon programmatic review -- Appendix F.
ODEQ, ODA, SWCD, USFS	Sedimentation Monitoring (TMDL Development and Implementation)	Throughout the Middle Fork watershed		See State of Oregon programmatic review -- Appendix F. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005). See discussion in Gaps commentary below.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

Low streamflows during the hottest part of the year exacerbate the already warm water temperatures. Opportunities for increasing streamflow through leasing of water rights, which often results in cooler water over a longer stream reach, are being pursued by Oregon Water Trust and US Bureau of Reclamation. Constraints for future projects include acceptance by landowners and a secure, long term funding source.

The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.

Reducing water temperatures through the use of improved riparian vegetation and more efficient methods of irrigation may take several years to provide measurable results. Many projects that improve water quality by reducing irrigation return water have been completed.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore native upland plant communities	MaSAs; Middle Fork and north side tributaries below Highway 395 (1), Long Cr (1), Slide Cr (2)	Altered hydrology, sediment routing, channel stability, floodplain and riparian area	Upland land use practices, loss of water storage	Abundance, productivity	Fry and 0+	Upland improvements such as restoring native plant communities and controlling invasive weed species will improve

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
		degradation, water quality	capacity			precipitation infiltration rates and ultimately improve watershed health, including the hydrograph.
Upgrade or remove problem forest roads	Forest lands, 46 miles on Camp Cr and five miles on the Upper MF have been identified for treatment	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Road network	Abundance, productivity	Fry and 0+	
Initiate upland improvement demonstration projects	None identified	Same as above	Upland land use practices	Abundance, productivity	Fry and 0+	
Manage vegetation, including juniper removal	Middle Fork and north side tributaries below Highway 395 (1), Long Cr (1), Slide Cr (2)	Altered hydrology, sediment routing	Invasive plants	Abundance, productivity	Fry and 0+	
Demonstration projects to restore forest health and resilience to wildfire	Private and forest lands	Altered hydrology, sediment, water quality, riparian functions, LWD recruitment	Conversion of vegetative communities	Abundance, productivity	All	Suppression of fires has altered fire regimes and increased threat of high intensity fires.
Employ BMPs to forest practices including fuels management and fire suppression mitigation; livestock grazing; roads; and agricultural practices	Middle Fork and north side tributaries below Highway 395 (1), Long Cr (1), Slide Cr (2)	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices	Abundance, productivity	Fry and 0+	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore native upland plant communities	SWCD, USFS, BLM	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Long term	5-15 years	Moderate, depending upon which treatments are used to restore native plant communities, and whether appropriate short term restrictions on grazing are adopted
Upgrade or remove problem forest roads	USFS, ODF, ODOT	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, many forest roads have legacy issues with regard to sediment transport and routing of runoff. Decommissioning may take many years	15 years	Moderate, although funding on public lands and landowner cooperation on private lands will determine rate of treatment
Initiate upland improvement demonstration projects	ODFW, NOAA Fisheries, USFWS, USFS, BLM, CTWSRO, Watershed Councils, SWCDs	Ongoing	Entire subbasin	Long term	Variable lag time	Unknown, depends upon action taken as a result of being more informed
Manage vegetation, including juniper removal	USFS, BLM, NRCS, SWCDs, Watershed Councils	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Juniper control can be done quickly, other strategies such as control of invasive plants may take more than 20 years	5-30 years	Moderate

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
Demonstration projects to restore forest health and resilience to wildfire	ODF	Ongoing	Private and state forest lands	Long term	Variable 5-20 years	Moderate
Employ BMPs to forest practices including fuels management and fire suppression mitigation; livestock grazing; roads; and agricultural practices	SWCD, USFS, ODA, CTWSRO, BLM, private landowners	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, dependent on implementation of Agricultural Water Quality Management Plans	0-20,years, depending upon treatments applied	Moderate, dependent upon voluntary landowner participation

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
NRCS/Farm Service Agency	CRP	Long Creek, Basin Creek	No	Program needs expansion.
SWCDs	Juniper control	Long Creek, Basin Creek	No	More areas need treatment, rate of treatment restrictive.
ODFW	Green Forage	Long Creek, Basin Creek	No	Very small program.
USFS/BLM	Forest Plan, PACFISH, Resource Management Plan	Federal lands within the Middle Fork watershed	Uncertain	See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005). See discussion in Gaps commentary below.
ODF	Private land protection from fire, Private Forest Program	Private and state forestlands throughout population		See State of Oregon programmatic review -- Appendix F.
ODF	Oregon Forest Practices Act	Private and state forest lands		See State of Oregon programmatic review -- Appendix F.
ODA	Agricultural Water Quality Management Program	Private lands within the Middle Fork watershed		See State of Oregon programmatic review -- Appendix F.
CTWSRO	Watershed Restoration	Oxbow and Forrest Ranch properties	Likely where implemented	Could be expanded.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
See Strategy 8, Lower Mainstem John Day River population for further discussion. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed. Implementation of PACFISH standards and guides for Forest and BLM programs, has been highly successful for passive upland restoration over most of this population's area.

9.3.8 Habitat Strategies and Actions for South Fork John Day River Steelhead Population

Primary limiting factors: altered sediment routing, degraded channel structure and complexity (habitat quantity and diversity), altered hydrology and low flow, water temperature, and impaired fish passage.

Primary threats: riparian disturbance, stream channelization and relocation, grazing, forest practices, road building, fish passage barriers (culverts, and other seasonal barriers), and irrigation withdrawals.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

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Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Protect high quality habitats through acquisition or conservation easements	Lower Murderers Cr tributaries draining the south side of Aldrich Mountain: Todd (1), Cabin (1), Dry Cabin (1), Duncan (1) and Dry Duncan (1); Black Canyon Cr (1); mainstem South Fork, north boundary of PW Schneider WMA to Izee Falls (2)	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing,	Many threats including livestock overgrazing of riparian area, channelization, stream bank armoring, agricultural practices (fertilizers, herbicides, sediments, changes in plant communities), water withdrawals, loss of beaver dams	Productivity, abundance	Primarily fry and 0+	Protecting base streamflows from further appropriations is a very important function of protecting existing high quality habitats. Protection of high quality habitats is the most cost effective way of ensuring fish have good quality habitat. Land acquisitions, easements, and cooperative agreements may also facilitate the implementation of active restoration projects.
Adopt and manage Cooperative Agreements	South Fork, north boundary of PW Schneider WMA to Dayville (1); South Fork above Izee Falls (2)	Same as above	Same as above	Productivity, abundance	Primarily fry and 0+	
Special management designations in forest and BLM plans	Public lands as identified in Forest Plan Revision	Same as above	livestock overgrazing of riparian area, changes in plant communities	Productivity, abundance	Primarily fry and 0+	
Designate additional wilderness and wild and scenic status	Public lands identified as meeting the criteria during the Forest Plan Revision process	Same as above	livestock overgrazing of riparian area, changes in plant communities	Productivity, abundance	Primarily fry and 0+	
Protect access to key habitats	Black Canyon Cr (1)	Passage barriers, altered hydrology, channel structure		Productivity, abundance, distribution	Primarily fry and 0+	Thoroughly review projects that may block fish passage. Current ODFW policy is to grant exemptions from fish passage requirements only if mitigation meets or exceeds the loss of habitat. Exemptions must be approved by the Fish and Wildlife Commission

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes	Population-wide	All	Same as above	Productivity, abundance	Primarily fry and 0+	

Action Implementation

Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Protect the highest quality habitats through acquisition or conservation easements	CTUIR, TNC, RMEF, John Day Basin Trust, SWCDs, CTWSRO, USFS, ODFW	Ongoing	Water quality improvement have high dispersal downstream, stream corridor and function improvements would be confined to the specific site	Existing conservation agreements are complete. Full implementation of conservation measures will take 5-15 years or more	5-15 years with passive restoration approaches	High, based on previous cooperative agreements
Adopt and manage Cooperative Agreements	ODFW, SWCDs, FSA	Ongoing	Same as above	Agreements are for 10 to 15 years	Immediate	High, although not in perpetuity
Special management designations in forest and BLM plans	USFS, BLM	Ongoing as identified	Same as above	Many complete, potentially subject to change in Forest Plan revisions	Immediate	High, although subject to change from Forest Plan or mgmt plan revision
Designate additional wilderness and wild and scenic status	Public lands identified as meeting the criteria in the Forest Plan Revision process and BLM Resource Management Plan revision.	Same as above	livestock overgrazing of riparian area, changes in plant communities	Immediate depending on socio-political acceptance	5-15 years	High
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	NRCS, SWCDs, USFS, ODFW, ODF, DSL, BLM, ODOT, CTWSRO, ODA, FSA, private landowners	Ongoing	Population-wide	Long term	5-15 years	High

Status of Existing Programs through which Actions are Implemented

Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
USFS, BLM	Wilderness Areas, Wilderness Study Areas, Wild and Scenic River corridors, Special Management designations, PACFISH	Black Canyon, SF Wild and Scenic Corridor, and other FS and BLM lands	Yes, PACFISH standards are good, but implementation is inconsistent between forests. See discussion below.	See USFS/BLM Program Sufficiency Assessment -- Appendix E.
ODFW	Cooperative Agreements and PW Schneider Wildlife Management Area	Murderers Creek, SF John Day between Murderers Cr and Dayville, Upper SF on private lands	No	The agreements are for only 10-15 years and need to be for longer time periods.
FSA	CREP	Upper SF John Day	No	The agreements are for only 10-15 years and need to be for longer time periods.
NGOs	Lease or purchase of lands or instream water rights	None currently identified	Yes, although limited by acceptance from landowners	Important to secure critical habitat and/or water rights when opportunities arise.
ODA	Agricultural Water Quality Management Program	Private lands, primarily in upper SF (above Izee Falls)		See State of Oregon programmatic review -- Appendix F.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.				
CTWSRO	Watershed Restoration	Upper SF in cooperation with SWCD	Yes	Funding uncertain.
ODF	Oregon Forest Practices Act	Private and state owned timberlands	Likely	See State of Oregon programmatic review -- Appendix F.
Local Government	City and County Planning and Zoning	Private lands	Likely, riparian setbacks are sufficient when enforced	Monitoring of compliance needs to be increased.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Federally designated Wild and Scenic River reaches include the South Fork John Day River from Smokey Cr (RM 6.5) to the Malheur National Forest boundary (RM 52.5). State designated reaches include the South Fork from the PW Schneider Wildlife Management Area Boundary (RM 5.5) to County Road 63 (RM 35). Although wild and scenic designation does not preclude development, it requires development to be consistent with protecting the ORVs for which the river was designated, requires review of any activity that may affect ORVs within the ¼ mile river corridor, and protects the free flowing condition of the river. Designation as W&S essentially precludes construction of any major dam. A Management Plan was adopted by BLM and Oregon State Parks Department in 2001 for the designated rivers segments. Implementation of all the actions identified in the plan will likely take many years; however, grazing management plans for most of the allotments within corridor are complete. BLM allotment plans are complete. One of the reasons for purchase of ODFW's Philip W. Schneider Wildlife Management Area in the South Fork John Day River subbasin was for its value as a steelhead spawning and rearing area. The mixture of BLM and ODFW owned lands, along with the adjoining Malheur National Forest lands are under a Coordinated Resource Management Plan (CRMP). The mainstem South Fork John Day River, which runs through the CRMP lands, has shown remarkable riparian recovery in the last 30 years, with 100% canopy closure on some reaches. Unfortunately several of the tributaries have not benefited as much from the same management strategy. Wilderness designation essentially prevents any development and offers the greatest opportunity for protection of high quality habitat. Wilderness areas within the South Fork population boundary include, Black Canyon Wilderness (13,400 acres). Other special designated areas include the Utley Butte and Dry Cabin wildlife emphasis areas. Implementation of PACFISH standards and guides for most Forest and BLM programs has been highly successful over most of this population's area, but implementation of PACFISH Standards and Guides for FS grazing management programs remains challenging in some locations. See Strategy 1, Lower Mainstem John Day River population for further discussion.				

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Remove or minimize use of push up dams	South Fork John Day River mainstem (1); Wind Cr (2)	Impaired fish passage	Push up dams	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	Push up dams in the South Fork mainstem are scheduled for replacement within the next year. Annual maintenance and construction of push up dams contributes to onsite and downstream channel stability, loss of pools and other structure, and increased sediment loads.
Remove or replace barriers blocking passage such as dams, road culverts and irrigation structures	Culverts on Deer, Murderers (1), SF Murderers (2), Tex (1) and Thorn (2) crs; head cut on SF Murderers Cr (1) A total of 74 culverts need replacement (see Appendix G).	Impaired fish passage	Dams, culverts, instream structures	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	
Construct ladders over existing permanent concrete or earth fill dams	None identified below Izee Falls	Impaired fish passage	Dams	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
Provide screening at 100% of irrigation diversions	South Fork below PW Schneider boundary (1)	Impaired fish passage	Irrigation diversions	Abundance, productivity, spatial structure	Emergent fry	All known diversions in the drainage area currently screened.
Replace screens that do not meet criteria	South Fork John Day River (1)	Impaired fish passage	Irrigation diversions	Abundance, productivity, spatial structure	Emergent fry	Most irrigation diversions are in the Upper John Day drainage and it has been the major emphasis for replacement of screens not meeting criteria.

Action Implementation

Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Remove or minimize use of push up dams	SWCD	Ongoing	Provide access to upstream habitat	Ongoing, but all push up dams not expected to be corrected for at least 15 years	Immediate	High, if comply with fish passage design criteria
Remove or replace barriers blocking passage -- dams, road culverts and irrigation structures	USFS, BLM, watershed councils, SWCDs, ODOT	Ongoing	Access to upstream habitat	Ongoing, replacing all culverts blocking fish passage expected to take 50 years (see Appendix G)	Immediate	High, if comply with fish passage design criteria
Construct ladders over existing permanent concrete or earth fill dams	ODFW, SWCDs	Ongoing	Provide access to upstream habitat	Ongoing, providing passage at all diversion and pond barriers will take many years (none below Izee falls)	Immediate	High if comply with fish passage design criteria
Provide screening at 100% of irrigation diversions	ODFW, SWCDs	Ongoing	At point of diversion	No screening currently needed	Immediate	High if comply with fish passage design criteria
Replace screens that do not meet criteria	ODFW	Ongoing	At point of diversion	Approximately four screens need to be replaced	Immediate	High if comply with fish passage design criteria

Status of Existing Programs through which Actions are Implemented

Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
Soil and Water Conservation Districts	Irrigation dam improvements, culvert replacement or retrofits	Private land on SF John Day and tributaries below Izee Falls		The Grant Soil and Water District is constrained by the construction window of opportunity. See State of Oregon programmatic review -- Appendix F.
ODFW	Fish Passage/Screening	Private and state owned lands on SF John Day and tributaries below Izee Falls	Likely	The program completes a minimum of one project per year, but is dependent upon landowner cooperation and limited funding. No screen upgrades currently identified.
USFS, BLM	Culvert replacement	Federal lands, BLM previously corrected the Smokey Creek culvert. The BLM has no adult barriers at culverts. Monitoring is needed to determine if upstream passage for juveniles is an issue.	Uncertain	Slow pace will take 50 years to complete. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005). See discussion in Gaps commentary below.
Watershed Councils	Road Crossing Passage improvements, passage improvements	Private land on SF John Day and tributaries below Izee Falls	No	Program needs expansion.
BOR	John Day Basin Program	Private land on SF John Day and tributaries below Izee Falls	Yes	No

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.				
CTWSRO	John Day Basin Program	Private land on SF John Day and tributaries below Izee Falls in cooperation with SWCD	No	The tribe contracts with Soil and Water Districts to assist with consultation, permits, and monitoring, program needs additional resources.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
See discussion in Strategy 2, Lower Mainstem John Day River population. Most of the mainstem passage problems have been addressed, but there are many tributaries where adult passage is blocked and more areas where juvenile passage problems occur. Soil and Water Districts are correcting passage at irrigation diversions and improperly installed culverts, but are constrained by funding and by personnel needed for construction oversight. An inventory of road crossings on state and county roads in 1999 indicated no culverts on state owned roads and 10 culverts on county owned roads did not meet fish passage criteria within the South Fork population boundary. Appendix G presents an inventory of culverts with known passage problems on state or county owned roads. The US Forest Service and BLM are constrained primarily by funding and the personnel needed for NEPA analysis. At the current rate of culvert replacements it will take over 50 years to correct all passage problems on National Forests, however the Forest Service Pacific Northwest Region's Aquatic Restoration Strategy (USDA-FS, 2005) provides guidance that will help prioritize culvert replacements for this population. The BLM has no adult barriers at culverts. Monitoring is needed to determine if upstream passage for juveniles is an issue.				

Strategy 3. Maintain and restore floodplain connectivity and function.

Strategy 3. Maintain and restore floodplain connectivity and function.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Reconnect floodplains to channels	Murderers Cr, Chickenhouse Gulch to Todd Cr (2); South Fork mainstem, Izee Falls upstream to Malheur NF boundary (1)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	Primarily, fry and 0+.	The upper South Fork from Indian Cr upstream to the Malheur NF boundary is no longer connected to its floodplain and is deeply incised. Although this is above steelhead distribution, it would have substantial benefits to steelhead rearing in the SF below Izee Falls.
Reconnect side channels and off-channel habitats to stream channels	Murderers Cr, Chickenhouse Gulch to Todd Cr (2); South Fork mainstem, Izee Falls upstream to Malheur NF boundary (1)	Degraded floodplain, altered hydrology	Removal of side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity, spatial structure	Primarily, fry and 0+.	There has been a loss of off-channel and side-channel habitats that once provided habitat for spawning and rearing, and refugia from high flows.
Restore wet meadows	SF Murderers (1); Murderers (2); Upper Deer Cr. (1)	Degraded floodplain, altered hydrology	Removal of wetlands	Abundance, productivity	Primarily, fry and 0+.	
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes	Murderers Cr, Chickenhouse Gulch to Todd Cr (2); South Fork mainstem, Izee Falls upstream to Malheur NF boundary (1); SF Murderers (1); Wind (2); and Deer (1) crs	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat	Abundance, productivity, spatial structure	Primarily, fry and 0+.	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Reconnect floodplain to channel	ODFW, watershed council, SWCD, USFS, BLM	Ongoing	For the treated stream reach	Short term, once identified	Physical response will be immediate, biological response may take 5-10 years	High

Strategy 3. Maintain and restore floodplain connectivity and function.						
Reconnect side channels and off-channel habitats to stream channels	ODFW, watershed council, SWCD, USFS, BLM, CTUIR	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Long term, because of widespread need	5-15 years, depending upon frequency and duration of channel altering flows	Moderate, depends on how extensive the project is and frequency and duration of channel altering flows
Restore wet meadows	TNC, USFS, CTWSRO	Ongoing and planned	Benefits of improved channel morphology localized, improved water table and resulting increased streamflow and lower water temperatures have high dispersal downstream	Intermediate	5-15 years	Moderate
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	ODFW, CTWSRO, USFS, BLM	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Long term, due to acceptance by landowners and widespread need	Within 5 years once the dams are built	Moderate-high, depends upon acceptance by landowners

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program	Private and state owned lands on SF John Day above Izee Falls, SF John Day below Izee Falls, Murderers Cr	No	Sufficient approach, resource limited.
USFS, BLM	Stream enhancement program	SF John Day and tributaries above and below Izee Falls on Federal land. Only when specifically identified that passive restoration is not working.	Yes in some areas, no in others	The USFS preferred strategy is passive restoration; managing riparian areas to protect channel-forming processes. May need expansion. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005). See discussion in Gaps commentary below.
Watershed Councils	Watershed restoration	Private lands on SF John Day and tributaries above Izee Falls	Uncertain	Active approaches only if specific needs cannot be addressed by passive restoration techniques.
Soil and Water Conservation Districts	Watershed restoration	Private lands on SF John Day and tributaries above and below Izee Falls		Active approaches only if specific needs cannot be addressed by passive restoration techniques.
Nature Conservancy and other NGOs	Restoration projects	None currently identified	Uncertain	Needs expansion.
CTWSRO	Watershed restoration	Private lands in SF John Day and tributaries above and below Izee Falls in cooperation with SWCD and Watershed Council	Likely	Could be expanded to other areas.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural channel form	Murderers Cr, Chickenhouse Gulch to Todd Cr (2); South Fork mainstem, Izee Falls upstream to Malheur NF boundary (1)	Degraded channel structure and complexity, habitat diversity, riparian area degradation, connectivity with floodplain, sediment routing, water temperature, flows	Stream channelization, bank armoring, large wood removal, beaver removal, removal of riparian vegetation, livestock overgrazing in riparian areas	Abundance, productivity	Primarily eggs, fry and 0+.	The upper South Fork from Indian Cr upstream to the Malheur NF boundary is no longer connected to its floodplain and is deeply incised.
Place stable wood and other large organic debris in streambeds and in floodplains	Murderers Cr, Chickenhouse Gulch to Todd Cr (1); South Fork mainstem, Izee Falls upstream to Malheur NF boundary 92); Deer (1); SF Murderers (1)	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	large wood removal channelization	Abundance, productivity	Primarily eggs, fry and 0+.	More active restoration techniques, such as rootwad placement or channel reconfiguration, may be appropriate in these reaches. Typical structures include rootwads, boulder clusters, whole trees, and rock weirs where appropriate.
Stabilize streambanks	South Fork mainstem from Izee Falls upstream to Malheur NF boundary (1)	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	Stream channelization, berming, bank armoring, overgrazing in riparian areas	Abundance, productivity	Primarily eggs, fry and 0+.	Some bank erosion is inevitable and beneficial. However, where erosion is actively taking place due to unnatural processes, stabilization may be needed to reduce fine sediments

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural channel form	ODFW, SWCDs, USFS, BLM, watershed councils	Ongoing and planned	For the treated stream reach	Short term, once identified	Physical response will be immediate, biological response may take 5-10 years	High
Place stable wood and other large organic debris in streambeds and in floodplains	ODFW, USFS, watershed councils, BLM, SWCDs	As needed	For the immediate stream reach	Once identified, short term	Immediate	High
Stabilize streambanks	ODFW, USFS, watershed councils, BLM, SWCDs	Ongoing	For the treated stream reach, physical benefits dispersed downstream	Passive stabilization techniques are preferred and take longer to implement	With passive restoration the response may take 15 years	Medium to high, depending upon the extent of the treatments

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program	None currently identified.	No	When specific needs cannot be addressed by passive restoration techniques.
USFS, BLM	Stream enhancement program	Deer, Wind and Murderers creeks on Federal lands, but only	Yes in some areas, no in others	The USFS preferred strategy is passive restoration; managing riparian areas to protect channel-forming

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.				
		when specifically identified as deficient in habitat diversity and that passive restoration is not working		processes. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005). See discussion in Gaps commentary below.
Watershed Councils	Watershed restoration	None currently identified.	Uncertain	Only if specific needs cannot be addressed by passive restoration techniques.
Soil and Water Conservation Districts	Watershed restoration	None currently identified.		See State of Oregon programmatic review -- Appendix F.
CTWSRO	Watershed restoration	None currently identified.	Uncertain	No opportunities currently identified.
NGOs	Watershed restoration	None currently identified.	Uncertain	No opportunities currently identified.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Instream activities have not been identified as a high priority by the recovery planning team or the subbasin plan team except when identified as a need for specific sites. The planning team prefers that more passive approaches, such as riparian and upland improvements be emphasized. Typically, instream activities that would improve floodplain function and channel migration processes would include placement of rootwads, whole trees, or boulder clusters to improved habitat complexity and habitat diversity where those parameters are deficient and not expected to improve with passive restoration. Another structural activity would be to construct boulder or log weirs to raise the water table, but only where a passive approach has not worked. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.				

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural riparian vegetative communities including vegetative planting	mainstem South Fork John Day above Izee Falls (1); Murderers Cr between the lower USFS boundary up to Tex Cr (2); SF Murderers (1); Deer Cr, mouth to headwaters (1)	Degraded riparian area, channel structure and complexity, floodplain degradation, altered hydrology, sediment, water quality	Overgrazing of riparian area, channelization, stream bank armoring, tree harvest in riparian areas, changes in plant communities (including invasive plants), loss of beaver dams	Abundance, productivity	Primarily fry and 0+	Primary methods of riparian enhancement include riparian corridor fences to exclude livestock, changes in grazing management that promote riparian recovery, and planting of native shrubs.
Develop grazing strategies that promote riparian recovery	mainstem South Fork John Day above Izee Falls (1); Murderers Cr between the lower USFS boundary up to Tex Cr (2); SF Murderers (1); Deer Cr, mouth to headwaters (1)	Same as above	Livestock overgrazing of riparian area	Abundance, productivity	Primarily fry and 0+	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural riparian vegetative communities	ODFW, Watershed Councils, SWCDs, USFS, BLM, CTUIR	Ongoing	Riparian function will be limited to specific reach; water quality	Long term because of widespread need	5-15 years	High, based upon experience with existing grazing

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
			benefits will have high dispersal downstream from site			management and riparian recovery projects
Develop grazing strategies that promote riparian recovery	NRCS, AFS, USFS, BLM, SWCDs, ODFW, Watershed Councils, CTUIR	Ongoing	Riparian function will be limited to specific reach; water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years, depending upon grazing plan adopted. Riparian corridor fencing and removal of riparian grazing has the fastest recovery rate.	High, based upon experience with existing grazing management and riparian recovery projects

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program	Indian and Murderers creeks, SF John Day below Izee Falls	No	Limited by resources.
SWCDs	Upland improvements, riparian improvements	Private lands on SF John Day and tributaries above and below Izee Falls. Active program on SF above Izee Falls		See State of Oregon programmatic review -- Appendix F.
Watershed Councils	Upland improvements, riparian improvements	Private lands on SF John Day and tributaries above Izee Falls	No	Resource limited.
USFS, BLM	Upland improvements, riparian improvements	Federal lands on SF John Day and tributaries above and below Izee Falls. Murderers and Wind creeks	Likely	See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005). See discussion in Gaps commentary below.
NRCS	Upland improvements, riparian improvements	Indian Creek, SF John Day above Izee Falls	Yes	Program sufficient.
ODA	Agricultural Water Quality Management Program	SF John Day above Izee Falls		See State of Oregon programmatic review -- Appendix F.
CTWSRO	Watershed restoration	Private lands on SF John Day and tributaries above and below Izee Falls in cooperation with SWCD and Watershed Council	Uncertain	Limited opportunities currently identified for this program.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

See discussion for Strategy 5, Lower Mainstem John Day River population.

In the last 20+ years ODFW, Watershed Councils, NRCS and Soil and Water Districts have implemented hundred of miles of riparian improvements on private lands, primarily through construction of riparian corridor fences that exclude livestock grazing, and development of off channel watering devices. Public land managers have implemented PACFISH standards for protection and restoration of USFS and BLM lands. Implementation of PACFISH standards and guides for most Forest and BLM programs has been highly successful over most of this population's area, but implementation of PACFISH Standards and Guides for FS grazing management programs remains challenging in some locations. The Forest Services Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed. Primary constraints on implementing additional projects for more riparian improvements are funding and personnel needed for planning, promotion, education of landowners, and implementation.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Implement agricultural water conservation measures	Mainstem South Fork John Day above Izee Falls (1); Murderers Cr between the lower USFS boundary up to Tex Cr (2); SF Murderers (1); Deer Cr, mouth to headwaters (1)	Altered hydrology, low flows, high temperatures	water withdrawals, land conversion on uplands, road network	Abundance, productivity	Primarily fry and 0+	The lower and upper mainstem South Fork John Day is used extensively for irrigation purposes, small diversions are present on Wind and Murderers crs
Improve irrigation conveyance and efficiency	South Fork John Day River below PW Schneider WMA boundary (1); Upper South Fork John Day River (1); Wind (2) and Murderers (2) crs	Low flows, high temperatures	Water withdrawals, loss during conveyance	Abundance, productivity	Primarily fry and 0+	
Increase pool habitat (beaver ponds)	Lower South Fork John Day River (2); Upper South Fork John Day River (1); Wind (2); Deer (1); SF Murderers (1); and Murderers (1) crs	Habitat complexity		Abundance, productivity	Primarily fry and 0+	
Floodplain aquifer recharge		Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily fry and 0+	
Lease or acquire water rights and convert to instream	Lower South Fork John Day River (2); Upper South Fork John Day River (1); Wind (2) and Murderers (2) crs	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily fry and 0+	
Monitor/regulate water withdrawals	All MaSAs	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily fry and 0+	
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs	Population-wide	Low flows, high temperatures	Water withdrawals	Abundance, productivity, spatial structure, diversity	All stages	New programs in development

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Implement agricultural water conservation measures	SWCD, watershed councils, NRCS	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and dependent upon landowner willingness to participate and availability of projects	Immediate	High, if the saved water is protected from being appropriated to a downstream user in areas with instream water rights
Improve irrigation conveyance and efficiency	SWCD, OWEB, watershed councils, NRCS, landowners	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and dependent upon landowner willingness to participate and availability of	Immediate	High, if the saved water is protected from being appropriated to a

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
				projects		downstream user in areas with instream water rights
Increase pool habitat (beaver ponds)	SWCD, ODFW, CTWSRO, USFS, BLM	Ongoing	High dispersal downstream	Unknown	Immediate increase in instream flow	High
Floodplain aquifer recharge	CTWSRO, SWCDs	Planned, some ongoing	Potentially high dispersal from recharge project site downstream for many miles	Long term, although opportunities for pilot projects is dependent upon willing landowner	Immediate	High, if the additional water is protected from being appropriated to a downstream user in areas with instream water rights
Lease or acquire water rights and convert to instream	OWRD, FSA, OWEB, Oregon Water Trust, others	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and highly dependent upon landowner willingness to lease.	Immediate	High, if the leased water is protected from being appropriated to a downstream user in areas with instream water rights. FSA pays higher rates for CREP enrollment when water rights are leased for instream use.
Monitor/regulate water withdrawals	OWRD	Ongoing	Point of diversion downstream to mouth of John Day River	Long term, dependent upon OWRD enforcing the requirement to measure water usage	Immediate	High if water user reporting requirement and installation of measuring devices on diversions is implemented
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs	OWRD	Ongoing	Population-wide	2007-2009 except incentive funding ongoing	Long term	Moderate

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program, riparian improvements	Private land on SF John Day above Izee Falls, private and state lands on Murderers and Indian creeks	No	Limited by resources.
OWRD	Streamflow Monitoring and Restoration, Flow Restoration, Lease/Transfer Water Rights, Administration of Water Rights, Water Use Measurement, Water Needs Assessment, Storage Assessment, Conservation Assessment	SF John Day and tributaries where irrigation withdrawals occur		See State of Oregon programmatic review -- Appendix F.
Oregon Water Trust and BOR	Leasing and Purchase of Water Rights	None currently identified, dependent upon cooperating landowner	No	No program currently active.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.				
Soil and Water Conservation Districts	Improve irrigation efficiency, upland improvements, riparian improvements	Private lands on SF John Day and tributaries above and below Izee Falls		Could increase in scope.
Watershed Councils	Upland improvements, riparian improvements	SF John Day above Izee Falls	No	Needs expansion.
NRCS	Upland improvements, riparian improvements	SF John Day above Izee Falls	No	Needs expansion.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Approximately 22 miles of stream in the South Fork are protected with either existing or pending instream water rights. The instream water rights do not preclude further appropriation of water until flows in the affected reach drop down to the instream water rights as adopted by OWRD. Voluntary efforts restored 0.6 cfs instream in 2006. See Strategy 6, Lower Mainstem John Day River population for further discussion.				

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Increase riparian shading	Upper South Fork and tributaries above Izee Falls (1); Lower South Fork near the town of Dayville (2); Deer (2); SF Murderers (1); Murderers (2) crs	High water temperatures	Degraded riparian forests	Abundance, productivity	Primarily fry and 0+	Elevated water temperature is a pervasive water quality problem for the South Fork John Day River population, with 6 stream reaches listed as water quality limited. Additional reaches would probably be listed if water temperature data were available.
Manage return flow to reduce extreme stream temperatures	Upper South Fork and tributaries above Izee Falls (1); Lower South Fork near the town of Dayville (2); Wind (2) and Murderers (1) crs	High water temperatures	Water withdrawals	Abundance, productivity	Primarily fry and 0+	
Reduce chemical pollution and nutrient inputs	Upper South Fork and tributaries above Izee Falls (1); Lower South Fork near the town of Dayville (2)	Chemical pollution	Pesticides, fertilizers, herbicides, vehicle hydrocarbons, etc.	Abundance, productivity	Primarily fry and 0+	Using more efficient irrigation methods, which reduces the amount of surface water returning to the stream, should result in fewer nutrients from pastures reaching the South Fork John Day River and tributaries. Reducing nutrient loads will contribute to increased water quality by reducing biological oxygen demand and algae blooms.
Apply BMPs to animal feeding operations	South Fork John Day River above Izee Falls (1)	Degraded water quality	Animal feed operations	Abundance, productivity	Eggs, fry, juveniles	
Continue TMDL monitoring	Upper South Fork and tributaries above Izee Falls (1) Lower South Fork near the town of Dayville (2)	Degraded water quality, sediment routing	Land use practices, water withdrawals, pesticides, fertilizers, herbicides	Abundance, productivity	Primarily fry and 0+	

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
Action Implementation						
Actions	**Implementing Entity**	**Status**	**Spatial Coverage**	**Implementation Timeframe**	**Expected Biophysical Response Timeframe**	**Certainty of Outcome**
Increase riparian shading	ODFW, Watershed Councils, SWCDs, USFS, BLM, CTUIR	Ongoing	water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years	High
Manage return flow to reduce extreme stream temperatures	SWCDs, watershed councils	Ongoing	Water quality improvement would have high dispersal downstream	Less than 5 years, once the project has been identified	Immediate	High, reduced temperatures has been well documented
Reduce chemical pollution and nutrient inputs	ODEQ, others	Ongoing		Ongoing	Reduce chemical pollution immediately	High
Apply BMPs to animal feeding operations	ODA	Ongoing	Water quality improvement would have high dispersal downstream	Some treatments could be done immediately. There are few animal feeding operations within the subbasin, only one of which has been identified as a problem	5-15 years	High, once a treatment has been agreed upon
Continue TMDL monitoring	USFS, ODFW, SWCD, ODEQ	Ongoing	Subbasin-wide	Ongoing	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	**Program Name**	**Geographic Locations**	**Sufficient* (yes, likely, uncertain, no)**	**Sufficiency Rationale**
FSA	CREP, CRP	Private lands on SF John Day above Izee Falls	No	Could be expanded with additional funding.
ODA	Confined animal feeding operations (CAFO), AgWQM	SF John Day above Izee Falls		See State of Oregon programmatic review -- Appendix F.
ODEQ, ODA, SWCD, USFS	Sedimentation Monitoring (TMDL Development and Implementation)	Throughout SF John Day watershed		See State of Oregon programmatic review -- Appendix F. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005). See discussion in Gaps commentary below.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

Low streamflows during the hottest part of the year exacerbate the already warm water temperatures. Opportunities for increasing streamflow through leasing of water rights, which often results in cooler water over a longer stream reach, are being pursued by Oregon Water Trust and US Bureau of Reclamation. Constraints for future projects include acceptance by landowners and a secure, long term funding source.

The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritization restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.

Reducing water temperatures through the use of improved riparian vegetation and more efficient methods of irrigation may take several years to provide measurable results. Many projects that improve water quality by reducing irrigation return water have been completed.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore native upland plant communities	South Fork mainstem above Izee Falls (1); Deer Cr (1); Murderers Cr (1)	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices, loss of water storage capacity	Abundance, productivity	Primarily fry and 0+	Upland improvements such as restoring native plant communities and controlling invasive weed species will improve precipitation infiltration rates and ultimately improve watershed health, including the hydrograph.
Upgrade or remove problem forest roads	Forest lands	Same as above	Road network	Abundance, productivity	Primarily fry and 0+	
Initiate upland improvement demonstration projects	South Fork mainstem above Izee Falls (1); Deer Cr (2); Murderers Cr (1)	Same as above	Upland land use practices	Abundance, productivity	Primarily fry and 0+	
Manage vegetation, including juniper removal	South Fork mainstem above Izee Falls (1); Deer Cr (2); Murderers Cr (1)	Altered hydrology, sediment routing	Invasive plants	Abundance, productivity	Primarily fry and 0+	
Demonstration projects to restore forest health and resilience to wildfire	Private and state forest lands	Altered hydrology, sediment, water quality, riparian functions, LWD recruitment	Conversion of vegetative communities	Abundance, productivity	All	Suppression of fires has altered fire regimes and increased threat of high intensity fires.
Employ BMPs to forest practices including fuels management and fire suppression mitigation, livestock grazing, road management and agricultural practices	Throughout population	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices	Abundance, productivity	Primarily fry and 0+	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore native upland plant communities	SWCD, USFS, BLM	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Long term	5-15 years	Moderate, although funding on public lands and landowner cooperation on private lands will determine rate of treatment
Upgrade or remove problem forest roads	USFS, ODF, ODOT	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, many forest roads have legacy issues with regard to sediment transport and routing of runoff. Decommissioning may take many years	5-15 years	Moderate, although funding on public lands and landowner cooperation on private lands will

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
						determine rate of treatment
Initiate upland improvement demonstration projects	ODFW, NOAA Fisheries, USFWS, USFS, BLM, CTWSRO, Watershed Councils, SWCDs	Ongoing	Entire subbasin	Long term	Variable lag time	Unknown, depends upon action taken as a result of being more informed
Mange vegetation, including juniper removal	USFS, BLM, NRCS, SWCDs, Watershed Councils	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Juniper control can be done quickly, other strategies such as control of invasive plants may take more than 20 years	5-30 years	Moderate
Demonstration projects to restore forest health and resilience to wildfire	ODF	Ongoing	Private and state forest lands	Long term	Variable 5-20 years	Moderate
Employ BMPs to forest practices including fuels management and fire suppression mitigation, livestock grazing, road management and agricultural practices	SWCD, VSFS, ODA, CTWSRO, private landowners	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, dependent on implementation of Agricultural Water Quality Management Plans	0-20,years, depending upon treatments applied	Moderate, dependent upon voluntary landowner participation

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
NRCS/Farm Service Agency	CRP	Private lands on SF John Day and tributaries above Izee Falls	No	Could be expanded.
SWCDs	Juniper control	Private lands on SF John Day and tributaries above and below Izee Falls		Could be expanded.
ODFW	Green Forage	Private lands on SF John Day and tributaries above Izee Falls, PW Schneider WMA	No	Very small program.
USFS, BLM	Forest Plan, PACFISH	Federal lands	Likely	See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005). See discussion in Gaps commentary below.
ODF	Private land protection from fire, Private Forest Program	Private and state forestlands throughout population		See State of Oregon programmatic review--Appendix F.
ODF	Oregon Forest Practices Act	Private and state forest lands		See State of Oregon programmatic review--Appendix F.
ODA	Agricultural Water Quality Management Program	Private lands on SF John Day and tributaries above and below Izee Falls		See State of Oregon programmatic review--Appendix F.
CTWSRO	Watershed Restoration	Private lands on SF John Day and tributaries above Izee Falls in cooperation with SWCD and Watershed Council	Uncertain	Currently limited in scope.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
See discussion for Strategy 8, Lower Mainstem John Day River population. NRCS, SWCD and ODFW programs are relatively small, with the CRP program the largest and best funded. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed. Implementation of PACFISH standards and guides for Forest and BLM programs has been highly successful for passive upland restoration over most of this population's area. The limitations to all the programs are funding and, to a lesser extent, acceptance by landowners.

9.3.9 Habitat Strategies and Actions for Upper Mainstem John Day River Steelhead Population

Primary limiting factors: degraded channel structure and complexity (habitat quantity and diversity), degraded riparian areas and LWD recruitment, altered sediment routing, water temperatures, altered hydrology and degraded floodplain function and connectivity. Impaired fish passage is also a priority limiting factor in Beech and Laycock creeks.

Primary threats: agricultural practices, overgrazing by livestock, removal of large trees from the riparian corridor, wetland draining and conversion, stream channelization and diking, mining, and dredging.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Protect high quality habitats through acquisition or conservation easements	EF and Middle Fork of Canyon Cr (1), tributaries draining the north side of Strawberry Wilderness (2), upper McClellan Cr (tributary to John Day River) (2), McClellan Cr (tributary to EF Beech Cr) (2), upper Fields Cr (2), John Day River above Blue Mt. Hot Springs (1) and tributaries Rail (1), Roberts (1), Reynolds (1), Deardorff (1), and Call (1) crs.	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing,	Many threats including livestock overgrazing of riparian area, channelization, stream bank armoring, agricultural practices (fertilizers, herbicides, sediments, changes in plant communities), water withdrawals, loss of beaver dams	Productivity, abundance	Primarily fry and 0+	Protecting base streamflows from further appropriations is a very important function of protecting existing high quality habitats. Protection of high quality habitats is the most cost effective way of ensuring fish have good quality habitat. Land acquisitions, easements, and cooperative agreements may also facilitate the implementation of active restoration projects.
Adopt and manage Cooperative Agreements	Grub Cr (2), John Day River between John Day and Blue Mt. Hot Springs (1), Indian Cr (2), Beech Cr (2), Cummings Cr (2), Canyon Cr (1)	Same as above	Same as above	Productivity, abundance	Primarily fry and 0+	
Special management designations in forest and BLM plans	Riparian Habitat Conservation Areas identified in existing Forest Plans	Same as above	Livestock overgrazing of riparian area, changes in plant communities	Productivity, abundance	Primarily fry and 0+	
Designate additional wilderness and wild and scenic status	Public lands identified in the Forest Plan Revision process	Same as above	Livestock overgrazing of riparian area, changes in plant communities	Productivity, abundance	Primarily fry and 0+	
Protect access to key habitats	Mainstem John Day River above Prairie City (1)	Passage barriers, altered hydrology, channel structure	Irrigation withdrawals, channelization	Productivity, abundance, distribution	Primarily fry and 0+	Thoroughly review projects that may block fish passage. Current ODFW policy is to grant exemptions from fish

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
						passage requirements only if mitigation meets or exceeds the loss of habitat. Exemptions must be approved by the Fish and Wildlife Commission.
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	Population-wide	All	Same as above	Productivity, abundance	All	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Protect the highest quality habitats through acquisition or conservation easements	CTUIR, TNC, RMEF, John Day Basin Trust, SWCDs, USFS, CTWSRO, ODFW	Ongoing	Water quality improvement have high dispersal downstream, stream corridor and function improvements would be confined to the specific site	Existing conservation agreements are complete. Full implementation of conservation measures will take 5-15 years or more	5-15 years with passive restoration approaches	High, based on previous cooperative agreements
Adopt and manage Cooperative Agreements	ODFW, SWCDs, FSA	Ongoing	Same as above	Agreements are for 10 to 15 years	Immediate	High, although not in perpetuity
Special management designations in forest and BLM plans	USFS, BLM	Ongoing as identified	Same as above	Many complete, potentially subject to change in Forest Plan revisions	Immediate	High, although subject to change from Forest Plan or mgmt plan revision
Designate additional wilderness and wild and scenic status	Public lands identified in Forest Plan Revision	Same as above	livestock overgrazing of riparian area, changes in plant communities	Long term	Long term	High
Protect access to key habitats	ODFW, SWCD, Oregon Water Resources	Ongoing	Population-wide	Long term	Long term	Moderate
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes	NRCS, SWCDs, USFS, ODFW, ODF, DSL, BLM, ODOT, CTWSRO, ODA, FSA, private landowners	Ongoing	Population-wide	Long term	5-15 years	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
USFS, BLM	Wilderness Areas, Wilderness Study Areas, Wild and Scenic River corridors, Special Management designations, PACFISH	Strawberry Mt. Wilderness, scattered BLM parcels and Malheur National Forest	Yes, PACFISH standards are good, but implementation is inconsistent between forests. See discussion below.	See USFS/BLM Program Sufficiency Assessment -- Appendix E.
ODFW	Cooperative Agreements	Private lands on John Day River above John Day, Grub, Indian, Beech, and Canyon crs	No	The agreements are for only 10-15 years and need to be longer.
FSA	CREP	Private lands on John Day River above Dayville, Indian and Beech crs	No	The agreements are for only 10-15 years and need to be longer.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.				
NGOs	Lease or purchase of lands or instream water rights	Private lands on John Day River and tributaries above Dayville. Current conservation agreements exist on Dry and Widows creeks	Yes	Important to secure critical habitat and/or water rights as opportunities arise.
ODA	Agricultural Water Quality Management Program	Private lands on John Day River and tributaries above Dayville		See State of Oregon programmatic review -- Appendix F.
CTWSRO	Watershed Restoration	Forrest Ranch and private lands in cooperation with SWCD	Likely	Expand as opportunities arise.
ODF	Oregon Forest Practices Act	State and private timberlands		See State of Oregon programmatic review -- Appendix F.
Local Government	City and County Planning and Zoning	Private lands	Uncertain	
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Federally designated Wild and Scenic River reaches include the mainstem John Day from Tumwater Falls (RM 10) to Service Cr (RM 157). State designated reaches include the mainstem John Day from Tumwater Falls to Parrish Cr (RM 170). Implementation of PACFISH standards and guides for most Forest and BLM programs has been highly successful over most of this population's area, but implementation of PACFISH Standards and Guides for FS grazing management program remains challenging in some locations. The CTWSRO owns a mitigation property (3,365 acres) on the Mainstem John Day River above Prairie City that is managed for the benefit of fish and wildlife. See Strategy 1, Lower Mainstem John Day River population for further discussion.				

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Remove or minimize use of push up dams	Warrens (2), Bridge (2), Birch (2), Belshaw (2), Fields (1), Moon (2), McClellan (2), Beech (1), Canyon (1), Strawberry (1), Dixie (1), Isham (2), Dads (2), and Reynolds (1) crs.	Impaired fish passage	Push up dams	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	Push up dams are most common in the Upper John Day and tributaries. Annual maintenance and construction of push up dams contributes to onsite and downstream channel stability, loss of pools and other structure, and increased sediment loads.
Remove or replace barriers blocking passage such as dams, road culverts and irrigation structures	Irrigation or water storage related issues: Warrens (2), Bridge (2), Birch (2), Belshaw (2), Fields (1), Moon (2), McClellan (2), Beech (1), Canyon (1), Strawberry (1), Dixie (1), Isham (2), Dads (2), and Reynolds (1) crs Culverts: Canyon Cr and tributaries (1), Reynolds Cr (1), John Day River above Blue Mt Hot Springs (2), and Fields Cr (2) A total of 120 culverts have been identified in this population as needing replacement (see Appendix G)	Impaired fish passage	Dams, culverts, instream structures	Abundance, productivity, spatial structure	Primarily adults and 0+ juveniles	Push up irrigation dams, concrete diversions, in-channel stock ponds, and road culverts are located throughout the entire subbasin. Passage problems at culverts are widespread throughout all subbasins

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
Construct ladders over existing permanent concrete or earth fill dams	Beech Cr (1)	Impaired fish passage	Dams	Abundance, productivity, spatial structure	Primarily adults and 0+juveniles	Concrete structures are located primarily in the Rock Cr. (Lower John Day) drainage although there are a number of structures scattered throughout other parts of the subbasin, including Beech Cr. and Reynolds Cr.
Provide screening at 100% of irrigation diversions	Dans (2), Jeff Davis (2), Strawberry (2), Pine (1), Ingles (2), Moon (1), Canyon (1), Cummings (1), Widows (2), Laycock (1) crs	Impaired fish passage	Irrigation diversions	Abundance, productivity, spatial structure	Emergent fry, smolts	
Replace screens that do not meet criteria	Beech (1), Canyon (1), Dixie (2), Fields (1), Indian (1), Upper John Day River (1), Roberts (1) crs	Impaired fish passage	Irrigation diversions	Abundance, productivity, spatial structure	Emergent fry	Most migration diversions are in the Upper John Day drainage and it has been the major emphasis for replacement of non-criteria screens.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Remove or minimize use of push up dams	SWCD	Ongoing	Provide access to upstream habitat	Ongoing, but all push up dams not expected to be corrected for at least 15 years. A comprehensive survey has not been completed	Immediate	High, if comply with fish passage design criteria
Remove or replace barriers blocking passage -- dams, road culverts and irrigation structures	USFS, BLM, watershed councils, SWCDs, ODOT	Ongoing	Access to upstream habitat	Ongoing, replacing all culverts blocking fish passage expected to take 20 years (see Appendix G)	Immediate	High, if comply with fish passage design criteria
Construct ladders over existing permanent concrete or earth fill dams	ODFW, SWCDs	Ongoing	Provide access to upstream habitat	Ongoing, providing passage at all diversion and pond barriers will take many years	Immediate	High if comply with fish passage design criteria
Provide screening at 100% of irrigation diversions	ODFW, SWCDs	Ongoing	At point of diversion	Approximately 39 diversions need to be screened	Immediate	High if comply with fish passage design criteria
Replace screens that do not meet criteria	ODFW	Ongoing	At point of diversion	Approximately 47 screens need to be replaced, should take many years	Immediate	High if comply with fish passage design criteria

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
Soil and Water Conservation Districts	Irrigation dam improvements, culvert replacement or retrofits	Private lands on John Day R and steelhead bearing tributaries above Dayville		The Grant Soil and Water District is constrained by the construction window of opportunity.
ODFW	Fish Passage/Screening	Private lands on John Day R and steelhead bearing tributaries above Dayville	No	The program completes a minimum of one project per year, but is dependent upon landowner cooperation and limited funding
USFS, BLM	Culvert replacement	Federal lands on Canyon Creek, Little Pine have been recently emphasized, others may be identified	Uncertain	See USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005). See discussion in Gaps commentary below. The BLM has no adult barriers at culverts. Monitoring is needed to determine if upstream passage for juveniles is an issue.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.				
Watershed Councils	Road Crossing Passage improvements, passage improvements	Private lands on John Day R and steelhead bearing tributaries above Dayville	No	Yes
ODOT	Culvert replacement or retrofit	Pine and Beech creeks, others may be identified		See State of Oregon programmatic review -- Appendix F.
BOR	John Day Basin Program	As identified by SWCD, ODFW, and others	Yes	No
CTWSRO	John Day Basin Program	Private lands on John Day R and steelhead bearing tributaries above Dayville in cooperation with SWCD	No	Yes, the tribe contracts with Soil and Water Districts to assist with consultation, permits, and monitoring

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

Most of the mainstem passage problems have been addressed, but there are many tributaries where adult passage is blocked and more areas where juvenile passage problems occur. Irrigation dams, stock ponds, and road culverts are the primary causes of passage issues. In the Upper John Day subbasin, the Grant SWCD has implemented many passage improvement projects and currently has a waiting list of landowners who want them to correct passage problems at irrigation diversions on tributaries as well as the few remaining mainstem problem areas. The Grant SWCD is currently constrained by a relatively short in-water work period (4-6 weeks), so it will likely take another 10 years to address most of the tributary passage problems. Other Soil and Water Districts are also correcting passage at irrigation diversions and improperly installed culverts, but are constrained by funding and by personnel needed for construction oversight. An inventory of road crossings on state and county roads in 1999 indicated 14 culverts on state owned roads and 43 culverts on county owned roads within the Upper Mainstem John Day population boundaries did not meet fish passage criteria. Appendix G presents an inventory of culverts with known passage problems on state or county owned roads. Some of those culverts have been replaced with structures that do meet the fish passage criteria, but much work remains. Watershed councils and ODOT, who are the principal entities working on culverts are constrained primarily by funding. An inventory of road crossings on federal lands indicates juvenile passage problems are pervasive, particularly on National Forests, with approximately 54 culverts not meeting passage criteria in this population. The US Forest Service and BLM are constrained primarily by funding and the personnel needed for NEPA analysis. At the current rate of culvert replacements it will take over 50 years to correct all passage problems on National Forests, however, the Forest Service Pacific Northwest Region's Aquatic Restoration Strategy (USDA-FS, 2005) provides guidance that will help prioritize culvert replacements for this population. The BLM has no adult barriers at culverts. Monitoring is needed to determine if upstream passage for juveniles is an issue.Another constraint is that existing state laws do not require passage improvements at existing barriers unless there is a major change in the structure, such as reconstruction or significant modifications, so landowner cooperation is critical for improving passage throughout the subbasin.

See Strategy 2, Lower Mainstem John Day River population for further discussion.

Strategy 3. Maintain and restore floodplain connectivity and function.

Strategy 3. Maintain and restore floodplain connectivity and function.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Reconnect floodplains to channels	Mainstem John Day River from Dayville to Blue Mt. Hot Springs (1)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	Primarily fry and 0+	Restoring channel migration processes will require a landowner willing to sacrifice irrigated pastureland. Opportunities may be limited to property owned by CTWSRO, above Prairie City.
Reconnect side channels and off-channel habitats to stream channels	Mainstem John Day River from Dayville to Blue Mt. Hot Springs (1), Canyon (1), Indian (2), and Pine (2) crs	Degraded floodplain, altered hydrology	Removal of side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity, spatial structure	Primarily fry and 0+	There has been a loss of off-channel and side-channel habitats that once provided habitat for spawning and rearing, and refugia from high flows.
Restore wet meadows	Canyon (2), EF Beech (2), Upper Belshaw (1)	Degraded floodplain, altered hydrology	Removal of wetlands	Abundance, productivity	Primarily fry and 0+	

Strategy 3. Maintain and restore floodplain connectivity and function.						
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes	Canyon (1), Fields (1), Belshaw (2), Dixie (2), Strawberry (2)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat	Abundance, productivity, spatial structure	Primarily fry and 0+	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Reconnect floodplain to channel	ODFW, watershed council, SWCD, USFS, BLM	Ongoing	For the treated stream reach	Short term, once identified	Physical response will be immediate, biological response may take 5-10 years	High
Reconnect side channels and off-channel habitats to stream channels	ODFW, watershed council, SWCD, USFS, BLM, CTUIR	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Long term, because of widespread need	5-15 years, depending upon frequency and duration of channel altering flows	Moderate, depends upon how extensive the project is and frequency and duration of channel altering flows
Restore wet meadows	TNC, USFS, CTWSRO	Ongoing and planned	Benefits of improved channel morphology localized, improved water table and resulting increased streamflow and lower water temperatures have high dispersal downstream	Long term	5-15 years	Moderate
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes	ODFW, CTWSRO, USFS, BLM	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Long term, due to acceptance by landowners and widespread need	Within 5 years once the dams are built	Moderate-high, dependent upon acceptance by landowners

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program	Private lands on John Day River and tributaries above Dayville	No	Active measures used only if specific needs cannot be addressed by passive restoration techniques, program limited by funding.
USFS, BLM	Stream enhancement program	Federal lands on John Day River and tributaries above Dayville. Only when specifically identified that passive restoration is not working.	Yes in some areas, no in others due to limited funding	The USFS preferred strategy is passive restoration; managing riparian areas to protect channel-forming processes. May need expansion. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005). See discussion in Gaps commentary below.
Watershed Councils	Watershed restoration	Private lands on John Day River and tributaries above Dayville	Dependent upon need and funding	Active measures used only if specific needs cannot be addressed by passive restoration techniques, limited by funding.
Soil and Water Conservation Districts	Watershed restoration	Private lands on John Day River and tributaries above Dayville		See State of Oregon programmatic review -- Appendix F.

Strategy 3. Maintain and restore floodplain connectivity and function.				
Nature Conservancy and other NGOs	Restoration projects	None currently identified, but conservation easement exist on Dry and Widows creeks	Yes	No actions currently underway, should seek new opportunities.
CTWSRO	Watershed restoration	Forrest Ranch and private lands in cooperation with SWCD	Uncertain	Dependent on funding availability.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Bank stabilization using some rock is still infrequently occurring after high water events in the Upper John Day River, primarily along irrigated pastures. These bank stabilization projects have historically relied on riprap and large rock, however in recent years the high economic and ecological cost of bank armoring with riprap and of channelization has been recognized, so the emphasis has shifted toward a more passive approach for stabilization, primarily through riparian vegetation improvements. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.				

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural channel form	Mainstem John Day River from Dayville to Blue Mt. Hot Springs (1), Indian (1), Pine (1), lower Beech (1), lower McClellan (2), lower Moon (2), lower Laycock (2), middle Canyon (1), lower Fields (2), lower Strawberry (1), lower Dixie (2), lower Isham (2), lower Dans (2) crs	Degraded channel structure and complexity, habitat diversity, riparian area degradation, connectivity with floodplain, sediment routing, water temperature, flows	Stream channelization, bank armoring, large wood removal, beaver removal, removal of riparian vegetation, livestock overgrazing in riparian areas	Abundance, productivity	Primarily fry and 0+	Restoring channel migration processes will require a landowner willing to sacrifice irrigated pastureland. Opportunities may be limited to property owned by CTWSRO, above Prairie City.
Place stable wood and other large organic debris in streambeds	Mainstem John Day River from Dayville to Blue Mt. Hot Springs (2), Indian (1), Pine (1), lower Beech (1), lower McClellan (2), lower Moon (2), lower Laycock (2), middle Canyon (1), lower Fields (2), lower Strawberry (1), lower Dixie (2), lower Isham (2), lower Dans (2), crs	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	Large wood removal channelization	Abundance, productivity	Primarily fry and 0+	More active restoration techniques, such as rootwad placement or channel reconfiguration, may be appropriate in these reaches. Typical structures include rootwads, boulder clusters, whole trees, and rock weirs where appropriate.
Stabilize streambanks	Mainstem John Day River from Dayville to Blue Mt. Hot Springs (1), lower Beech (2), lower Indian (2),	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	Stream channelization, berming, bank armoring, overgrazing in riparian areas	Abundance, productivity	Primarily eggs, fry and 0+	Some bank erosion is inevitable and beneficial. However, where erosion is actively taking place due to unnatural processes, stabilization may be needed to reduce fine sediments.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural channel form	ODFW, SWCDs, USFS, BLM, watershed councils	Ongoing and planned	For the treated stream reach	Short term, once identified	Physical response will be immediate, biological response may take 5-10 years	High

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.						
Place stable wood and other large organic debris in streambeds	ODFW, USFS, watershed councils, BLM, SWCDs	As needed	For the immediate stream reach	Once identified, short term	Immediate	High
Stabilize streambanks	ODFW, USFS, watershed councils, BLM, SWCDs	Ongoing	For the treated stream reach, physical benefits dispersed downstream	Passive stabilization techniques are preferred and take longer to implement	With passive restoration the response may take 15 years	Medium to high, depending upon the extent of the treatments

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program	Private lands on John Day River and tributaries, once identified as deficient	No	Active measures used only if specific needs cannot be addressed by passive restoration techniques, program limited by funding.
USFS, BLM	Stream enhancement program	Federal lands on John Day River and tributaries, once identified as deficient. Only when specifically identified that passive restoration is not working.	Yes in some areas, no in others	The USFS preferred strategy is passive restoration; managing riparian areas to protect channel-forming processes. PACFISH BMPs are generally sufficient for passive restoration but active restoration funds are limited. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005). See discussion in Gaps commentary below.
Watershed Councils	Watershed restoration	Population-wide	Uncertain	Limited resources.
Soil and Water Conservation Districts	Watershed restoration	Private lands on John Day River and tributaries, once identified as deficient		Active management, only if specific needs cannot be addressed by passive restoration techniques.
CTWSRO	Watershed restoration	Private lands on John Day River and tributaries, once identified as deficient in cooperation with SWCD	Uncertain	
NGOs	Watershed restoration	None currently identified	Uncertain	No actions currently planned.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

Instream activities have not been identified as a high priority by the recovery planning team or the subbasin plan team except when identified as a need for specific sites. The planning team prefers that more passive approaches, such as riparian and upland improvements be emphasized. Typically, instream activities that would improve floodplain function and channel migration processes would include placement of rootwads, whole trees, or boulder clusters to improved habitat complexity and habitat diversity where those parameters are deficient and not expected to improve with passive restoration. Another structural activity would be to construct boulder or log weirs to raise the water table, but only where a passive approach has not worked.

The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural riparian vegetative communities including vegetative planting	Some reaches of the upper mainstem John Day River (1) and Ingle (2), Harper (2), Beech (1), Bear (1), Birch (2), Dans (2), and Reynolds (2) crs; the lower reaches of Fields (1), Belshaw (1), Cummings (2), Moon (2), Riley (1), Strawberry (2), Pine (2), and Laycock (2) crs	Degraded riparian area, channel structure and complexity, floodplain degradation, altered hydrology, sediment, water quality	Overgrazing of riparian area, channelization, stream bank armoring, tree harvest in riparian areas, changes in plant communities (including invasive plants), loss of beaver dams	Abundance, productivity	Primarily fry and 0+	Primary methods of riparian enhancement include riparian corridor fences to exclude livestock, changes in grazing management that promote riparian recovery, and planting of native shrubs.
Develop grazing strategies that promote riparian recovery	Some reaches of the upper mainstem John Day River (1) and Ingle (2), Harper (2), Beech (1), Bear (1), Birch (2), Dans (2), and Reynolds (2) crs; the lower reaches of Fields (1), Belshaw (1), Cummings (2), Moon (2), Riley (1), Strawberry (2), Pine (2), and Laycock (2) crs	Same as above	Livestock overgrazing of riparian area	Abundance, productivity	Primarily fry and 0+	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural riparian vegetative communities	ODFW, Watershed Councils, SWCDs, USFS, BLM, CTUIR	Ongoing	Riparian function will be limited to specific reach; water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years, (see above)	High, based on experience with existing grazing management and riparian recovery projects
Develop grazing strategies that promote riparian recovery	NRCS, AFS, USFS, BLM, SWCDs, ODFW, Watershed Councils, CTUIR	Ongoing	Riparian function will be limited to specific reach; water quality benefits will have high dispersal downstream from site	Long term because of widespread need	5-15 years, depending upon grazing plan adopted. Riparian corridor fencing and removal of riparian grazing has the fastest recovery rate.	High, based on experience with existing grazing management and riparian recovery projects

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program	Private lands on John Day River and tributaries above Dayville	No	Limited by funds.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.				
SWCDs	Upland improvements, riparian improvements	Private lands on John Day River and tributaries above Dayville		
USFS and BLM	Upland improvements, riparian improvements	Federal lands on John Day River and tributaries above Dayville	Uncertain	PACFISH BMPs are generally sufficient for passive restoration, but active restoration funds are limited. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005). See discussion in Gaps commentary below.
NRCS	Upland improvements, riparian improvements	Private lands on John Day River and tributaries above Dayville	Yes	Program sufficient.
ODA	Agricultural Water Quality Management Programs	Private lands on John Day River and tributaries above Dayville		See State of Oregon programmatic review -- Appendix F.
CTUIR	Watershed restoration	Forrest Ranch property and private lands on John Day River and tributaries above Dayville in cooperation with SWCD	Uncertain	Program approach sufficient. Scope could be increased.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Overgrazing of riparian areas by livestock continues, however it is not as widespread as historically. Interest by private landowners and public land managers in riparian improvement remains high. See Strategy 5, Lower Mainstem John Day River population for further discussion. Implementation of PACFISH standards and guides for most Forest and BLM programs has been highly successful over most of this population's area, but implementation of PACFISH Standards and Guides for FS grazing management program remains challenging in some locations. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.				

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Implement agricultural water conservation measures	Fields (1), Indian (1), McClellan (2), Pine (1), Beech (1), Bear (2), Strawberry (1), Isham (2), Dean (2), Moon (2), Laycock (1), Dog (2), Ingle (2), and Riley (2)crs; John Day River, Dayville to Mt. Vernon (1)	Altered hydrology, low flows, high temperatures	water withdrawals, land conversion on uplands, road network	Abundance, productivity	Primarily, fry and 0+	Fields, Indian, McClellan, Pine, Beech, Bear, Strawberry, Isham, Dean, Moon, Laycock, Dog, Ingle, and Riley crs (all Upper John Day) have significantly less than naturally available flow or are either dry or intermittent in their lower reaches due to irrigation withdrawals. During low water years, the mainstem John Day River from Dayville to Mt. Vernon is intermittent.
Improve irrigation conveyance and efficiency	Fields (1), Indian (1), McClellan (2), Pine (1), Beech (1), Bear (2), Strawberry (1), Isham (2), Dean (2), Moon (2), Laycock (1), Dog (2), Ingle (2), and Riley (2)crs; John Day River, Dayville to Mt. Vernon (1)	Low flows, high temperatures	Water withdrawals, loss during conveyance	Abundance, productivity	Primarily, fry and 0+	

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
Increase pool habitat (beaver ponds)	Fields (2), Indian (1), McClellan (2), Pine (1), Beech (1), Bear (1), Strawberry (2), Isham (2), Dean (2), Moon (2), Laycock (1), Dog (2), Ingle (2), and Riley (1)crs				Primarily, fry and 0+	
Floodplain aquifer recharge		Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily, fry and 0+	
Lease or acquire water rights and convert to instream	Fields (1), Indian (1), McClellan (2), Pine (1), Beech (1), Bear (2), Strawberry (1), Isham (2), Dean (2), Moon (2), Laycock (2), Dog (2), Ingle (2), and Riley (2)crs; John Day River, Dayville to Mt. Vernon (1)	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily, fry and 0+	The Upper John Day River does not meet requested in stream water right flows for all of August and the first half of September during irrigation season. Some tributaries are dry where they join the John Day River.
Monitor/regulate water withdrawals	Population-wide	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Primarily, fry and 0+	
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs	Population-wide	Low flows, high temperatures	Water withdrawals	Abundance, productivity, spatial structure, diversity	All stages	New programs in development.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Implement agricultural water conservation measures	SWCD, watershed councils, NRCS	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and dependent upon landowner willingness to participate and availability of projects	Immediate	High, if the saved water is protected from being appropriated to a downstream user in areas with instream water rights
Improve irrigation conveyance and efficiency	SWCD, OWEB, watershed councils, NRCS, landowners	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and dependent upon landowner willingness to participate and availability of projects	Immediate	High, if the saved water is protected from being appropriated to a downstream user in areas with instream water rights
Increase pool habitat (beaver ponds)	SWCD, ODFW, CTWSRO, USFS	Ongoing	High dispersal downstream	Unknown	Immediate increase in instream flow	High
Floodplain aquifer recharge	CTWSRO, SWCDs	Planned, some ongoing	Potentially high dispersal from recharge project site downstream for many miles	Long term, although opportunities for pilot projects is dependent upon willing landowner	Immediate	High, if the additional water is protected from being appropriated to a downstream user in areas with instream water rights
Lease or acquire water rights and convert to instream	OWRD, FSA, OWEB, Oregon Water Trust, others	Ongoing	Point of diversion downstream to mouth of John Day River	Long term and highly dependent upon landowner willingness to lease.	Immediate	High, if the leased water is protected from being appropriated to a downstream user in areas with instream

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
						water rights. FSA pays higher rates for CREP enrollment when water rights are leased for instream use.
Monitor/regulate water withdrawals	OWRD	Ongoing	Point of diversion downstream to mouth of John Day River	Long term, dependent upon OWRD enforcing the requirement to measure water usage	Immediate	High if water user reporting requirement and installation of measuring devices on diversions is implemented
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs	OWRD	Ongoing	Population-wide	2007-2009 except incentive funding ongoing	Long term	Moderate

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program, riparian improvements	Private lands on John Day River and tributaries above Dayville	No	Limited in scope.
OWRD	Streamflow Monitoring and Restoration, Flow Restoration, Lease/Transfer Water Rights, Administration of Water Rights, Water Use Measurement, Water Needs Assessment, Storage Assessment, Conservation Assessment	Private lands on John Day River and tributaries above Dayville where irrigation withdrawals occur	Uncertain	See State of Oregon programmatic review–-Appendix F.
Oregon Water Trust and BOR	Leasing and Purchase of Water Rights	John Day River and above John Day and tributaries above Dayville. Leases currently exist on Dixie Creek and John Day River above Mt Vernon.	No	Sufficient where applied, program could expand with additional funding.
Soil and Water Conservation Districts	Improve irrigation efficiency, upland improvements, riparian improvements	Private lands on John Day River and tributaries above Dayville		See State of Oregon programmatic review – Appendix F.
NRCS	Upland improvements, riparian improvements	Private lands on John Day River and tributaries above Dayville	No	Limited in scope.
CTWSRO	Watershed restoration program	Forrest Ranch property and private lands on John Day River and tributaries above Dayville in cooperation with SWCD	Uncertain	Approach sufficient, scope is limited.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
Many landowners have converted from flood to sprinkler or gated pipe irrigation that makes more efficient use of the water and grows more palatable forage, but there has not been an effective mechanism to protect saved water from being used by another irrigator downstream. Water measuring devices are just beginning to be required on irrigation withdrawals and while progress is being made there is considerable resistance from irrigators, particularly in the Upper John Day. Flows are also improving because of projects that restore historical cover types by removing juniper, reintroducing fire, enrollment into CRP, and control of invasive/noxious plants. Primary constraints on implementing additional projects are funding, instream water rights that are junior to most irrigation rights, and water laws that sometimes conflict with conservation practices.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.
Approximately 120 miles of stream in the Upper Mainstem are protected with either existing or pending instream water rights. The instream water rights do not preclude further appropriation of water until flows in the affected reach drop down to the instream water rights as adopted by OWRD. US Bureau of Reclamation, as required in the Columbia River Biological Opinion, is required to identify and assist with passage improvement design and flow restoration. They have partnered with Oregon Water Trust on several water leases, most notably in Standard Creek, tributary to Dixie Creek.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Increase riparian shading	Mainstem John Day River (1), Beech (1), EF Beech (2), Canyon (1), Grub (2), Indian (1), Pine (1), Laycock (2), Belshaw (1), Fields (1), Strawberry (2), lower Dans (2), Riley (1), Ingle (1), Harper (1), and Bear (2) crs	High water temperatures	Degraded riparian forests	Abundance, productivity	Primarily fry, juveniles	Elevated water temperature is the most pervasive water quality problem for the Upper John Day River population, with 27 stream reaches listed as water quality limited. Additional reaches would probably be listed if water temperature data were available.
Manage return flow to reduce extreme stream temperatures	Mainstem John Day River, from South Fork to Blue Mt Hot Springs (1).	High water temperatures	Water withdrawals	Abundance, productivity	Primarily fry, juveniles	Many projects that improve water quality by reducing irrigation return water have been completed, particularly between the town of John Day and the National Forest Boundary above Blue Mt. Hot Springs.
Reduce chemical pollution and nutrient inputs	Mainstem John Day River from the South Fork to Blue Mt Hot Springs (1).	Chemical pollution	Pesticides, fertilizers, herbicides, vehicle hydrocarbons, etc.	Abundance, productivity	Primarily fry, juveniles	Using more efficient irrigation methods, which reduces the amount of surface water returning to the stream, should result in fewer nutrients from pastures reaching the John Day River. Reducing nutrient loads will contribute to increased water quality by reducing biological oxygen demand and algae blooms.
Apply BMPs to animal feeding operations	John Day River between the South Fork and Blue Mt. Hot Springs (1)	Degraded water quality	Animal feed operations	Abundance, productivity	Primarily fry, juveniles	There are very few feedlots, but significant use of riverside meadows for winter feeding operations.
Continue TMDL monitoring	Temperature: Mainstem John Day River (1), Beech (1), EF Beech (2), Canyon (2), Grub (2), Indian (1), Laycock (1), Belshaw (2), Fields (2), and Bear (2) crs Sediment: Indian Cr (from burned area) (1)	Degraded water quality, sediment routing	Land use practices, water withdrawals, pesticides, fertilizers, herbicides	Abundance, productivity	Primarily fry, juveniles	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Increase riparian shading	ODFW, Watershed Councils,	Ongoing	Water quality benefits will have	Long term because of widespread	5-15 years	High

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
	SWCDs, USFS, BLM, CTUIR		high dispersal downstream from site	need		
Manage return flow to reduce extreme stream temperatures	SWCDs, watershed councils	Ongoing	Water quality improvement would have high dispersal downstream	Less than 5 years, once the project has been identified	Immediate	High, reduced temperatures has been well documented
Reduce chemical pollution and nutrient inputs	ODEQ, others	Ongoing		Ongoing	Reduce chemical pollution immediately	High
Apply BMPs to animal feeding operations	ODA	Ongoing	Water quality improvement would have high dispersal downstream	Some treatments could be done immediately. There are few animal feeding operations within the subbasin, only one of which has been identified as a problem	5-15 years	High, once a treatment has been agreed upon
Continue TMDL monitoring	USFS, ODFW, SWCD, ODEQ	Ongoing	Basinwide	Ongoing	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
FSA	CREP, CRP	Resource need is widespread, but acceptance is lacking	No	Limited by acceptance of landowners.
ODEQ	Mine Waste Program	None currently identified, although extensive gold mining has occurred on John Day River near the town of John Day, on Canyon Creek and Dixie Creek		See State of Oregon programmatic review -- Appendix F.
ODA	Confined animal feeding operations (CAFO), Agricultural Water Quality Management Program	None currently identified		See State of Oregon programmatic review -- Appendix F.
ODEQ, ODA, SWCD, USFS	Sedimentation Monitoring (TMDL Development and Implementation)	John Day River and tributaries above Dayville		See State of Oregon programmatic review -- Appendix F. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005). See discussion in Gaps commentary below.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

Reducing water temperatures through the use of improved riparian vegetation and more efficient methods of irrigation may take several years to provide measurable results. Many projects that improve water quality by reducing irrigation return water have been completed. Opportunities for additional irrigation return water cooling projects exist above and below the town of John Day. Low streamflows during the hottest part of the year exacerbate the already warm water temperatures. Opportunities for increasing streamflow through leasing of water rights, which often results in cooler water over a longer stream reach, are being pursued by Oregon Water Trust and US Bureau of Reclamation. Constraints for future projects include acceptance by landowners and a secure, long term funding source.

The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore native upland plant communities	Bear (2), Grub (1), Beech (1), Belshaw (1), Cummings (1), Pine (2), Indian (2), Strawberry (2), and Laycock (2) crs	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices, loss of water storage capacity	Abundance, productivity	Primarily fry, juveniles	Upland improvements such as restoring native plant communities and controlling invasive weed species will improve precipitation infiltration rates and ultimately improve watershed health, including the hydrograph.
Upgrade or remove problem forest roads	Forest lands	Same as above	Road network	Abundance, productivity	Primarily fry, juveniles	
Initiate upland improvement demonstration projects	Bear (2), Grub (1), Beech (1), Belshaw (1), Cummings (1), Pine (2), Indian (2), Strawberry (2), and Laycock (2)crs	Same as above	Upland land use practices	Abundance, productivity	Primarily fry, juveniles	
Manage vegetation, including juniper removal	Bear (2), Grub (1), Beech (1), Belshaw (1), Cummings (1), Pine (2), Indian (2), Strawberry (2), and Laycock (2) crs	Altered hydrology, sediment routing	Invasive plants	Abundance, productivity	Primarily fry, juveniles	
Demonstration projects to restore forest health and resilience to wildfire	Private and state forest lands	Altered hydrology, sediment, water quality, riparian functions, LWD recruitment	Conversion of vegetative communities	Abundance, productivity	All	Suppression of fires has altered fire regimes and increased threat of high intensity fires.
Employ BMPs to forest practices including fuels management and fire suppression mitigation, livestock grazing, road management and agricultural practices	Population-wide	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices	Abundance, productivity	Primarily fry, juveniles	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore native upland plant communities	SWCD, USFS, BLM	ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Long term		
Upgrade or remove problem forest roads	USFS, BLM, ODF, ODOT	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, many forest roads have legacy issues with regard to sediment transport and routing of runoff. Decommissioning may take many years	5-15 years	Moderate, although funding on public lands and landowner cooperation on

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
						private lands will determine rate of treatment
Initiate upland improvement demonstration projects	ODFW, NOAA Fisheries, USFWS, USFS, BLM, CTWSRO, Watershed Councils, SWCDs	Ongoing	Entire subbasin	Long term	Variable lag time	Unknown, depends upon action taken as a result of being more informed
Manage vegetation, including juniper removal	USFS, BLM, NRCS, SWCDs, Watershed Councils	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Juniper control can be done quickly, other strategies such as control of invasive plants may take more than 20 years	5-30 years	Moderate
Demonstration projects to restore forest health and resilience to wildfire	ODF	Ongoing	Private and state forest lands	Long term	Variable 5-20 years	Moderate
Employ BMPs to forest practices including fuels management and fire suppression mitigation, livestock grazing, road management and agricultural practices	SWCD, USFS, ODA, CTWSRO, private landowners	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, dependent on implementation of Agricultural Water Quality Management Plans	0-20,years, depending upon treatments applied	Moderate, dependent upon voluntary landowner participation

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
NRCS/Farm Service Agency	CRP	Private lands on John Day River and tributaries above Dayville	No	Limited in scope.
SWCDs	Juniper control	Private lands on John Day River and tributaries above Dayville		Needs expansion.
ODFW	Green Forage	Private lands on John Day River and tributaries above Dayville	No	Very small program.
USFS/BLM	Forest Plan, PACFISH, Resource Management Plan	Federal lands on John Day River above Forest boundary, and tributaries on Malheur National Forest	Yes, but highly dependent upon funding and monitoring	Particularly monitoring needs expansion. See USFS/BLM Program Sufficiency Assessment -- Appendix E and USFS Region's Aquatic Restoration Strategy (USDA-FS, 2005). See discussion in Gaps commentary below.
ODF	Private land protection from fire, Private Forest Program	Private and state forestlands throughout population		See State of Oregon programmatic review -- Appendix F.
ODF	Oregon Forest Practices Act	Private and state forest lands		See State of Oregon programmatic review -- Appendix F.
ODA	Agricultural Water Quality Management Program	Private lands on John Day River and tributaries above Dayville		See State of Oregon programmatic review -- Appendix F.
CTWSRO	Watershed Restoration	Forrest Ranch property and private lands on John Day River and tributaries above Dayville in cooperation with SWCD	Uncertain	Continued funding is uncertain.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
See discussion for Strategy 8, Lower Mainstem John Day River population. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed. Implementation of PACFISH standards and guides for Forest and BLM programs has been highly successful for passive upland restoration over most of this population's area. The limitations to all the programs are funding and, to a lesser extent, acceptance by landowners.

9.3.10 Habitat Strategies and Actions for Umatilla River Steelhead Population

Primary limiting factors: high water temperature, sediment routing, impaired fish passage, degraded channel structure and complexity and altered hydrology (low flow).

Primary threats: current land use practices that reduce habitat quality, quantity and disrupt ecosystem functions.

Table 9-2, behind the habitat strategy and action tables for the Umatilla, provides a cross reference of Geographic Areas and MaSAs/MiSAs. Table 8-35 identifies stream barriers to upstream steelhead passage in the Umatilla watershed.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Protect high quality habitats through acquisition, conservation easements and cooperative agreements	North Fork Umatilla R (1); Umatilla R., Meacham Cr. to forks (1); Buck Creek (1); NF Meacham Cr. (1); E. Meacham Cr (1); Thomas Cr.(1); W. Birch Cr., Bear Cr. to headwaters (1); E. Birch Cr., California Gulch to headwaters (1); SF Umatilla R., mouth to Thomas Cr.(1); Umatilla R., Butter Cr. to Westland Dam and Stanfield Dam to McKay Cr.(2); Umatilla R., Three Mile Dam to Butter Cr. (2)	Loss of habitat quantity and diversity, channel stability, sediment, low flow and high temperatures	Cultivation, forestry, grazing, urban development	Abundance, productivity	All	Agreements (conservation easements, cooperative agreements, etc.) could be made with private landowners in areas where priority habitats exist to maintain the current habitat values. Agreements in areas with priority habitats may include: Putting in no-cultivation riparian buffers on agricultural lands that are currently cultivated up to the channel's edge, increasing riparian buffer widths associated with forested areas, protecting unstable areas, or changing other types of management in riparian areas.
Continue existing protections and/or increase protection of Federal lands; implement Forest Practices Act and PACFISH	North Fork Umatilla R (1); Umatilla R., Meacham Cr. to forks (1); Buck Creek (1); NF Meacham Creek (1); East Meacham Cr (1); Thomas Cr. (1); West Birch Cr., Bear Cr. to headwaters (1); E. Birch Cr., California Gulch to headwaters (1); SF Umatilla R., mouth to Thomas Cr. (1)	Same as above	Forestry, cultivation, grazing, urban development	Abundance, productivity	All	Current protections on USFS lands such as Riparian Habitat Conservation Areas should be continued and maintained. Protection on Federal lands may be increased through the NEPA process or ESA consultation. Aquatic habitat issues are addressed through both processes. Actions may include expanding riparian buffers, changing management within or near riparian areas, and identifying sensitive areas to avoid. All the options listed for added protection are directed through PACFISH program/management direction but would be considered "New" actions to be applied if/when the need is identified. Forest Plan management

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
						direction (landscape-scale) for roadless areas, wildlife management emphasis and Wilderness are unlikely to change significantly in the near future.
Establish setbacks to protect waterways from forest management, agricultural activities, and other land use practices that would disrupt ecosystem function	Umatilla R., Meacham Cr. to forks ; Thomas Creek (1); West Birch Cr., Bear Cr. to headwaters (1); Bear Creek (West Birch) and tribs (1); E. Birch Cr., mouth to headwaters (1); SF Umatilla R., mouth to Thomas Cr. (1); Umatilla R., Butter Cr. to Westland Dam and Stanfield Dam to McKay Cr (2); Umatilla R., Three Mile Dam to Butter Cr. (2); Birch Cr., mouth to forks (2); Umatilla R., Mission Br. To Meacham Cr. (1); Meacham Cr., mouth to North Fork (1); West Birch Cr., mouth to Bear Cr. (1); Buckaroo Cr (1); Meacham Cr., Sheep Cr. to headwaters (1)	Same as above	Same as above	Abundance, productivity	All	Setbacks could include: no-cultivation riparian buffers on agricultural lands that are currently cultivated up to the channel's edge, increasing riparian buffer widths associated with forested areas, protecting unstable areas, or changing other types of management in riparian areas.
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes	Subbasin-wide	Same as above	Same as above	Abundance, productivity	All	To prevent degradation of existing habitat, Best management Practices and existing laws that protect aquatic habitat should be applied across the subbasin with emphasis on areas of very high quality.
Review, modify and enforce existing land use planning documents and ordinances pertaining to riparian and floodplain management to better address habitat and water quality issues	Subbasin-wide	Same as above	Urban development	Abundance, productivity	All	Enforce existing land use laws that affect aquatic habitat and update laws that do not provide adequate protection.
Incorporate priority habitat areas into the Natural Area Overlay Zone provision of the Umatilla County Development Ordinance	Umatilla R., Meacham Cr. to forks (1); W. Birch Cr., Bear Cr. to headwaters (1); Bear Creek (West Birch) and tribs (1); E. Birch Cr., mouth to headwaters (1); Umatilla R., Butter Cr. to Westland Dam and Stanfield Dam to McKay Cr. (1); Umatilla R., Three Mile Dam to Butter Cr. (1); Birch Cr., mouth to forks (1); Umatilla R., Mission Br. To Meacham Cr. (1); Meacham Cr., mouth to North Fork (1); West Birch Cr., mouth to Bear Cr. (1); Iskuulpa Cr., Bachelor Cyn to headwaters(1); Buckaroo C (1); Meacham Cr., Sheep Cr. to headwaters(1)	Same as above	Urban development	Abundance, productivity	Abundance, productivity	Incorporating MCR steelhead priority habitat areas into the Natural Area Overlay Zone provision of the Umatilla County Development Ordinance would allow the priority habitat areas to be protected while providing an expedient process for reviewing land uses.
Explore opportunities to incorporate priority areas into state legislation	NF Umatilla R (1); Umatilla R., Meacham Cr. to forks (1); Buck Creek (1); NF Meacham Cr (1); East Meacham Cr (1); Thomas Cr (1); West Birch Cr., Bear Cr.	Same as above	Rural and urban development	Abundance, productivity	All	Look for opportunities to make amendments that would incorporate increased protection for priority habitat areas.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
	to headwaters (1); E. Birch Cr., California Gulch to headwaters (1); SF Umatilla R., mouth to Thomas Cr. (1); Umatilla R., Butter Cr. to Westland Dam and Stanfield Dam to McKay Cr. (1); Umatilla R., Three Mile Dam to Butter Cr. (1)					
Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Protect high quality habitats through acquisition, conservation easements and cooperative agreements	CTUIR, ODFW, UBWC, TNC, RMEF, SWCDs	Ongoing	Water quality improvement have high dispersal downstream, stream corridor and function improvements would be confined to the specific site	Existing conservation agreements are complete. Full implementation of conservation measures will take 5-15 years or more	5 years to decades with passive restoration approaches	High, based on previous cooperative agreements
Continue existing protections and/or increase protection of Federal lands; implement Forest Practices Act and PACFISH	USFS, ODF	Ongoing	Benefits accruing since 1995 for all streams in Umatilla subbasin on USFS lands, including priority GAs. Forest Practices Act applies to all commercial timber operations on private lands	Long term	Maintenance/improvement of existing conditions	High
Establish setbacks to protect waterways from forest management, agricultural activities, and other land use practices that would disrupt ecosystem function	CTUIR, ODFW, USFS, FSA, NRCS, SWCD	When need identified	Riparian areas associated with priority habitat areas	Long term	Immediate with continued improvement for up to 50 years. After 50 years habitat effectiveness will be maintained.	High
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	USFS, SWCDs, ODA, FSA, NRCS, CTUIR, ODSL, USACE	Ongoing	All priority areas within the Umatilla subbasin	Long Term	Maintenance of existing conditions	Moderate
Review, modify and enforce existing land use planning documents and ordinances pertaining to riparian and floodplain management to better address habitat and water quality issues.	Municipalities	Unknown	Mid and lower subbasin; High dispersal downstream	Ongoing - unknown	Response is uncertain	It is unknown to what extent governments will address this need.
Incorporate priority habitat areas into the Natural Area Overlay Zone provision of the Umatilla County Development Ordinance	Umatilla County, CTUIR, ODFW	When possible	All priority areas within the Umatilla subbasin	Short term	Immediate with continued improvement for up to 50 years. After 50 years habitat effectiveness will be maintained.	Moderate, depends on implementation and enforcement

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Explore opportunities to incorporate priority areas into state legislation.	ODFW, CTUIR	When funding is available and amendment is possible	All priority areas within the Umatilla subbasin	Long term	Immediate with continued improvement for up to 50 years. After 50 years habitat effectiveness will be maintained.	Low

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
CTUIR	CTUIR Umatilla River Basin Anadromous Fish Habitat Enhancement Projects – Riparian Function	Birch Creek, Meacham Creek, Umatilla River	No	Yes, there is still potential for more conservation easements.
ODFW	Umatilla River Subbasin Fish Habitat Improvement Program, Fish Management Program	Birch Creek, Meacham Creek, Umatilla River	No	Yes, there is still potential for more conservation easements.
USFS	North Fork Umatilla River Wilderness and other specific Forest Plan management area allocations	Meacham Creek, North and South Fork Umatilla River and tribs	Yes	See USFS/BLM Program Sufficiency Assessment -- Appendix E.
USFS	Land Exchange Program	Meacham Creek, North and South Fork Umatilla River and tribs, Pearson Creek (East Birch Creek)	No	See discussion below.
USFS	PACFISH/Umatilla Forest Plan	Meacham Creek, North and South Fork Umatilla River and tribs, West Birch Creek, Pearson Creek and other East Birch Creek tribs	Yes	See USFS/BLM Program Sufficiency Assessment -- Appendix E.
USFWS	Umatilla Wildlife Refuge	Umatilla Wildlife Refuge	Yes	
US Army Corps of Engineers	Section 404/401 water alteration permitting	Subbasin-wide	No	Compliance validation and enforcement is inadequate due to lack of resources
ODSL	Waterway alteration permitting	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.
ODA, SWCD	Agricultural Water Quality Management Program	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.
FSA, NRCS, SWCD	CREP, CCRP, CSP, EQIP	Subbasin-wide	No	The potential coverage of these programs has not been realized in Umatilla County.
CTUIR	Iskuulpa Creek	Iskuulpa Creek	Yes	Program meeting objectives.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

CTUIR and ODFW conservation easement programs have been effective at protecting and improving riparian habitat condition in the Umatilla subbasin. There is potential for considerable expansion of these programs. Emphasis should be placed on priority habitat areas for establishing easements. These agreements are typically 10 or 15 years in duration. Continuation of management and derived benefits are uncertain once agreements expire.

The Umatilla National Forest should emphasize protecting priority areas during project planning and implementation. Ongoing management actions sufficiently protect high priority aquatic habitats. These existing protections should be continued. PACFISH/Forest Plan Programs per se are sufficiently protective for lands in current ownership and require changing management or increasing buffers only when need is identified site-specifically ("New" actions). Most of FS lands (Meacham watershed, SF and NF Umatilla R. are already essentially fully protected under Forest Plan by protective management direction,- Roadless and Wilderness and Wildlife Emphasis Management Areas that prohibit road building and forest practices except in rare circumstances; PACFISH protections apply to all such activities. Meacham and Umatilla watersheds (FS) are essentially unroaded and unharvested, majority of existing road system is located on ridgetops, very little in stream bottoms. When/if needs are identified, additional aquatic habitat could receive increased protective status and a "new action". Adding additional wilderness areas and wild and scenic river segments would require designation by Congress. Priority areas for habitat protection as listed above that reside within the Umatilla National Forest should be assessed as to whether administrative designations apply to the areas that will support protection of these areas over the long term.

While permit processes implemented by the US Army Corps of Engineers are thorough and actions authorized are protective of aquatic resources, the program lacks personnel resources to insure that terms and conditions of permitted actions are followed. In addition, the agency lacks resources to adequately monitor waterways for non-permitted actions or act upon non-permitted situations reported by other agencies or private parties. See State of Oregon programmatic review -- Appendix F for comments on ODSL.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.
The USFS land exchange program has the potential to bring existing private lands under federal ownership and PACFISH protections. However, this program is completely voluntary on the landowner's part and the landowner would acquire public land and could very likely lower standards of resource protection. The land exchange is, however, a tool that could be used under very controlled circumstances to see increased protection of important aquatic habitats. But the purpose of the program is focused on consolidating land holdings and not necessarily protection of habitat.
The Umatilla and Walla Walla Agricultural Water Quality Management (AgWQM) Area Rules require that management on agricultural lands allow the establishment, growth and maintenance of riparian or stream-side vegetation, consistent with site capability, to promote habitat and protect water quality by filtering sediment, stabilizing streambanks, naturally storing water, and providing shade. The AgWQM program is outcome-based rather than prescriptive, therefore allows landowners the flexibility to achieve water quality goals using available equipment, technology and innovation. The rules for each Management Area provide the enforceable backstop to the voluntary initiatives. The SWCDs are the local management agencies that provide the outreach, education and technical assistance. ODA is responsible for complaint investigations and enforcement actions. Technical and financial assistance is available through state and federal programs to landowners for establishing adequate riparian areas.
The CREP program agreements are for durations of 10 or 15 years. There is no guarantee that the benefits and management actions will be continued beyond the duration of the agreements.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Remove or replace barriers blocking passage such as dams, road culverts and irrigation structures	Per Table 8-35 Priority (1) Butter Creek system priority (2) See Appendix G that identifies 25 culverts in need of replacement	Impaired fish passage	Dams, culverts, instream structures	Abundance, productivity, spatial structure, diversity	Primarily adults and 0+juveniles	See Table 8-35 for list of known passage barriers. The most serious passage barriers on the mainstem of the Umatilla River have been addressed. The watershed with the greatest need for passage remediation is Birch Creek.
Construct ladders over existing permanent concrete or earth fill dams	Per Table 8-35 Priority (1) Butter Creek system priority (2)	Impaired fish passage	Dams	Abundance, productivity, spatial structure, diversity	Primarily adults and 0+juveniles	
Provide screening at 100% of irrigation diversions	Unscreened diversions within current steelhead distribution (1); Butter Creek system priority (2)	Impaired fish passage	Irrigation diversions	Abundance, productivity	All	There is only one gravity flow diversion known to not have inadequate screening in areas that are occupied by steelhead. However, it is not known to what extent pump diversion are adequately screened.
Replace screens that do not meet criteria	Diversions within current steelhead distribution (1); Butter Creek system priority (2)	Impaired fish passage	Irrigation diversions	Abundance, productivity	All	
Operate and maintain fish passage facilities to meet criteria	Within current steelhead distribution (1); Butter Creek system priority (2)	Impaired fish passage and entrainment	Dams, culverts and irrigation diversions	Abundance, productivity, spatial structure, diversity	All	There are cooperative projects in place in the Umatilla subbasin to both physically maintain the facilities and provide biological oversight so they are operated to maintain optimum fish passage conditions.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Remove or replace barriers blocking passage such as	ODFW, CTUIR, SWCD, UBWC, USFS, ODOT, Umatilla County,	Ongoing	Access upstream of obstruction	Within 5 years	Immediate	High

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
dams, road culverts and irrigation structures	Municipalities, private landowners					
Construct ladders over existing permanent concrete or earth fill dams	ODFW, CTUIR, private landowners	Ongoing	Access upstream of obstruction	5-10 years	Immediate	High
Provide screening at 100% of irrigation diversions	ODFW, private landowners	Ongoing	Point of diversion	10-20 years	Immediate	High
Replace screens that do not meet criteria	ODFW, private landowners	Ongoing	Point of diversion	10-20 years	Immediate	High
Operate and Maintain fish passage facilities to meet criteria	CTUIR, ODFW, WID, private landowners	Ongoing	Facility site	Ongoing	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program, Fish Management Program	Subbasin-wide	No	More funding/implementation needed.
CTUIR	BPA Habitat Program	Subbasin-wide	No	More funding/implementation needed.
ODFW	Fish Screening Program	Subbasin-wide	Yes for gravity diversions	Need to inventory and address pump screening.
Westland Irrigation District	Fish facilities O and M	Lower Umatilla River	Yes	Program meeting objectives.
CTUIR/ODFW	Fish passage operations	Lower Umatilla River	Yes	Program meeting objectives.
USFS	Road Maintenance	Upper subbasin	No	More funding needed to address fish passage problems. Timeframe of implementation slow due to funding. See comments below.
SWCD, UBWC	Watershed Improvement	Subbasin-wide		See State of Oregon programmatic review – Appendix F.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

McKay, Butter and Willow creeks all historically supported summer steelhead, but steelhead are not currently present due to passage obstructions, inadequate screening and low flow problems. McKay Dam, constructed to store water for irrigation in the 1920's, completely blocks upstream passage of fish at RM 6 on McKay Creek. Until recent years, McKay Creek downstream of McKay Dam was completely de-watered when the reservoir was being filled. Butter Creek has a series of large diversion dams that block upstream passage throughout the subbasin. In addition, water withdrawal for irrigation is so severe that water flows out of the mouth for only a few days or weeks in any given year. Willow Creek Dam Was constructed in 1980 on Willow Creek just upstream of Heppner (RM 56) for flood control. Willow Creek Dam completely blocks upstream passage of fish. In addition, to Willow Creek Dam, numerous irrigation diversion dams throughout the Willow Creek watershed block passage. The lowest barrier in Willow Creek that blocks anadromous passage exists at RM 11. Steelhead are occasionally seen holding downstream of this dam. While the general condition of passage in these streams (McKay, Butter and Willow creeks) is understood, a thorough inventory and assessment is needed. This information can be used to pursue passage improvement for redband trout and to assess the feasibility of restoring passage for steelhead.

The USFS has identified passage barriers in addition to the ones listed in Table 8-35. The Forest Service's Aquatic Restoration Strategy for the Pacific Northwest Region (USDA-FS, 2005) helps prioritize restoration actions for this population, and helps deploy limited active restoration funding where it is most needed within the ESU.

Screening of gravity-feed irrigation diversions within currently occupied steelhead habitat is thought to be adequate, with the exception of the lower six miles of McKay Creek and one site in the Birch Creek drainage that is known to not meet criteria. There is now documented use of steelhead juveniles in lower McKay Creek, but no efforts have been made in the past or present to screen water diversions there. It is not known to what extent pump-feed irrigation diversions are adequately screened. There is a critical need to inventory and screen all pump-feed irrigation diversions within currently occupied steelhead habitat. A comprehensive inventory of water diversions and screening needs has never been done in the Umatilla subbasin. Thus, while it is not likely that there are gravity feed diversions that are not screened, there exists the possibility, lacking a thorough assessment of the situation. A comprehensive inventory of all water diversions should be done and inspection of these diversions to ensure adequate screening.

Strategy 3. Maintain and restore floodplain connectivity and function.

Strategy 3. Maintain and restore floodplain connectivity and function.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Reconnect floodplains to channels	Umatilla R., Mission Br. to forks (1); Meacham Cr., mouth to North Fork (1); Birch Creek (1); West Birch, mouth to gorge (1); East Birch Creek mouth to Pearson Cr. (1)	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	All	Watershed scale problems and riparian management issues should be considered before active stream channel restoration is employed.
Reconnect side channels and off-channel habitats to stream channels	Umatilla R., Mission Br. to forks (1); Meacham Cr., mouth to North Fork (1); Birch Creek (1); West Birch, mouth to gorge (1); East Birch Creek mouth to Pearson Cr. (1)	Degraded floodplain, altered hydrology, habitat quantity and diversity	Removal of side channels, off-stream habitat	Abundance, productivity	All	Many streams in the subbasin are bordered by dikes and levies.
Remove dikes and levies	Umatilla R., Mission Br. to forks (1); Meacham Cr., mouth to North Fork (1)	Degraded channel structure and complexity	Stream channelization, bank armoring	Abundance, productivity	All	Many streams in the subbasin are bordered by dikes and levies.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Reconnect floodplain habitats	ODFW, UBWC,, SWCD, USFS, CTUIR	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Short term, once identified	Physical response will be immediate for some, others will develop over years to decades	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes
Remove dikes and levies	CTUIR, UBWC, CDs	When opportunity identified	Within the stream reach and reaches downstream for temp and sediment	10+ years	Improved stream and floodplain functions - some benefits will be realized immediately and others will develop over years	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes
Reconnect side channels and off-channel habitats to stream channels	ODFW, UBWC, SWCD, USFS, CTUIR	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Short term, once identified	Physical response will be immediate for some, others will develop over years to decades	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes

Strategy 3. Maintain and restore floodplain connectivity and function.				
Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program	Birch Creek, Meacham Creek, Umatilla River	No	Additional implementation needed
CTUIR	BPA Habitat Program	Birch Creek, Meacham Creek, Umatilla River	No	Additional implementation needed
SWCD, UBWC	Watershed Restoration	Subbasin-wide		Involvement is currently limited. See State of Oregon programmatic review – Appendix F.
Watershed Council	Watershed Restoration	Subbasin-wide	No	There is a continuing need for landowner assistance to insure that issues are dealt with appropriately.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Intensive land uses within Umatilla subbasin flood plains and upslope habitats have led to dramatic changes in waterway characteristics since arrival of Euro-American pioneers to the area during the middle 1800's (Nagel 1997, unpublished; Beschta 1994). Channel alterations in the Umatilla subbasin have resulted in 1) straight, incised channels with minimal woody riparian vegetation, and 2) wide channels with increased dynamics and minimal woody riparian vegetation. There is a need for continued implementation of measures to address limiting factors.				

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural channel form	Umatilla River, Mission Br. to forks (1); Meacham Creek, mouth to North Fork (1); Birch Creek (2); West Birch Creek (1), mouth to Gorge; East Birch Cr. (1)	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature, flows	Stream channelization, bank armoring, large wood removal, loss of beaver dams, removal of riparian vegetation, livestock overgrazing in riparian areas	Abundance, productivity	All	Stream channel reconstruction and instream structures can be designed to correct channel stability problems. Where appropriate, passive treatments are preferred.
Place stable wood and other large organic debris in streambeds	Umatilla River, Mission Br. to forks (1); Meacham Creek, mouth to headwaters (1); North Fork Meacham Cr. (1); Birch Creek (1); West Birch Creek, mouth to Gorge (1); East Birch Creek (1); Bear Cr. (West Birch) (1)	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	Removal of large wood, beaver, trees in riparian areas; channelization and streambank armoring, livestock grazing	Abundance, productivity	Fry to adult	Aside from riparian vegetation, removal of large woody debris is one of the most pervasive habitat deficiencies in the Umatilla subbasin, either from direct removal or from removal of vegetation from riparian zones and floodplains. In areas where direct and immediate benefits to viability parameters can be addressed, large wood should be placed to improve overall ecosystem function. In areas where the lack of large wood is in addition to other habitat deficiencies such as flow and water quality, then restoration should focus on these over riding factors first.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.						
Stabilize and protect streambanks	Umatilla River, Mission Br. to forks (1); Birch Creek (1); W. Birch Creek, mouth to Gorge (1); East Birch Cr. (1)	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	Stream channelization, bank armoring, livestock grazing in riparian areas	Abundance, productivity	Eggs, fry and adults	Stream that have been altered by human activities such as grazing, removal of riparian vegetation, Channelization and bank armoring often have vertical and/or lateral erosion rates elevated above natural conditions, as well as coarse substrates that are not suitable for spawning.
Construct rock and log weirs to create pool habitats or elevate incised channels	Umatilla River, Mission Br. to forks (1); Meacham Cr, mouth to North Fork (1); Birch Cr (1); West Birch Cr, mouth to Gorge (1); East Birch Creek (1); Bear Cr. (West Birch) (1)	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	Large wood removal, trees in riparian area	Abundance, productivity	Fry to adult	Pools should be constructed strategically where other alternatives are not likely to accomplish this need, or constraints will not allow natural processes to form them. Artificial enhancement of pools should only be performed in areas where other parameters, such as water quality, would allow immediate use/benefits to be realized.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural channel form	ODFW, SWCDs, CTUIR, UBWC	Ongoing; some needs identified in ODFW/CTUIR five-year action plan	Within the stream reach and reaches downstream for temp and sediment	25 years	Improved riparian vegetation and associated attributes and improved stream and floodplain structure and function – response time immediate to 10 years	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes
Place stable wood and other large organic debris in streambeds	ODFW, UBWC, CTUIR, SWCDs	Ongoing as needed	Reach affected	Short term	Improved instream channel habitat diversity - some benefits will be realized immediately and others will develop in 1-5 years	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes
Stabilize and protect streambanks	ODFW, CTUIR, SWCD, UBWC, private landowners	Ongoing; when specific opportunity identified	Within the stream reach and reaches downstream for temp and sediment	10+ years	Improved water quality – response time 1-5 years	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes
Construct rock and log weirs to create pool habitats or elevate incised channels	ODFW, CTUIR	Ongoing; current action planned for Meacham Cr.	Treatment site	25 years	Increased quantity of pool habitat and channel and floodplain function – response time immediate to 5 years	High over short term, however structures often require maintenance
Remove dikes and levies	ODFW, CTUIR, SWCD, UBWC	When specific opportunities identified	Within the stream reach and reaches downstream for temp and sediment	Once specific action planned, short term	Some benefits will be realized immediately and others will develop over years to decades	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.				
Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODFW	BPA Habitat Program	Birch Creek, Meacham Creek, Umatilla River	No	Additional implementation needed
CTUIR	BPA Habitat Program	Birch Creek, Meacham Creek, Umatilla River	No	Additional implementation needed
SWCD	Watershed Restoration	Subbasin-wide		See State of Oregon programmatic review – Appendix F.
Watershed Council	Watershed Restoration	Subbasin-wide	No	There is a continuing need for landowner assistance to insure that issues are dealt with appropriately.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Intensive land uses within Umatilla subbasin flood plains and upslope habitats have led to dramatic changes in waterway characteristics since arrival of Euro-American pioneers to the area during the middle 1800's (Nagel 1997, unpublished; Beschta 1994). Channel alterations in the Umatilla subbasin have resulted in 1) straight, incised channels with minimal woody riparian vegetation, and 2) wide channels with increased dynamics and minimal woody riparian vegetation. There is a need for continued implementation of measures to address limiting factors.				

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural riparian vegetative communities including vegetative planting	Umatilla River, Mission Br. to forks (1); Meacham Creek, mouth to headwaters (1); Birch Cr (1); West Birch Cr, mouth to Gorge (1); East Birch Cr (1); Bear Cr. (West Birch) (1); Iskuulpa Cr. (1)	Degraded riparian area, channel stability, floodplain degradation, sediment, water temperature	Livestock grazing, channelization, stream bank armoring, cutting of trees in riparian areas, changes in plant communities (including invasive plants), loss of beaver dams	Abundance, productivity, diversity	All	Historically, bank armoring with rock and channelization were used to stabilize stream banks at the detriment of riparian vegetation growth. In the last 15 years the high economic and ecological cost of bank armoring with riprap and of channelization has been recognized, so the emphasis has shifted toward a more passive approach for stabilization, primarily through riparian vegetation improvements.
Develop grazing strategies that promote riparian recovery	Umatilla River, Mission Br. to forks (1); Meacham Creek, mouth to headwaters (1); Birch Cr (1); West Birch Cr, mouth to Gorge (1); East Birch Cr (1); Bear Cr. (West Birch) (1); Iskuulpa Cr. (1)	Degraded riparian area, channel stability	Livestock overgrazing of riparian area	Abundance, productivity, diversity	All	Grazing strategies, other than exclusion, should be developed to achieve riparian recovery in the next 10-15 years. Permanent or temporary exclusion of livestock from riparian areas remains the surest way to achieve riparian restoration where livestock have been the primary impact.
Develop no-cultivation riparian buffer on agricultural lands and establish riparian setbacks for structures in	Umatilla River, Mission Br. to Meacham (1); Birch Cr (1); West Birch Cr, mouth to Gorge (1); East Birch Cr (1); Bear Cr. (West Birch) (1)	Degraded riparian area, channel stability, floodplain degradation, sediment, water	Degradation of riparian areas and function; residential	Abundance, productivity, diversity	All	In areas where development is occurring, that development should be adequately set back from streams so as not to interrupt natural stream processes.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
areas where activities could upset riparian function		temperature	development and cultivation			
Maintain existing widths of RHCAs on USFS lands	Umatilla R. and tribs, Meacham Cr. to Forks (1); South Fork Umatilla and tribs (1); Buck Cr. and tribs (1); Thomas Cr. and tribs (1); North Fork Meacham and tribs (1); East Meacham and tribs (1); Butcher Creek and tribs (1)	Degraded riparian area, channel stability, floodplain degradation	cutting of trees in riparian areas, changes in plant communities	Abundance, productivity, diversity	All	
Riparian exclosure fencing	Umatilla River, Mission Br. to forks (1); Meacham Creek, mouth to headwaters (1); Birch Cr (1); West Birch Cr, mouth to Gorge (1); East Birch Cr (1); Bear Cr. (West Birch) (1)	Degraded riparian area, channel stability	Livestock grazing	Abundance, productivity, diversity	All	Excluding livestock from riparian areas remains the most effective tool of mitigating livestock impacts.
Close, remove, and restore riparian road prisms	Umatilla River, Mission Br. to forks (1); Meacham Creek, mouth to headwaters (1); Birch Cr (1); West Birch Cr, mouth to Gorge (1); East Birch Cr (1); Bear Cr. (West Birch) (1)	Degraded riparian area, channel stability, sediment	Roads	Abundance, productivity, diversity	All	In many areas of the Umatilla subbasin, riparian roads have reduced riparian vegetation, confined stream channels, and continue to deliver fine sediment to channels. Regular road maintenance, or road relocation or elimination will restore allow natural riparian processes.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural riparian vegetative communities including vegetative planting	ODFW, CTUIR, NRCS/FSA , UBWC, SWCD, ODA, private landowners	Ongoing	High dispersal downstream from site	25 years	Improved riparian vegetation and associated attributes – response time 5 years to decades	Moderate – plant survival varies based on techniques used
Develop/implement grazing strategies that promote riparian recovery	ODA, NRCS, FSA, USFS, private landowners	Ongoing	High dispersal downstream from site	Long term	Improved riparian vegetation and associated attributes – response time 5 years to decades	Depends on diligence of management applications
Develop no-cultivation riparian buffer on agricultural in areas where activities could upset riparian function	CTUIR, landowners, FSA/NRCS, ODFW	Ongoing	Cultivated land in close proximity to priority habitat areas within the Umatilla subbasin	Long term	Immediate with continued improvement for up to 50 years or until easement ends and management changes. After 50 years habitat effectiveness will be maintained	High
Maintain existing widths of RHCAs on USFS land	USFS	Ongoing	Benefits accruing since 1995 for all streams in Umatilla subbasin on USFS lands, including priority GAs.	Long Term	Maintenance/improvement of existing conditions	High
Riparian exclosure fencing	ODFW, CTUIR, NRCS/FSA, Watershed Council, SWCD, private landowners	Ongoing	High dispersal downstream from site	25 years	Improved riparian vegetation and associated attributes – response time 5 years to decades	High
Close, remove, and restore riparian road prisms	USFS, ODOT, Umatilla County, private landowners	Ongoing	Riparian areas within the subbasin where potential for riparian road closure and removal exists	Based on opportunity and need	Improved water quality – response time immediate with continued response for up to 50 years	High

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.				
Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODA, SWCD	Agricultural Water Quality Management Program	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.
FSA, NRCS, SWCD	CREP, CCRP, CSP, EQIP	Subbasin-wide	No	The potential coverage of these programs has not been realized in Umatilla County
ODFW, CTUIR	BPA Habitat Program		No	Many additional miles of stream to be treated
USFS	Grazing management	Upper subbasin	Yes	See USFS/BLM Program Sufficiency Assessment -- Appendix E.
USFS	Vegetation management	Upper subbasin	Yes	See USFS/BLM Program Sufficiency Assessment -- Appendix E.
ODEQ	TMDL	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.
Municipalities	Land use planning ordinances	Subbasin-wide	No	Needs expansion.
USFS	Road management	Upper subbasin		See USFS/BLM Program Sufficiency Assessment -- Appendix E.
ODOT	Road maintenance	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.
ODF	Forest Practices Act, Road management	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.
Umatilla County	Road maintenance	Subbasin-wide	No	Needs expansion to better address water and sediment routing to waterways.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
The Umatilla and Walla Walla AgWQM Area Rules require that management on agricultural lands allow the establishment, growth and maintenance of riparian or stream-side vegetation, consistent with site capability, to promote habitat and protect water quality by filtering sediment, stabilizing streambanks, naturally storing water, and providing shade. The AgWQM program is outcome-based rather than prescriptive, therefore allows landowners the flexibility to achieve water quality goals using available equipment, technology and innovation. The rules for each Management Area provide the enforceable backstop to the voluntary initiatives. The SWCDs are the local management agencies that provide the outreach, education and technical assistance. ODA is responsible for complaint investigations and enforcement actions. Technical and financial assistance is available through state and federal programs to landowners for establishing adequate riparian areas. The CREP program agreements are for durations of 10 or 15 years. There is no guarantee that the benefits and management actions will be continued beyond the duration of the agreements. Continued development adjacent to waterways is not suitable to the recovery of Mid. Columbia steelhead. Fish managers need to review the issue with Umatilla County and municipalities and identify ways to resolve problems with current regulations or their implementation.				

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Implement Umatilla Basin Project Phase I and II	Umatilla River from mouth to McKay Cr. (1)	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, diversity	Parr to adult	Agricultural water diversions constructed on the lower Umatilla in the early 20th century lead to dewatering of the channel throughout the spring summer and fall. Implementation of the Umatilla Basin Water Exchange project has resulted in
Implement Umatilla Basin Project Phase III	Umatilla River from mouth to Thornhollow (1)	Flows, water temperatures, habitat	Water withdrawals	Abundance, productivity,	Parr to adult	

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
		quantity/diversity		diversity		restoration of flows in the mainstem of the Umatilla River so that migration and rearing of steelhead is better supported, but conditions are not fully restored. Continued implementation an maintenance of this project is critical for providing migration and rearing.
File for additional ISWRs	Butter Creek system (2); Bear Cr. (West Birch) (1); South Canyon Cr. (East Birch) (1); Westgate Canyon (East Birch) (1); East Fork Meacham Cr. (1); Twomile Cr. (2); Butcher Cr. (1)	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, spatial structure, diversity	Parr to adult	Most important spawning and rearing stream in currently utilized spawning and rearing habitat have instream water rights. However, no instream water rights exist in the Butter Cr. system
Implement agricultural water conservation measures	Butter Creek system (2); Umatilla River, Mission Br. to forks (2); Birch Creek (1); West Birch Creek, mouth to Gorge (1); East Birch Creek (1); Bear Cr. (West Birch)(1)	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, diversity, spatial structure	All	The primary tributary streams where water withdrawals are affecting migration and rearing of steelhead include the Birch and Butter Creek watersheds. Dewatering and passage barriers are so severe in Butter Creek that steelhead are currently not documented to occur. Birch Creek continues to support steelhead, but water withdrawals are significantly impacting rearing and migration habitats.
Lease or acquire water rights and convert to instream	Butter Cr system (2); Umatilla River, Mission Br. to forks (2); Birch Cr (1); West Birch Cr, mouth to Gorge (1); East Birch Cr (1); Bear Cr. (W Birch) (1)	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, diversity, spatial structure	Parr to adult	
Downstream water rights transfers	Umatilla River, Mission Br. to forks (2); Birch Creek (1); West Birch Creek, mouth to Gorge (1); East Birch Creek (1); Bear Cr. (West Birch) (1)	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, diversity	Parr to adult	
Monitor/regulate water withdrawals	Subbasin-wide	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Parr to adult	Many streams that historically flowed year long are now intermittent, creating fish passage barriers in the dewatered reach. Many of these due to water withdrawals
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs	Population-wide	Low flows, high temperatures	Water withdrawals	Abundance, productivity, spatial structure, diversity	All stages	New programs in development.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Implement Umatilla Basin Project Phase I and II	BPA, BOR, OWRD, WEID, HID, SID, CTUIR, ODFW	Ongoing	From McKay Reservoir to mouth of the Umatilla River	Long Term	Improved water quality and flow – immediate response	High, but depends on continued BPA funding
Implement Umatilla Basin Project Phase III	BPA, BOR, OWRD, WEID, CTUIR, ODFW	In-planning	From McKay Reservoir to mouth of the Umatilla River	Long Term	Uncertain	Uncertain

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
File for additional ISWRs	ODFW	On hold	Specific to the stream reach	Unknown	Maintenance of existing conditions	High, depends on how resource managers implement protection
Implement agricultural water conservation measures	SWCDs	Ongoing	Depends on means used to protect instream flows	Short Term	Improved instream flow – response immediate	Moderate – depends on how saved water is protected, if any.
Lease or acquire water rights and convert to instream	OWRD., Oregon Water Trust, water right holders	Ongoing, when opportunities arise	From point of diversion downstream	Long term	Improved instream flow – response immediate	High, depending upon priority date of water right
Downstream water rights transfers	OWRD, private landowners	Ongoing	Reach between old and new point of diversion	Long Term	Improved instream flow – response immediate	High
Monitor/regulate water withdrawals	OWRD	Ongoing	From the point of diversion downstream to the mouth of the Umatilla River	Long term	Maintenance or improvement of existing conditions – response to regulation immediate	Moderate, staffing levels are inadequate
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs	OWRD	Ongoing	Population-wide	2007-2009 except incentive funding ongoing	Long term	Moderate

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
BOR/BPA	Umatilla Basin Project	Lower Umatilla River	No	Additional water is needed to meet target flows established for the basin project
OWRD	Streamflow Monitoring and Regulation, Flow Restoration, Lease/Transfer Water Rights, Administration of Water Rights, Water Use Measurement, Water Needs Assessment, Storage Assessment, Conservation Assessment	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.
Oregon Water Trust and BOR	Leasing and Purchase of Water Rights	Umatilla River, Birch Cr. system and Butter Cr. system	No	Additional implementation would help meet flow restoration needs
SWCD, ODFW, CTUIR, Watershed Council	Improve irrigation efficiency	Umatilla River, Birch Cr. system and Butter Cr. System	No	Additional implementation would help meet flow restoration needs
UBWC, SWCD, ODFW, CTUIR, NRCS	Upland improvements, riparian improvements	Subbasin-wide	Uncertain	Additional implementation would help meet flow restoration needs
Umatilla County	Noxious weed control	Subbasin-wide	Yes	
ODF	Forest Practices Act	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.
USFS	Forest Management	Upper Subbasin	Yes	See USFS/BLM Program Sufficiency Assessment -- Appendix E.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)				
Phase I and II of the Umatilla Basin Project are currently meeting critical flow needs in the mainstem of the Umatilla River. This program should be continued to support migration and rearing of steelhead. Target flows				

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.
for the Umatilla River mainstem were established as part of the Basin Project to the life history needs of Chinook and coho salmon and steelhead. The Basin Project as currently implemented does not provide adequate water to meet the target flows throughout the times needed by these species, and fails to provide any flow mitigation for a significant length of the river in July and August. BOR, CTUIR and WID are currently seeking to expand the Basin Project (Phase III) to better meet flow needs for migration and rearing. As Phase III of the Basin project is developed, priority should be given to providing additional flow at the time and locations to meet the needs of MCR steelhead.
Significant efforts have been made in the lower Umatilla subbasin to use more efficient means of applying water to agricultural crops. There has been less emphasis on irrigation efficiency in other areas of the subbasin. Efforts should be taken to improve irrigation efficiency in areas such as the Birch Creek watershed where flow is a primary limiting factor. There are approximately 238 stream miles protected by instream water rights in the Umatilla subbasin. Voluntary flow restoration projects restored 14.9 cfs instream during 2006.
The Oregon Water Trust has put significant effort into gaining instream water leases in the Umatilla subbasin, with limited success. While it is unlikely that this approach could make a significant difference on the lower Umatilla River, tributary habitats could benefit substantially from water leasing. The Oregon Water Trust should maintain a "presence" in the subbasin to be in a position to capitalize on opportunities as they arise.
While instream water rights have been established on many of the important spawning and rearing stream in the subbasin, some have not. Where important spawning and rearing streams have not been protected by instream water rights, appropriate instream flow studies should be conducted and instream water rights applied for. In addition, consideration should be given to protecting and restoring flows in the Butter Creek drainage, where steelhead are currently extinct.
Projects to improve summer and fall streamflow and temperature by recharging shallow aquifers have been proposed, but none have been implemented to date. These types of projects are highly experimental in nature and should be accompanied by rigorous monitoring and evaluation to determine the net benefits of the action.
The primary tributaries in need of flow restoration actions are Birch and Butter creeks.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Address point sources of water pollution	Umatilla River (1); Birch Creek (1)	Chemical pollution	Sewage, Pesticides, fertilizers, herbicides	Abundance, productivity	Egg to Smolt	Point sources of water pollution are direct impacts that should be corrected through implementation of the TMDL and associated water quality management plan.
Implement water quality management plans	Subbasin-wide	Degraded water quality, flows, sediment routing, water quality	Land use practices, water withdrawals, pesticides, fertilizers, herbicides	Abundance, productivity	All	The Umatilla River water quality management plan addresses many water quality problems in the drainage.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Address point sources of water pollution	ODEQ, others	Ongoing	Specific point location	Ongoing	Reduce chemical pollution immediately	High
Implement water quality management plans	ODA, SWCD, Municipalities, Umatilla County, USFS, ODF, Irrigation Districts, private landowners, Industry, ODEQ	Ongoing	High dispersal downstream	Ongoing	Immediate	Moderate – degree of implementation is uncertain

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.				
Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
FSA, NRCS, SWCD	CREP, CCRP, CRP, EQIP, CSP	Subbasin-wide	Uncertain	The potential coverage of these programs has not been realized in Umatilla County.
ODFW	BPA Habitat Program	Umatilla R. Birch Cr., Meacham Cr.	No	There is a need for additional buffers.
CTUIR	BPA Habitat Program	Umatilla R. Birch Cr., Meacham Cr.	No	There is a need for additional buffers.
ODEQ	TMDL, NPDES	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.
ODF	Forest Practices Act	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.
USFS	PACFISH	Upper Subbasin	Yes	See USFS/BLM Program Sufficiency Assessment -- Appendix E.
SWCD	Landowner cost share programs for conservation farming practices	Subbasin-wide		More landowners could be included if funds were available. See State of Oregon programmatic review -- Appendix F.
Umatilla County	Noxious weed control	Subbasin-wide	Yes	Program sufficient.
US Army Corps of Engineers	Section 404/401 water alteration permitting	Subbasin-wide	No	Compliance validation and enforcement is inadequate due to lack of resources.
ODSL	Waterway alteration permitting	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.
ODA, SWCD	Agricultural Water Quality Management Program	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

Although this threat is partially addressed by the Umatilla River Water Quality Management Areas Plan (WQMAP), the guidance provided to landowners on management of riparian areas is fairly general. There is also some uncertainty regarding the implementation of this plan's requirements, as enforcement is based on a complaint-driven system. There is a continuing need to establish more riparian buffers. Achievement of the TMDL targets is dependent of determination of system potential vegetation. During TMDL development, the best professional judgment of the team described the potential streamside shade-producing vegetation broadly, as continuous tree-belts on each side of the river.

The Umatilla and Walla Walla AgWQM Rules require control of sediment delivery to streams to acceptable levels, control of irrigation runoff, management of livestock grazing to prevent runoff of waste and sediment, and establishment and maintenance of riparian and streamside vegetation. Beginning in 2008, these land conditions will be enforceable by ODA. SWCD provides technical and financial assistance to private landowners.

The SWCD, in partnership from OSU Extension Service and NRCS, has been a leader in promoting adoption of high tech conservation farming practices. They have received grants to provide cost share for farmers to adopt direct seeding, variable rate fertilizer placement and selective weed control. This technology reduces tillage that results in less erosion and healthier soils, applies only the needed amount of fertilizer to crops and reduces the application of herbicides.

The CREP program agreements are for durations of 10 or 15 years. There is no guarantee that the benefits and management actions will be continued beyond the duration of the agreements.

While permit processes implemented by the US Army Corps of Engineers are thorough and actions authorized are protective of aquatic resources, this program lacks personnel resources to insure that terms and conditions of permitted actions are followed. In addition, the agency lacks resources to adequately monitor waterways for non-permitted actions or act upon non-permitted situations reported by other agencies or private parties. See State of Oregon programmatic review -- Appendix F for ODSL.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore native upland plant communities	Subbasin-wide	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices, loss of water storage capacity	Abundance, productivity	All	There are cooperative projects in place in the Umatilla subbasin.
Upgrade or remove problem forest roads	Subbasin-wide	Altered hydrology, sediment routing	Road network	Abundance, productivity	All	
Initiate upland improvement demonstration projects	Subbasin-wide	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices	Abundance, productivity	All	
Demonstration projects to restore forest health and resilience to wildfire	Private and state forest lands	Altered hydrology, sediment, water quality, riparian functions, LWD recruitment	Conversion of vegetative communities	Abundance, productivity	All	Suppression of fires has altered fire regimes and increased threat of high intensity fires.
Employ BMPs to forest practices including fuels management and fire suppression mitigation, livestock grazing, road management and agricultural practices	Subbasin-wide	Altered hydrology, sediment routing	Upland land use practices	Abundance, productivity	All	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore native upland plant communities	SWCD, USFS, NRCS, private landowners	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Long term	Decades	Moderate, although funding on public lands and landowner cooperation on private lands will determine rate of treatment
Upgrade or remove problem forest roads	BLM, ODF, private landowners	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, many forest roads have legacy issues with regard to sediment transport and routing of runoff. Decommissioning may take many years	5-15 years	Moderate, although funding on public lands and landowner cooperation on private lands will determine rate of treatment
Initiate upland improvement demonstration projects	ODFW, USFS, CTUUIR, Watershed Councils, SWCDs	Ongoing	Entire subbasin	Long term	Variable lag time	Unknown, depends upon action taken as a result of being more informed

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
Demonstration projects to restore forest health and resilience to wildfire	ODF	Ongoing	Private and state forest lands	Long term	Variable 5-20 years	Moderate
Employ BMPs to forest practices including fuels management and fire suppression mitigation, livestock grazing, road management and agricultural practices	SWCD, USFS, ODA, CTUIR, private landowners	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, dependent on implementation of water quality management plans and other plans	0-20,years, depending upon treatments applied	Moderate, dependent upon voluntary landowner participation

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
FSA, NRCS, SWCD	EQIP, CRP, CREP, CCRP	Subbasin-wide	Uncertain	The potential coverage of these programs has not been realized in Umatilla County.
USFS	Forest Management	Upper subbasin	Yes	See USFS/BLM Program Sufficiency Assessment -- Appendix E.
ODFW/CTUIR	BPA Habitat Program	Umatilla R., Birch Cr., Meacham Cr.	No	Additional implementation is needed.
SWCD, Watershed Council	Watershed Restoration, OWEB	Subbasin-wide		Additional implementation is needed.
ODF	Private land protection from fire, Private Forest Program	Private and state forestlands throughout population		See State of Oregon programmatic review -- Appendix F.
ODF	Oregon Forest Practices Act	Private and state forest lands		See State of Oregon programmatic review -- Appendix F.
ODA, SWCD	Agricultural Water Quality Management Program	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

The degree to which upland vegetation management issues are being addressed has not been summarized subbasin-wide so sufficiency is currently not well understood.

The AgWQM Area Plan addresses upland conditions, both on rangeland and cropland that must be met to prevent and control erosion and improve overall watershed health to achieve water quality goals. The Area Rules require control of soil erosion to acceptable levels, allowing riparian and stream-side vegetation to establish for bank stability, filtering and shade, and management of livestock to prevent runoff of sediment and animal wastes. SWCD and NRCS programs are providing incentives to landowners to adopt farming practices that are more environmentally protective.

Implementation of PACFISH standards and guides for Forest programs has been highly successful for passive upland and riparian restoration in this population's area.

The CREP program agreements are for durations of 10 or 15 years. There is no guarantee that the benefits and management actions will be continued beyond the duration of the agreements.

Table 9-2. Umatilla Subbasin Geographic Areas

GA	Stream	Segment	MaSA	MiSA
1	Umatilla River	Mouth to Three Mile Dam		
2	Umatilla River	Three Mile Dam to Butter Creek		
3	North Hermiston Drain	All		
4	Butter Creek	Mouth to Madison diversion	Butter	
5	Butter Creek	Madison Diversion to East Butter Creek	Butter	
6	Little Butter Creek	All	Little Butter	
7	East Fork Butter and tributaries	All	Butter	
8	Butter Creek	East Fork to Headwaters and Johnson Creek	Butter	
9	Umatilla River	Butter Creek to Westland Dam and Stanfield Dam to McKay Creek		
10	Stage Gulch	All		
11	Umatilla River	Westland Dam to Stanfield Dam		
12	Birch Creek	Mouth to forks including Stewart Creek		Birch, Stewart
13	West Birch Creek	Mouth to Bear Creek	West Birch	
14	Bear Creek	All, including tributaries	West Birch	
15	West Birch Creek	Bear Creek to top of gorge, including tributaries	West Birch	
16	West Birch Creek	Gorge to headwaters	West Birch	
17	East Birch Creek	Mouth to California Gulch	East Birch	
18	East Birch Creek	California Gulch to headwaters, including tributaries except Pearson Cr.	East Birch	
19	Pearson Creek	All	East Birch	
20	McKay Creek	Mouth to McKay Dam	McKay	
21	McKay Creek	McKay Dam to North Fork		
22	North Fork McKay	All, including tributaries	McKay	
24	McKay Creek	North Fork to headwaters, including tributaries	McKay	
25	Umatilla River	McKay Creek to Mission Bridge		
26	Wildhorse Creek	Mouth to Athena, including tributaries		Wildhorse
27	Widlhorse Creek	Athena to headwaters, including tributaries		Wildhorse
28	Umatilla River	Mission Bridge to Meacham Creek	Middle Umatilla	
29	Umatilla Tributaries	Mission, Cottonwood, Moonshine and Coonskin creeks	Middle Umatilla	
30	Buckaroo Creek	All	Middle Umatilla	
31	Iskuulpa Creek	Mouth to Bachelor Canyon	Middle Umatilla	
32	Iskuulpa Creek	Bachelor Canyon to headwaters, including tributaries	Middle Umatilla	
33	Meacham Creek	Mouth to North Fork	Meacham	
34	Meacham Creek	Tributaries from mouth to North Fork	Meacham	
35	North Fork Meacham	All, including tributaries	Meacham	
36	Meacham Creek	North Fork to Twomile Creek, including Sheep Creek	Meacham	
37	East Meacham	All including tributaries and Butcher Creek	Meacham	
38	Meacham Creek	Twomile Creek to headwaters, including Twomile Creek	Meacham	
39	Beaver Creek	All, including tributaries	Meacham	
40	Umatilla River	Meacham Creek to forks	Upper Umatilla	
41	Ryan Creek	All	Upper Umatilla	
42	North Fork Umatilla	Mouth to headwaters, including tributaries	Upper Umatilla	
43	South Fork Umatilla	Mouth to Thomas Creek	Upper Umatilla	
44	Buck Creek	All, including tributaries	Upper Umatilla	
45	Thomas Creek	All	Upper Umatilla	
46	South Fork Umatilla	Thomas Creek to headwaters, including Shimmiehorn Creek	Upper Umatilla	

Note: Minor spawning areas within the Umatilla Subbasin not represented include Cold Springs, Alkali, Speare, Mud Spring and Little McKay.

9.3.11 Habitat Strategies and Actions for Walla Walla River Steelhead Population

Primary limiting factors: high water temperature, sediment routing, impaired fish passage, degraded channel structure and complexity, degraded floodplain connectivity and function, and altered hydrology (low flow).

Primary threats: current land use practices that reduce habitat quality and quantity and disrupt ecosystem functions.

Several tables are included after the habitat strategies and actions for the Walla Walla River steelhead population. Tables 9-3 and 9-4 show priorities for steelhead habitat restoration and protection. This prioritization was developed by applying the Ecosystem Diagnosis and Treatment Model that determined limiting factors and the areas where the greatest increase in fish production could be realized from restoration and protection actions. Table 9-5 provides a cross reference of geographic areas and MaSAs/MiSAs.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Protect high quality habitats through acquisition, conservation easements and cooperative agreements	SF Walla Walla, Elbow to headwaters (1); SF Walla Walla Tribs (1) ; NF Walla Walla Little Meadows to headwaters (1); Walla Walla, Dry Cr. to Mill Cr.(2); Yellowhawk mainstem (2); Couse Cr. drainage (2)	Loss of habitat quantity and diversity, channel stability, sediment, low flow and high temperatures	Cultivation, forestry, grazing, urban development	Productivity, abundance	All	Agreements (conservation easements, cooperative agreements, etc.) could be made with private landowners in areas where priority habitats exist to maintain the current habitat values. Agreements in areas with priority habitats may include: Putting in no-cultivation riparian buffers on agricultural lands that are currently cultivated up to the channel's edge, increasing riparian buffer widths associated with forested areas, protecting unstable areas, or changing other types of management in riparian areas.
Implement Forest Practices Act	SF Walla Walla, Elbow to headwaters; SF Walla Walla Tribs; NF Walla Walla Little Meadows to headwaters; All are first priority (1)	Same as above	Forestry	Productivity abundance	All	
Establish setbacks to protect waterways from forest management, agricultural activities, and other land use practices that would disrupt ecosystem function	SF Walla Walla, mouth to headwaters (1); SF Walla Walla Tribs (1); NF Walla Walla mouth to headwaters (1); Walla Walla, Dry Cr. to forks (1); Yellowhawk mainstem (1); Couse Cr. drainage (1); Little Walla Walla System (2)	Same as above	Same as above	Productivity, abundance		Setbacks could include: no-cultivation riparian buffers on agricultural lands that are currently cultivated up to the channel's edge, increasing riparian buffer widths associated with forested areas, protecting unstable areas, or changing other types of management in riparian areas.

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Protect and conserve rare and unique functioning habitats	Upper South Fork Walla Walla (1)	Same as above	Same as above	Productivity, abundance	All	Priority areas can be identified and appropriate protective action can be taken.
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes	Subbasin-wide	Same as above	Same as above	Productivity, abundance	All	To prevent degradation of existing habitat, Best management Practices and existing laws that protect aquatic habitat should be applied across the subbasin with emphasis on areas of very high quality.
Review, modify and enforce existing land use planning documents and ordinances pertaining to riparian and floodplain management to better address habitat and water quality issues	SF Walla Walla, mouth to headwaters (1); SF Walla Walla Tribs (1); NF Walla Walla mouth to headwaters (1); Walla Walla, Dry Cr. to forks (1); Yellowhawk mainstem (1); Couse Cr. drainage (1); Little Walla Walla System (2)	Same as above	Urban development	Productivity, abundance	All	Enforce existing land use laws that affect aquatic habitat and update laws that do not provide adequate protection.
Incorporate priority habitat areas into the Natural Area Overlay Zone provision of the Umatilla County Development Ordinance	SF Walla Walla, mouth to headwaters (1); SF Walla Walla Tribs (1); NF Walla Walla mouth to headwaters (1); Walla Walla, Dry Cr. to forks (1); Yellowhawk mainstem (1); Couse Cr. drainage (1); Little Walla Walla System (2)	Same as above	Urban development	Productivity, abundance	Productivity, abundance	Incorporating MCR steelhead priority habitat areas into the Natural Area Overlay Zone provision of the county development ordinance would allow the priority habitat areas to be protected while providing an expedient process for reviewing land uses.
Explore opportunities to incorporate priority areas into state legislation.	SF Walla Walla, mouth to headwaters (1); SF Walla Walla Tribs (1); NF Walla Walla mouth to headwaters (1); Walla Walla, Dry Cr. to forks (1); Yellowhawk mainstem (1); Couse Cr. drainage (1); Little Walla Walla System (2)	Same as above	Rural and urban development	Productivity, abundance	All	Examine opportunities to amend laws that would increase protection for priority habitat areas.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Protect high quality habitats through acquisition, conservation easements and cooperative agreements	CTUIR, ODFW, WWBWC, WDFW,TNC, RMEF, SWCDs, CD's	Ongoing	Water quality improvement have high dispersal downstream, stream corridor and function improvements would be confined to the specific site	Existing conservation agreements are complete. Full implementation of conservation measures will take 5-15 years or more	5 years to decades with passive restoration approaches	High, based on previous cooperative agreements
Implement Forest Practices Act and PACFISH	ODF, WDOE	Ongoing	Forest Practices Act applies to all commercial timber operations on private lands	Long term	Maintenance/improvement of existing conditions	High
Establish setbacks to protect waterways from forest management, agricultural activities, and other land use practices that would disrupt ecosystem function	CTUIR, ODFW, WDFW, WDOE, USFS, FSA, NRCS, SWCD, CD's, WWBWC	When need identified	Riparian areas associated with priority habitat areas	Long term	Immediate with continued improvement for up to 50 years. After 50 years habitat effectiveness will be maintained.	High

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.						
Protect and conserve rare and unique functioning habitats	USFS, BLM	Protection ongoing	Affected area	Long term	Immediate – maintain existing high quality conditions where found; maintain or improve existing conditions elsewhere	High
Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes.	USFS, BLM, SWCDs, WDOE, WDFW, ODFW, ODA, FSA, NRCS, CTUIR, ODSL, USACE, private landowners	Ongoing	All priority areas within the Walla Walla subbasin	Long term	Maintenance of existing conditions	High for federal lands; moderate elsewhere
Review, modify and enforce existing land use planning documents and ordinances pertaining to riparian and floodplain management to better address habitat and water quality issues.	Municipalities, Counties	Unknown	Mid and lower subbasin; high dispersal downstream	Ongoing - unknown	Response is uncertain	It is unknown to what extent governments will address this need.
Incorporate priority habitat areas into the Natural Area Overlay Zone provision of the Umatilla County Development Ordinance	Counties, CTUIR, ODFW, WDFW	When possible	All priority areas within the Umatilla subbasin	Short term	Immediate with continued improvement for up to 50 years. After 50 years habitat effectiveness will be maintained.	Moderate, depends on implementation and enforcement
Explore opportunities to incorporate priority areas into state legislation.	ODFW, CTUIR, WDFW, WDOE	When funding is available and amendment is possible	All priority areas within the Umatilla subbasin	Long term	Immediate with continued improvement for up to 50 years. After 50 years habitat effectiveness will be maintained.	Low

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
CTUIR	CTUIR Walla Walla River Basin Anadromous Fish Habitat Enhancement Projects – Riparian Function		No	Yes, there is still potential for more conservation easements.
USFS	Roadless Areas		Yes	See USFS/BLM Program Sufficiency Assessment -- Appendix E.
ODF	Forest Practices Act			See State of Oregon programmatic review -- Appendix F.
BLM	South Fork Walla Walla ACEC		Yes	See USFS/BLM Program Sufficiency Assessment -- Appendix E.
USFS	PACFISH, Umatilla Forest Plan		Yes	Existing actions are adequate as implemented, but additional protection areas should be added as the need is identified.
CTUIR	Rainwater		Yes	Maintain current project.
USACE, ODSL	Waterway work permitting		No	Funding is not adequate.
ODA, SWCD	Walla Walla Ag.WQM rules			See State of Oregon programmatic review -- Appendix F.
SWCD/CDs/WWBWC/Tr-state Steelheaders	Watershed restoration		No	Programs have inadequate resources.
Municipalities	Land use ordinances		No	
Counties	Comprehensive plan		No	

Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.				
FSA, NRCS, SWCD	CREP, CCRP, CSP, EQIP		Uncertain	The potential coverage of these programs has not been realized in Umatilla County.
OLCD	Statewide planning goals			See State of Oregon programmatic review -- Appendix F.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

CTUIR conservation easement programs have been effective at protecting and improving riparian habitat condition in the Walla Walla subbasin. There is potential for considerable expansion of this program. Emphasis should be placed on priority habitat areas for establishing easements.

The Umatilla National Forest should emphasize protecting priority areas during project planning and implementation. Ongoing management actions sufficiently protect high priority aquatic habitats. These existing protections should be continued. PACFISH/Forest Plan Programs per se are sufficiently protective for lands in current ownership and require changing management or increasing buffers only when need is identified site-specifically ("New" actions). Most of FS lands are already essentially fully protected under Forest Plan by protective management direction - Roadless and Wilderness and Wildlife Emphasis Management Areas that prohibit road building and forest practices except in rare circumstances; PACFISH protections apply to all such activities. When/if needs are identified; additional aquatic habitat could receive increased protective status and a "new action". Priority areas for habitat protection as listed above that reside within the Umatilla National Forest should be assessed as to whether administrative designations apply to the areas that will support protection of these areas over the long term. Adding additional wilderness areas and wild and scenic river segments would require designation by Congress.

Actions implemented under PACFISH on Federal lands allow for a near natural rate of recovery. An individual action may result in a short-term disturbance with minor effects. This assures that conditions are maintained over the long term.

While permit processes implemented by the US Army Corps are thorough and actions authorized are protective of aquatic resources, the program lacks personnel resources to insure that terms and conditions of permitted actions are followed. In addition, this agency lacks resources to adequately monitor waterways for non-permitted actions or act upon non-permitted situations reported by other agencies or private parties. See State of Oregon programmatic review -- Appendix F for ODSL.

The USFS land exchange program has the potential to bring existing private lands under federal ownership and PACFISH protections. However, this program is completely voluntary on the landowner's part and the landowner would acquire public land and could very likely lower standards of resource protection. The land exchange is, however, a tool that could be used under very controlled circumstances to see increased protection of important aquatic habitats. But the purpose of the program is focused on consolidating land holdings and not necessarily protection of habitat.

The Umatilla and Walla Walla Agricultural Water Quality Management (AgWQM) Area Rules require that management on agricultural lands allow the establishment, growth and maintenance of riparian or stream-side vegetation, consistent with site capability, to promote habitat and protect water quality by filtering sediment, stabilizing streambanks, naturally storing water, and providing shade. The AgWQM program is outcome-based rather than prescriptive, therefore allows landowners the flexibility to achieve water quality goals using available equipment, technology and innovation. The rules for each Management Area provide the enforceable backstop to the voluntary initiatives. The SWCDs are the local management agencies that provide the outreach, education and technical assistance. ODA is responsible for complaint investigations and enforcement actions. Technical and financial assistance is available through state and federal programs to landowners for establishing adequate riparian areas.

The CREP program agreements are for durations of 10 or 15 years. There is no guarantee that the benefits and management actions will be continued beyond the duration of the agreements.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Remove or replace barriers blocking passage such as dams, bridges, road culverts and irrigation structures	Priorities shown in Table 8-38. See Appendix G for the 22 culverts that need replacement.	Impaired fish passage	Dams, culverts, instream structures	Abundance, productivity, spatial structure, diversity	Primarily adults and 0+juveniles	A comprehensive on-the-ground survey of passage barriers in the Oregon portion of the subbasin has not been completed. All passage barriers in known steelhead habitat should be addressed in a prioritized fashion.
Construct ladders over existing permanent irrigation diversions	Priorities shown in Table 8-38	Impaired fish passage	Dams	Abundance, productivity, spatial structure, diversity	Primarily adults and 0+juveniles	
Operate and Maintain fish passage facilities	Diversions within current steelhead distribution are first priority (1)	Impaired fish passage and entrainment	Dams, culverts and Irrigation diversions	Abundance, productivity, spatial structure, diversity	All	There are cooperative projects in place in the Walla Walla subbasin to both physically maintain the facilities and provide biological oversight so they are operated to maintain optimum fish passage conditions.
Provide screening at 100% of irrigation diversions	Unscreened diversions within current steelhead distribution are first priority (1)	Impaired fish passage	Irrigation diversions	Abundance, productivity	All	In Oregon, all known gravity flow diversions are screened to NOAA criteria. It is not known to what extent that pump diversions are screened in the Oregon part of the subbasin. Pump diversions should be inventoried and addressed as soon as possible. The Little Walla Walla system is screened at the point of diversion, but diversions within this system where steelhead could be present, by swimming up the outlet in Washington, are not currently screened.
Replace screens that do not meet criteria	Diversions within current steelhead distribution are first priority (1)	Impaired fish passage	Irrigation diversions	Abundance, productivity	All	There are cooperative projects in place in the Walla Walla subbasin to maintain facilities and provide oversight so they are operated to maintain optimum fish passage conditions.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Remove or replace barriers blocking passage such as dams, bridges, road culverts	ODFW, CTUIR, WWBWC, CDs, TSS, road departments, private landowners	Ongoing	Fish access upstream of obstruction	Known issues addressed within 10 years	Immediate	High

Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.						
and irrigation structures						
Construct ladders over existing permanent irrigation diversions	ODFW, CTUIR, WWBWC, CDs, TSS, private landowners	Ongoing	Fish access upstream of obstruction	Known issues addressed within 10 years	Immediate	High
Operate and Maintain fish passage facilities	CTUIR, ODFW, HBDIC, GFID,, private landowners	Ongoing	Facility site	ongoing	Immediate	High
Provide screening at 100% of irrigation diversions	ODFW, CTUIR, private landowners	Ongoing	Point of diversion	Status of most pump diversions unknown, remediation up to10-20 yrs	Immediate	High
Replace screens that do not meet criteria	ODFW, CTUIR, private landowners	Ongoing	Point of diversion	Status of most pump diversions unknown, remediation up to 10-20 yrs	Immediate	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
CTUIR	BPA Fish Passage program		No	More funding needed.
ODFW	Fish Screening Program		Yes, for gravity diversions	Need to inventory and address pump screening.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

It is currently unknown to what extent pump diversions in the Oregon portion of the subbasin are adequately screened. Pump diversion should be inventoried to determine screening status and all diversions screened to NOAA criteria. Washington currently has an initiative underway to provide landowners with funding to screen their diversions. This effort should be continued until all diversions are adequately screened. There is also a need for a comprehensive inventory of screening needs throughout the Oregon portion of the basin as this has not been done to date.

Table 8-38 is a list of known passage barriers in the Walla Walla subbasin in the area occupied by the Walla Walla steelhead population. These barriers should be addressed in a prioritized manner.

Strategy 3. Maintain and restore floodplain connectivity and function.

Strategy 3. Maintain and restore floodplain connectivity and function.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Reconnect floodplains to channels	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn (2).	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Abundance, productivity	All	Watershed scale problems and riparian management issues should be considered before active stream channel restoration is employed.
Reconnect side channels and off-channel habitats to stream channels	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn (2); Little Walla Walla System (2); Yellowhawk System (2).	Degraded floodplain, altered hydrology, habitat quantity and diversity,	Removal of side channels, off-stream habitat	Abundance, productivity	All	Channel reconstruction, placement of instream structures and large woody debris in concert with riparian restoration can be used to restore functionality of stream channels. Watershed scale problems and riparian management issues should be considered before active stream channel restoration is employed. In areas where direct and immediate

Strategy 3. Maintain and restore floodplain connectivity and function.						
						benefits to viability parameters can be addressed, large woody should be placed to improve ecosystem function. In areas where other habitat deficiencies, such as flow and water quality, also exist, restoration should focus on these other factors first.
Remove dikes and levies	Walla Walla R., Mill Cr. to forks (1)	Degraded floodplain connectivity, channel structure and complexity	Stream channelization, bank armoring	Abundance, productivity	All	Many streams in the subbasin are bordered by dikes and levies.
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	Subbasin-wide	Degraded floodplain connectivity, channel structure/complexity, flow, water quality, sediment	Loss of beaver dams	Abundance, productivity	all	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Reconnect floodplains to channels	ODFW, WWBWC, SWCD, USFS, CTUIR, WDFW, BLM, Tri-state Steelheaders (TSS)	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Short term, once identified	Physical response will be immediate for some, others will develop over years to decades	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes
Reconnect side channels and off-channel habitats to stream channels	ODFW, WWBWC, SWCD, USFS, CTUIR, , WDFW, BLM, Tri-state Steelheaders	Ongoing	Effect on physical habitat features will be localized, but effects on water quality will have high dispersal downstream	Short term, once identified	Physical response will be immediate for some, others will develop over years to decades	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes
Remove dikes and levies	CTUIR, WWBWC, COE, private landonwers	When opportunity identified	Within the stream reach and reaches downstream for temp and sediment	10+ years	Improved stream and floodplain functions - Some benefits will be realized immediately and others will develop over years	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes
Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes.	ODFW, WDFW, private landowners	Ongoing	Subbasin-wide	Long term	Undefined	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
CTUIR	BPA Habitat Program	Subbasin-wide	No	More funding needed.
SWCD, CD's, WWBWC/TSS	Watershed Restoration	Subbasin-wide	Uncertain	More funding/implementation needed.
ODOT, County road depts, Municipalities	Bridge maintenance	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.
FSA, NRCS, SWCD, CD's	CREP, CCRP, CRP, EQIP	Subbasin-wide	Varies by program	Additional implementation needed.

Strategy 3. Maintain and restore floodplain connectivity and function.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
Intensive land uses within Walla Walla subbasin flood plains and upslope habitats have led to dramatic changes in waterway characteristics since arrival of Euro-American pioneers during the middle 1800's. The common outcomes of intensive land use activities in the subbasin include: 1) straight, incised channels with minimal woody riparian vegetation, and 2) wide channels with increased dynamics and minimal woody riparian vegetation. Site specific measures will be implemented within the context of an overall hierarchical strategy for prioritizing restoration actions. As implementation actions are planned, consideration will be first given to actions that address watershed processes and passive techniques, but artificial enhancement methods will be used where previous watershed assessment (2004) indicate that such work will lead to significant benefits for Mid-C steelhead and alternative approaches are not available.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural channel form	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1); Little Walla Walla System (2); Yellowhawk System (2)	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature, flows	Stream channelization, bank armoring, large wood removal, loss of beaver damsl, removal of riparian vegetation areas	Abundance, productivity	All	Stream channel reconstruction and instream structures can be designed to correct channel stability problems. Where appropriate, passive treatments are preferred.
Place stable wood and other large organic debris in streambeds	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1)	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	Removal of large wood, trees in riparian areas; channelization and streambank armoring, livestock grazing	Abundance, productivity	Fry to adult	Large, complex pools and riffle habitats with appropriate sized spawning gravels are missing within many areas. The preferred approach is to allow natural processes to restore these habitat elements. EDT has identified locations where significant benefit would occur if pools were introduced.
Stabilize and protect streambanks	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1); Little Walla Walla System (2); Yellowhawk System (2)	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	Stream channelization, bank armoring, livestock grazing in riparian areas	Abundance, productivity	Eggs, fry and adults	Incised or over steepened stream channels that reduce riffle habitat should be repaired through passive and active approaches where water quality is currently adequate to support spawning and rearing.
Construct rock and log weirs to create pool habitats or elevate incised channels	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1)	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	large wood removal, loss of recruitment trees in riparian area	Abundance, productivity	Fry to adult	Pools should be constructed strategically where other alternatives are not likely to accomplish this need, or constraints will not allow natural processes to form them. Artificial enhancement of pools should only be performed in areas where other parameters such as water quality would allow immediate use/benefit to be realized.

Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.						
Implement bridge maintenance BMPs	Subbasin-wide	Degraded channel structure and complexity	Stream channelization, bank armoring	Abundance, productivity	All	Many streams in the subbasin are bordered by dikes and levies.
Educate landowners on importance of LWD	Subbasin-wide	Loss of pool habitat, channel structure and complexity	Large wood removal	Abundance and productive	all	

Action Implementation

Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural channel form	ODFW, SWCDs, CTUIR, WWBWC, CDs, WDFW, BLM	Ongoing; some needs identified in ODFW/CTUIR five-year action plan	Within the stream reach and reaches downstream for temp and sediment	25 years	Improved riparian vegetation and associated attributes and improved stream and floodplain structure and function; response time immediate to 10 years	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes
Place stable wood and other large organic debris in streambeds	ODFW, WWBWC, CTUIR, CDs, WDFW, TSS, BLM	Ongoing as needed	Reach affected	Short term	Improved instream channel habitat diversity - Some benefits will be realized immediately and others will develop in 1-5 years	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes
Stabilize and protect streambanks	ODFW, CTUIR, SWCD, CDs, WWBWC, BLM, private landowners	Ongoing; when specific opportunity identified	Within the stream reach and reaches downstream for temp and sediment	10+ years	Improved water quality – response time 1-5 years	High, but there is more risk with active restoration approaches in experiencing undesirable outcomes
Construct rock and log weirs to create pool habitats or elevate incised channels	ODFW, CTUIR, CDs, WWBWC, TSS	Ongoing; current action planned for Meacham Cr.	Treatment site	25 years	Increased quantity of pool habitat and channel and floodplain function – response time Immediate to 5 years	High over short term, however structures often require maintenance
Implement bridge maintenance BMPs	USFS, ODOT, WDOT, County road departments	Ongoing	Site specific	Long term	Improved LWD and water quality; slow response time	Moderate, depends on compliance with BMPs
Educate landowners on importance of LWD	Stellar, WWBWC, ODFW, BLM, CTUIR	Ongoing	Subbasin-wide	Long term	Variable lag time depending on actions	Moderate

Status of Existing Programs through which Actions are Implemented

Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
CTUIR	BPA Habitat Program		No	More funding needed.
SWCD, CD's	Watershed Restoration		Likely	Involvement is currently limited. See State of Oregon programmatic review – Appendix F.
WWBWC/Tri-state Steelheaders	Watershed Restoration		No	There is a continuing need for landowner assistance to insure that issues are dealt with appropriately.
ODOT, County road depts.	Bridge maintenance			See State of Oregon programmatic review -- Appendix F.
FSA, NRCS, SWCD, CD's	CREP, CCRP, CRP, EQIP		Varies by program	Additional implementation needed.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

See discussion in Strategy 3, Walla Walla River population.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore natural riparian vegetative communities including vegetative planting	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1); Little Walla Walla System (2); Yellowhawk System (2)	Degraded riparian area, channel stability, floodplain degradation, sediment, water temperature	Livestock grazing, channelization, stream bank armoring	Abundance, productivity, diversity	All	Historically, bank armoring with rock and channelization were used to stabilize stream banks at the detriment of riparian vegetation growth. In the last 15 years the high economic and ecological cost of bank armoring with riprap and of channelization has been recognized, so the emphasis has shifted toward a more passive approach for stabilization, primarily through riparian vegetation improvements and bioengineering treatments
Develop grazing strategies that promote riparian recovery	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1); Little Walla Walla System (2); Yellowhawk System (2)	Degraded riparian area, channel stability	Livestock overgrazing of riparian area	Abundance, productivity, diversity	All	Grazing strategies, other than exclusion, should be developed to achieve riparian recovery in the next 10-15 years. Permanent or temporary exclusion of livestock from riparian areas remains the surest way to achieve riparian restoration where livestock have been the primary impact.
Develop no-cultivation riparian buffer on agricultural lands and establish riparian setbacks for structures in areas where activities could upset riparian function	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1); Little Walla Walla System (2); Yellowhawk System (2)	Degraded riparian area, channel stability, floodplain degradation, sediment, water temperature	Degradation of riparian areas and function; residential development and cultivation	Abundance, productivity, diversity	All	In areas where development is occurring, that development should be adequately set back from streams so as not to interrupt natural stream processes. Ordinances pertinent to fish habitat and water quality must be enforced.
Riparian exclosure fencing	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1); Little Walla Walla System (2); Yellowhawk System (2)	Degraded riparian area, channel stability	Livestock grazing	Abundance, productivity, diversity	All	Excluding livestock from riparian areas remains the most effective tool of mitigating livestock impacts.
Close, remove, and restore riparian road prisms	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1); Little Walla Walla System (2); Yellowhawk System (2)	Degraded riparian area, channel stability, sediment	Roads	Abundance, productivity, diversity	All	In many areas of the Walla Walla subbasin, riparian roads have reduced riparian vegetation, confined stream channels, and continue to deliver fine sediment to channels. Relocating roads outside riparian and sensitive areas or eliminating roads from riparian and sensitive areas has a positive effect on steelhead habitat by allowing natural riparian processes to be restored.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.						
Protect high quality riparian habitats and unstable areas	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr. (1); NF Walla Walla R., mouth to Little Meadows Cyn. (1); Little Walla Walla System (2); Yellowhawk System (2)	Degraded riparian area, channel stability, floodplain degradation, sediment, water temperature	All	Abundance, productivity, diversity	All	

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore natural riparian vegetative communities including vegetative planting	CTUIR, NRCS/FSA, WWBWC, SWCD, CDs, TSS, private landowners	Ongoing	High dispersal downstream from site	25 years	Improved riparian vegetation and associated attributes – response time 5 years to decades	Moderate – plant survival varies based on techniques used
Develop grazing strategies that promote riparian recovery	ODA, NRCS, USFS, CDs, private landowners	Ongoing	High dispersal downstream from site	Long term	Improved riparian vegetation and associated attributes – response time 5 years to decades	Depends on diligence of management applications
Develop no-cultivation riparian buffer on agricultural in areas where activities could upset riparian function	CTUIR, ODFW, WWBWC, WDFW, WDOE, private landowners, TSS, FSA/NRCS	Ongoing	Cultivated land in close proximity to priority habitat areas within the Umatilla subbasin	Long term	Immediate with continued improvement for up to 50 years or until easement ends and management changes. After 50 years habitat effectiveness will be maintained.	High
Riparian exclosure fencing	CTUIR,ODFW, NRCS/FSA, WWBWC, SWCD, CDs, private landowners, TSS	Ongoing	High dispersal downstream from site	25 years	Improved riparian vegetation and associated attributes – response time 5 years to decades	High
Close, remove, and restore riparian road prisms	USFS, ODOT, WDOT, counties, private landowners	Ongoing	Riparian areas within the subbasin where potential for riparian road closure and removal exists	Based on opportunity and need	Improved water quality – response time immediate with continued response for up to 50 years	High
Protect high quality riparian habitats and unstable areas	CTUIR, ODFW, NRCS/FSA, BLM, SWCD, USFS, WWBWC, CDs	Ongoing	High dispersal downstream	Long Term	Depends on specific situation	High

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODA, SWCD	Agricultural Water Quality Management Program	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.
FSA, NRCS, SWCD, CD's, WWBWC	CREP, CCRP, CSP, EQIP	Subbasin-wide	Varies by program	Greater participation by landowners is needed in Oregon. Many more stream miles to be treated. See State of Oregon programmatic review -- Appendix F.
ODFW	Fish Management Program	Subbasin-wide	Yes	
CTUIR	BPA Habitat Program		No	Many additional miles of stream need to be treated.
ODEQ	TMDL			See State of Oregon programmatic review -- Appendix F.
ODF	Forest Practices Act			See State of Oregon programmatic review -- Appendix F.
USFS, BLM	Grazing management, Forest Plan, Resource Management Plan, PACFISH		Yes	See USFS/BLM Program Sufficiency Assessment -- Appendix E.

Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.
Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
The Oregon Walla Walla River Water Quality Management Areas Plan (WQMAP) provides general guidance to landowners on management of riparian areas and there is some uncertainty regarding the implementation of this plan's requirements, as enforcement is based on a complaint-driven system. While there are ongoing programs to restore riparian vegetation, determination of limiting factors through use of the EDT model indicates that additional coverage is necessary.
The Umatilla and Walla Walla AgWQM Area Rules require that management on agricultural lands allow the establishment, growth, and maintenance of riparian or stream-side vegetation, consistent with site capability, to promote habitat and protect water quality by filtering sediment, stabilizing streambanks, naturally storing water, and providing shade. The AgWQM program is outcome-based rather than prescriptive, therefore allows landowners the flexibility to achieve water quality goals using available equipment, technology and innovation. The rules for each Management Area provide the enforceable backstop to the voluntary initiatives. The SWCDs are the local management agencies that provide the outreach, education and technical assistance. ODA is responsible for complaint investigations and enforcement actions. Technical and financial assistance is available through state and federal programs to landowners for establishing adequate riparian areas.
The CREP program agreements are for durations of 10 or 15 years. There is no guarantee that the benefits and management actions will be continued beyond the duration of the agreements.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Investigate feasibility of water storage or exchange to improve instream flows for steelhead	Walla Walla River, mouth to Little Walla Walla diversion (1)	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, diversity	Parr to adult	
Close areas to appropriation of new water uses	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr (2); NF Walla Walla R., mouth to Little Meadows Cyn (1). Little Walla Walla System (1)	Flows	Water withdrawals	Abundance, productivity, diversity	Parr to adult	Surface water flows are over appropriated in many areas of the Walla Walla subbasin. The various legal means available should be used to increase streamflows where assessments indicate that there is on-going take, or where steelhead production could be increased
File for additional ISWRs	Pine Cr. (2), Birch Cr. (1), Cottonwood Cr. (1), Walla Walla R. downstream of Little Walla Walla (1)	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, diversity	Parr to adult	
Set criteria to protect flows for fish habitat from new appropriations	Subbasin-wide in Washington	Flows, water quality	Water withdrawals	Abundance, productivity	Parr to adult	High flow events are critical for maintaining quality instream habitat, and water quality. With increasing water demands for agricultural, industrial, municipal and domestic uses, the potential for mining of high flow increases. It is important that planners realize the importance of high flows for the maintenance of aquatic habitats and water quality, and that these flows are protected.
Improve irrigation conveyance and efficiency	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr (2); NF Walla Walla R., mouth to Little Meadows Cyn (1); Little Walla Walla System	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity	All	
Enhance hyporheic flows and spring inputs	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr (2); NF Walla Walla R.,	Flows, water temperatures, habitat	Water withdrawals	Abundance, productivity,	All	

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
	mouth to Little Meadows Cyn (1).	quantity/diversity		diversity, spatial structure		
Implement shallow aquifer recharge	Little Walla Walla system (1)	Flow, temperature	Water withdrawals	Abundance, productivity	All	While progress has been made, many streams t historically flowed year- long are now intermitten creating fish passage barriers in the dewatered reaches. Many of these are due to water withdrawals for agricultural, industrial, municipal and domestic uses.
Aquifer storage and recovery	Lower Mill Cr. (1)	Flow, temperature	Water withdrawals	Abundance, productivity	All	
Lease or acquire water rights and convert to instream	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr (2); NF Walla Walla R., mouth to Little Meadows Cyn (1).	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, diversity, spatial structure	Parr to adult	
Downstream water rights transfers	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr (2); NF Walla Walla R., mouth to Little Meadows Cyn (1).	Flows, water temperatures, habitat quantity/diversity	Water withdrawals	Abundance, productivity, diversity	Parr to adult	
Monitor/regulate water withdrawals	Subbasin-wide (1)	Low flows, high temperatures	Water withdrawals	Abundance, productivity	Parr to adult	
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs	Population-wide	Low flows, high temperatures	Water withdrawals	Abundance, productivity, spatial structure, diversity	All stages	New programs in development.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Investigate feasibility of water storage or exchange to improve instream flows for steelhead	USACE, CTUIR	Ongoing	Mid and lower Walla Walla	Uncertain	Improvements to flow depend on timing, magnitude and location of flow enhancement	Now in planning stage; actual implementation actions and potential funding are unknown
Close areas to appropriation of new water uses in Washington	WDOE	On hold	Affected reaches and downstream	Uncertain	Maintenance of existing conditions	High
File for additional ISWRs	ODFW, OWRD	On hold	Specific to the stream reach	Unknown	Maintenance of existing conditions	High, depends on how resource managers implement protection
Set criteria to protect flows for fish habitat from new appropriations	WDOE, WDFW	Ongoing	Affected reaches and downstream	Uncertain	Maintenance of existing conditions	Unknown
Enhance hyporheic flows and spring inputs	WWBWC, CTUIR, CDs	Ongoing	On site and downstream	Long term	Improved instream flow and water quality – response time depends on specific action	Depends upon specific approach used
Improve irrigation conveyance and efficiency	SWCD, WWBWC, private landowners, irrigation districts	Ongoing	Depends on means used to protect instream flows	Short term	Improved instream flow; response immediate	Moderate – depends on how saved water is protected, if any.
Implement shallow aquifer recharge	WWBWC, WDOE, HBDIC, GDID, WWRID, private landowners		Down gradient	Long term	Improved instream flow – uncertain response time	Undetermined

Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.						
Aquifer storage and recovery	City of Walla Walla	Ongoing	Downstream of Mill Creek POD	Long term	Improved instream flow – uncertain response time	Long term effectiveness is unknown
Lease or acquire water rights and convert to instream	OWRD, Oregon Water Trust, water right holders	Ongoing, when opportunities arise	Depends on means used to protect instream flows	10-15 years	Immediate	moderate, depending upon how saved water is protected
Downstream water rights transfers	OWRD, private landowners, irrigation districts	Ongoing	Reach between old and new point of diversion	Long term	Improved instream flow; response immediate	High
Monitor/regulate water withdrawals	OWRD, WDOE	Ongoing	From the point of diversion downstream to the mouth of Walla Walla River	Long term	Maintenance or improvement of existing conditions; response to regulation immediate	Moderate, staffing levels are inadequate
Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs	OWRD	Ongoing	Population-wide	2007-2009 except incentive funding ongoing	Long term	Moderate

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
USACE, CTUIR	Flow Restoration Feasibility Study	Lower Walla Walla	Unknown	
OWRD	Streamflow Monitoring and Restoration, Flow Restoration, Lease/Transfer Water Rights, Administration of Water Rights, Water Use Measurement, Water Needs Assessment, Storage Assessment, Conservation Assessment	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.
Oregon Water Trust, BPA	Leasing and Purchase of Water Rights	Walla Walla River	No	Needs expansion.
SWCD, Watershed Council, WWRID, HBDIC, GFID	Improve irrigation efficiency	Walla Walla R., Mill Cr. to forks; SF Walla Walla mouth to Elbow Cr; NF Walla Walla R., mouth to Little Meadows Cyn.	Varies by program	Needs expansion.
NRCS, Watershed Council	Upland improvements, riparian improvements	Subbasin-wide	No	Needs expansion.
ODF	Forest Practices Act	Subbasin-wide	Likely	See State of Oregon programmatic review -- Appendix F.
BPA	Columbia Basin Water Transaction Prgm	Walla Walla R., Mill Cr. to forks; SF Walla Walla mouth to Elbow Cr.; NF Walla Walla R., mouth to Little Meadows Cyn.	No	Needs expansion.
WDOE	Water Management Initiative	Walla Walla R., Mill Cr. to forks		

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
Significant progress has been made regarding flow issues on the mainstem Walla Walla River as a result of the Civil Penalty Agreement between the USFWS and three irrigation districts. However, significant flow issues remain along the Walla Walla River, NF Walla Walla R., Couse Cr., Dry and Pine creeks (Oregon) and Mill Creek. The Walla Walla subbasin has approximately 50 miles of stream protected by instream water rights. Voluntary flow restriction projects restored 4.4 cfs of flow in 2006.
The Walla Walla subbasin has approximately 50 miles of stream protected by instream water rights. Voluntary flow restoration projects restored 4.4 cfs of flow in 2006.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Address point sources of water pollution	Pine Creek (1), Walla Walla River (1)	Chemical pollution	Pesticides, fertilizers, herbicides	Abundance, productivity	All	Point sources of water pollution are direct impacts that should be corrected through implementation of the TMDL and associated water quality management plan.
Implement pest management plans for fruit growers	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr (1); NF Walla Walla (1)	Water quality	Pesticides, fertilizers, herbicides	Abundance, productivity	All	
Improve municipal stormwater management and treatment	Walla Walla R., Mill Cr. to forks (1)	Water quality	Stormwater management	Abundance, productivity	All	
Permit waterway alteration activities and enforce rules	Subbasin-wide					
Implement water quality management plans	Walla Walla River (1)	Degraded water quality, flows, sediment routing, water quality	Land use practices, water withdrawals, pesticides, fertilizers, herbicides	Abundance, productivity	All	
Permit and enforce actions that could affect water quality	Subbasin-wide	Water quality	Land use practices,	Abundance, productivity, diversity	All	Directed actions at known sources of thermal pollution and sediment should be addressed through BMPs and improvement projects.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Address point sources of water pollution	ODEQ, WDOE	Ongoing	Subbasin-wide	Ongoing	Reduce chemical pollution immediately	High
Implement pest management plans for fruit growers	ODEQ, OSU, Ext. WWBWC, fruit growers	Ongoing	NF, SF, mainstem Walla Walla and Little Walla Walla system	Long Term	Reduced mortality of food items and issues with fish toxicology – minor response expected	Moderate
Improve municipal stormwater management and treatment	municipalities	Ongoing	Within city limits. High dispersal downstream	Long term	Improved water quality – immediate response	Uncertain
Permit waterway alteration activities and enforce rules	USACE, ODSL	Ongoing	Subbasin-wide	Ongoing	Variable lag time depending on actions	Moderate, current implementation of permit requirements are very specific and conservative
Implement water quality management plans	ODA, SWCD, Municipalities, CDs, USFS, BLM, ODF, Irrigation Districts, private landowners, Industry, ODEQ	Ongoing	High dispersal downstream	Ongoing	Immediate	Moderate – degree of implementation is uncertain

Strategy 7. Improve degraded water quality and maintain unimpaired water quality.						
Permit and enforce actions that could affect water quality	ODEQ, WDOE	Ongoing	Subbasin-wide	Ongoing	Variable lag time depending on actions	Ability of agencies to enforce water quality violations appears limited by staffing.

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
ODA, SWCD	Agricultural Water Quality Management Program	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.
FSA, NRCS, SWCD, CD, WWBWC	CREP, CCRP, CSP, EQIP	Subbasin-wide	Varies by program	Greater participation by landowners is needed in Oregon. Many additional miles of stream to be treated. See State or Oregon programmatic review – Appendix F.
CTUIR	BPA Habitat Program	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr (2).; NF Walla Walla R., mouth to Little Meadows Cyn (1).	No	Many additional miles of stream to be treated.
USFS, BLM	Grazing management, Forest Plan, PACFISH	Upper Subbasin	Yes	See USFS/BLM Program Sufficiency Assessment -- Appendix E.
USACE/ODSL	Waterway work permitting	Subbasin-wide	Uncertain	See State of Oregon programmatic review -- Appendix F for ODSL.
ODF	Forest Practices Act	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.
ODEQ	Water Quality	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.
ODEQ, EPA	Pesticides/Toxics	Subbasin-wide		See State of Oregon programmatic review -- Appendix F for ODEQ.
Municipalities	Public Works		No	

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)

This threat is partially addressed by the Oregon Walla Walla River WQMAP, see discussion for Strategy in Section 5.

Implementation of PACFISH standards and guides for Forest and BLM programs, in conjunction with Forest Plan Management Area allocations, has been highly successful for passive upland restoration over most of this population's area.

The TMDLs set loading capacity to achieve water quality standards. To address high summer water temperatures, near stream vegetation disturbance, channel widening and low flows are the existing sources of increased solar radiation loading. Achievement of the TMDL targets is dependent of determination of system potential vegetation. During TMDL development, the best professional judgment of the team described the potential streamside shade-producing vegetation broadly, as continuous tree-belts on each side of the river.

While permit processes implemented by the US Army Corps of Engineers are thorough and actions authorized are protective of aquatic resources, the program lacks personnel resources to insure that terms and conditions of permitted actions are followed. In addition, this agency lacks resources to adequately monitor waterways for non-permitted actions or act upon non-permitted situations reported by other agencies or private parties. See State of Oregon programmatic review -- Appendix F for ODSL.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
Strategic Actions and Impacts on Limiting Factors, Threats, and Population						
Actions	Geographic Locations (1-first priority, 2-second priority)	Factors Addressed	Threats Addressed	VSP Parameters Addressed	Life Stages Affected	Discussion
Restore native upland plant communities	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr (1); NF Walla Walla R.,	Altered hydrology, sediment routing, channel stability,	Forestry, roads, overgrazing,	Abundance, productivity	All	

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
	mouth to Little Meadows Cyn (1).	floodplain and riparian area degradation, water quality	agricultural practices, noxious weeds			
Upgrade or remove problem forest roads	NF Walla Walla (1), SF Walla Walla (1)	Altered hydrology, sediment routing	Road network	Abundance, productivity	All	
Control noxious weeds through physical removal and chemical and biological agents	Subbasin-wide	Loss of native vegetation and watershed function	Noxious weed	Abundance, productivity	All	Control of noxious weeds is generally an issue that is not currently being addressed adequately at a regional scale.
Implement CREP and CCRP buffers	Walla Walla R., Mill Cr. to forks (1); SF Walla Walla mouth to Elbow Cr (1); NF Walla Walla R., mouth to Little Meadows Cyn (1)	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Agricultural practices	Abundance, productivity	All	
Initiate upland improvement demonstration projects	Subbasin-wide	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices	Abundance, productivity	All	
Conduct outreach to resource users and managers	Subbasin-wide	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices	Abundance, productivity	All	
Demonstration projects to restore forest health and resilience to wildfire	Private and state forest lands	Altered hydrology, sediment, water quality, riparian functions, LWD recruitment	Conversion of vegetative communities	Abundance, productivity	All	Suppression of fires has altered fire regimes and increased threat of high intensity fires.
Apply BMPs to forest practices including fuels management and fire suppression mitigation, livestock grazing, road management and agricultural practices	Subbasin-wide	Altered hydrology, sediment routing	Forestry, roads, overgrazing, agricultural practices, noxious weeds	Abundance, productivity	All	Upland land management practices affect the hydrologic function of the watershed, by causing rapid runoff rather than infiltration. BMPs should be implemented to insure that the watershed functions to its potential, given the anthropogenic influence in the watershed.

Action Implementation						
Actions	Implementing Entity	Status	Spatial Coverage	Implementation Timeframe	Expected Biophysical Response Timeframe	Certainty of Outcome
Restore native upland plant communities	SWCD, USFS, NRCS, BLM, ODF, Counties, private landowners	Ongoing	Effects of higher precipitation infiltration rates will have high dispersal downstream	Long term		
Upgrade or remove problem forest roads	BLM, ODF, private landowners	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term, many forest roads have legacy issues with regard to sediment transport and routing of runoff.	5-15 years	Moderate, although funding on public lands and landowner cooperation on private lands will determine rate of treatment
Control noxious weeds through physical removal and chemical and biological agents	County public works dept., public and private landowners, USFS, BLM	Ongoing	Subbasin-wide	Long term	Improvements to water quality expressed in decades	Uncertain. This is a broad landscape issue that is currently underfunded

Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.						
Implement CREP and CCRP buffers	FSA, NRCS, SWCD, CDs, private landowners	Ongoing, when opportunities available	High dispersal downstream	Depends on funding availability	5 years to decades	High
Initiate upland improvement demonstration projects	ODFW, WDFW, NMFS, USFWS, USFS, BLM, CTUIR, WWBWC, WDOE, SWCDs, CDs, TSS	Ongoing	Entire subbasin	Long term	Variable lag time	Unknown, depends upon action taken as a result of being more informed
Conduct outreach to resource users, managers, general public	ODFW, WDFW, NMFS, USFWS, USFS, BLM, CTUIR, WWBWC, WDOE, SWCDs, CDs	Ongoing	Entire subbasin	Long term	Variable lag time depending on actions	Unknown
Demonstration projects to restore forest health and resilience to wildfire	ODF	Ongoing	Private and state forest lands	Long term	Variable 5-20 years	Moderate
Apply BMPs to forest practices including fuels management and fire suppression mitigation, livestock grazing, road management and agricultural practices	NRCS, ODF, USFS, BLM, WDOE, SWCD, CDs, ODA, CTUIR, private landowners	Ongoing	Reduced sediment and improved hydrologic function will have high dispersal downstream	Long term	Improvements to water quality expressed in years to decades; improvements in riparian vegetation and all associated attributes response time 5 years to decades	Moderate, depends on participation

Status of Existing Programs through which Actions are Implemented				
Agency/Organization	Program Name	Geographic Locations	Sufficient* (yes, likely, uncertain, no)	Sufficiency Rationale
CTUIR	Rainwater	Subbasin-wide	Yes	Maintain current project.
County Public Works	Weed Control	Subbasin-wide	No	Funding not adequate to meet the needs.
ODA	Agricultural Water Quality Management Program	Subbasin-wide		See State of Oregon programmatic review -- Appendix F.
ODF	Oregon Forest Practices Act	Private and state forest lands		See State of Oregon programmatic review -- Appendix F.
SWCD/CD's	Watershed restoration	Subbasin-wide	Uncertain	
FSA,NRCS, SWCD, CD's	CREP,CCRP,CRP,EQIP	Subbasin-wide	Varies	Needs more coverage. See State of Oregon programmatic review -- Appendix F for SWCD.
ODOT	Weed control	Subbasin-wide		Program reviewed in State assessment.
Municipalities	Public Works	Subbasin-wide	No	Additional improvements needed.
SWCD	Direct Seed Program			Additional landowner assistance needed.
USFS, BLM	Forest Plan, Resource Management Plan, PACFISH	Federal lands	Yes	See USFS/BLM Program Sufficiency Assessment -- Appendix E.

Program Sufficiency and Gaps (including current and near-term efforts, and additional efforts needed, constraints)
Additional effort is needed to protect native plant communities and associated watershed functions. Vegetation management across the watershed varies in approach widely.

Table 9-3. Restoration Priority Geographic Areas from the Walla Walla Subbasin Plan (NPCC 2004).

GA	Description
27	Walla Walla River, Mill Cr. to East Little Walla Walla
31	Walla Walla River, East Little Walla Walla to Tumalum Bridge
35	Walla Walla River, Tumalum Bridge to Nursery Bridge
36	Walla Walla River, Nursery Bridge to Little Walla Walla Diversion
37	Walla Walla River, Little Walla Walla Diversion to forks
41	South Fork Walla Walla, mouth to Elbow Creek
39	North Fork Walla Walla, mouth to Little Meadows Canyon (plus Little Meadows Can.)
3	Coppei Drainage
4	Touchet River, Coppei to forks
10	South Fork Touchet Mainstem
11	South Fork Touchet Tribs
6	North Fork Touchet Mainstem
7	North Fork Touchet Tribs (excluding Wolf Fork)
8	Wolf Fork, mouth to Coates (plus Robinson and Coates)
9	Wolf Fork, Coates to access limit (plus Whitney)

Table 9-4. Protection Priority Geographic Areas from the Walla Walla Subbasin Plan (NPCC 2004).

GA	Description
	All Priority Restoration Geographic Areas
43	South Fork Walla Walla, Elbow to access limit
45	Skiphorton and Reser Creek Drainages
42	Lower SF Wall Walla Tribs (Flume Canyon, Elbow)
44	Upper SF Walla Walla Tribs (excluding Skiphorton and Reser)
40	North Fork Walla Walla, Little Meadows to access limit (plus Big Meadows)
5	Patit Drainage
17	Walla Walla River, Dry to Mill
32	Yellowhawk mainstem (mouth to source)
	Headwaters**
38	Couse Creek Drainage

**Headwaters is an assemblage of reaches covering the bull trout bearing (present or potential) waters upstream of the present reaches designated through the EDT process.

Table 9-5. Walla Walla Subbasin Geographic Areas.

GA	Stream	Segment	MaSA	MiSA
1	Walla Walla River	Mouth to Touchet River		
2	Touchet River	Mouth to Coppei Creek	NA	NA
3	Coppei Drainage	Mouth to presumed Steelhead access limit	NA	NA
4	Touchet River	Coppei to forks, including Whiskey Creek	NA	NA
5	Patit Drainage	Mouth to presumed steelhead access limit	NA	NA
6	North Fork Touchet	Mouth to presumed steelhead access limit	NA	NA
7	North Fork Touchet tribs	Rodgers, Jim, Weidman, Lewis and Spangler creeks; all from mouths to presumed steelhead access limit	NA	NA
8	Wolf Fork	Mouth to Coates Creek; also includes Robinson Cr and Coates Cr; mouths to presumed steelhead access limit	NA	NA
9	Wolf Fork	Coates Cr to presumed steelhead access limit; also includes Whiskey Cr mouth to presumed steelhead access limit	NA	NA
10	South Fork Touchet	Mouth to presumed steelhead access limit	NA	NA
11	South Fork Touchet tribs	Dry Fork SF Touchet, Griffin Fork, North Griffin Fork, Beaver Slide, Green Fork and Burnt Fork; mouths to presumed steelhead access limits	NA	NA
12	Walla Walla River	Mouth Touchet River to Dry Cr, including Mud Cr mouth to presumed steelhead access limit		
13	Pine Creek	Mouth to presumed steelhead access limit and Swartz Cr mouth to presumed steelhead access limit	Pine	

GA	Stream	Segment	MaSA	MiSA
14	Dry Creek Drainage (Pine)	Dry Cr (trib to Pine) mouth to presumed steelhead access limit	Pine	
15	Lower Dry Cr	Dry Cr (trib to Walla Walla), mouth to Sapolil Rd crossing	Dry	
16	Upper Dry Cr	Dry Cr (trib to Walla Walla). Sapolil Rd crossing to confluence of NF and SF Dry creeks	Dry	
17	Dry Cr tribs	Mud Cr (trib to Lower Dry Cr) , Mud Cr (trib to Upper Dry Cr, NF Dry Cr and SF Dry Cr; mouths to presumed steelhead access limit	Dry	
18	Walla Walla River	Dry Cr to Mill Cr		
19	West Little Walla Walla	West Little Walla Walla River Drainage and Walsh Cr drainage		
20	Mill Cr	Mouth to start of US Army Corps of Engineers project at Gose St near Walla Walla	Mill	
21	Mill Cr	Gose St to Bennington Dam	Mill	
22	Mill Cr	Bennington Dam to Blue Cr and Titus Cr drainage	Mill	
23	Blue Cr Drainage	Mouth to presumed steelhead access limit and Little Blue Cr mouth to presumed steelhead access limit	Mill	
24	Mill Cr	Blue Cr to City of Walla Walla water intake	Mill	
25	Middle Mill Cr tribs	Henry Canyon Cr, Webb Canyon Cr, Tiger Canyon Cr; mouth to presumed steelhead access limit	Mill	
26	Mill Cr	City of Walla Walla Water intake to presumed steelhead access limit	Mill	
27	Upper Mill Cr tribs	NF Mill Cr, Low Cr, Broken Cr, paradise Cr; mouth to presumed steelhead access limit	Mill	
28	Walla Walla River	Mill Cr to East Little Walla Walla River and McEvoy Cr and Springbranch		
29	Garrison Cr Drainage	Includes Bryant Cr and all Walla Walla Urban streams	Cottonwood	
30	Stone Cr Drainage	All	Cottonwood	
31	East Little Walla Walla Drainage	East Little Walla Walla Drainage; Unnamed Spring; Big Spring Cr, mouth to presumed steelhead access limit		
32	Walla Walla River	East Little Walla Walla To Tumalum Bridge	Walla Walla	
33	Yellowhawk mainstem	Yellowhawk drainage mouth to source	Cottonwood	
34	Cottonwood Cr Drainage	Including NF, MF and SF, mouth to presumed steelhead access limit	Cottonwood	
35	Birch Creek Drainage	Mouth to presumed steelhead access limit	Walla Walla	
36	Walla Walla River	Tumalum Br to Nursery Br	Walla Walla	
37	Walla Walla River	Nursery Br to Little Walla Walla Diversion	Walla Walla	
38	Walla Walla River	Little Walla Walla Diversion to forks	Walla Walla	
39	Couse Cr	Mouth to presumed steelhead access limit	Walla Walla	
40	North Fork Walla Walla	Mouth to Little Meadows Canyon and Little Meadows Canyon mouth to presumed steelhead access limit	Walla Walla	
41	North Fork Walla Walla	Little Meadows Canyon to Big Meadows Canyon and Big Meadows Canyon mouth to presumed steelhead access limit	Walla Walla	
42	South Fork Walla Walla	Mouth to Elbow Cr	Walla Walla	
43	Lower SF Walla Walla tribs	Flume Canyon Cr and Elbow Cr, mouth to presumed steelhead access limit	Walla Walla	
44	South Fork Walla Walla	Elbow Cr to presumed steelhead access limit	Walla Walla	
45	Upper South Fork Walla Walla tribs	Bear Cr, Kees Canyon Cr, Burnt Cabin Gulch, Swede Canyon, Table Cr, Husky Spring Cr, Bear Trap Springs; mouth to presumed steelhead access limit	Walla Walla	
46	Skiphorton & Reser Creek drainages	Mouth to presumed steelhead access limit	Walla Walla	

Note: Minor spawning areas within the Walla Walla subbasin not represented include: Woodward Canyon, Switzler, Vansyckle Canyon, Juniper, Spring Valley and Below Spring Valley.

9.4 Hydrosystem Strategies and Actions

Hydropower system operations and configurations on the mainstem Columbia remain a major factor limiting the viability of the Mid-Columbia River steelhead DPS. The ICTRT (2006) ranked the mainstem hydrosystem as one of the key limiting factors. Tributary dams that provide hydroelectric power also block and/or impair steelhead passage and habitats in several populations.

9.4.1 Mainstem Columbia River Hydropower Operations and Configurations

Recovery strategies and actions address both configurations and operations of the Columbia River hydroelectric system. Actions range from improving passage at particular dams to addressing flow and temperature issues. The following mainstem hydropower strategies and management actions include actions from the May 2008 Biological Opinion for the Federal Columbia River Power System (NOAA Fisheries 2008), as well as additional and alternative actions recommended by the State of Oregon. It is the position of the State of Oregon that additional or alternative actions should be taken in mainstem operations of the FCRPS for ESA-listed salmon and steelhead. Some additional or alternative actions recommended by Oregon, while considered, were not included in the FCRPS action agencies' proposed action or NOAA's FCRPS Biological Opinion. At the time this proposed recovery plan was being finalized, Oregon was a plaintiff in litigation against various federal agencies, including NOAA, challenging the adequacy of the measures contained in the current FCRPS Biological Opinion. Mainstem hydrosystem actions that improve survival are considered high priority because the survival benefits will be realized by all populations in the Mid-C DPS. We have provided a summary of strategies and reasonable and prudent alternatives (RPAs) taken directly from the FCRPS BiOp followed by the additional and alternative actions sought by the State of Oregon.

> *Hydropower Strategy 1*: Operate the FCRPS to provide flows and water quality to improve juvenile and adult fish survival.
>
> RPA 4: The action agencies will operate the FCRPS storage projects for flow management to aid anadromous fish.
>
> RPA 5: The action agencies will operate the FCRPS run-of-river mainstem lower Columbia River and Snake River projects to minimize water travel time through the lower Columbia and Snake rivers to aid in juvenile fish passage.
>
> RPA 6: In-season water management via water management plans and by the Regional Forum.
>
> RPA 7: To address forecasting and climate change/variability the action agencies will hold annual forecast performance reviews and report on effectiveness of experimental or developing/emerging technologies.
>
> RPAs 8-9: Manage for operations and fish emergencies.

RPAs 10-13: Columbia River Treaty and non-Treaty storage management, agreements, and coordination.

RPA 14: Manage flow during dry years to maintain and improve habitat conditions for ESA-listed species.

RPA 15: The action agencies will continue to update the Water Quality Plan for Total Dissolved Gas and Water Temperature temperature in the mainstem Columbia and Snake rivers, and implement water quality measures to enhance ESA-listed juvenile and adult fish survival and maintain spawning and rearing habitat.

Hydropower Strategy 2: Modify Columbia and Snake river dams to maximize juvenile and adult fish survival.

RPAs 18-21: The Corps will prepare, in cooperation with NOAA Fisheries and co-managing agencies, configuration and operational plans for the Bonneville Project (2008), The Dalles Project, John Day Project (2008) and McNary Project (2009).

RPA 27: The action agencies will operate turbine units to achieve best fish passage survival (currently within 1% of best efficiency at mainstem dams on the lower Columbia and lower Snake rivers.

RPA 28: The Corps will implement structural improvements to adult passage at the mainstem Columbia River and Snake River projects.

Hydropower Strategy 3: Implement spill and juvenile transportation improvements at Columbia River and Snake River dams.

RPA 29: The Corps and BPA will provide spill to improve juvenile fish passage while avoiding high TDG supersaturation levels or adult fallback problems.

RPA 30: Continue the juvenile fish transportation program toward meeting system survival performance metrics.

Hydropower Strategy 4: Operate and maintain facilities at Corps' mainstem projects to maintain biological performance.

RPA 32: The Corps will prepare annually a fish passage plan in coordination with NOAA and the Regional Forum. The Corps will operate its projects year around in accordance with the criteria in the fish passage plan.

At the time this proposed recovery plan was finalized, it was the position of the State of Oregon that additional or alternative actions should be taken in mainstem operations of the FCRPS for ESA-listed salmon and steelhead.

The State of Oregon recommends the following additional and alternative actions to better address survival and recovery needs of Mid-Columbia steelhead (see State of Oregon (2008) comments on Draft 2007 FCRPS Biological Opinion and State of Oregon's Supplemental Complaint-In-Intervention For Declaratory and Injunctive Relief (July 22, 2008) for detailed actions included here by reference).

- Draft storage reservoirs to meet lower Columbia summer flow and velocity equivalent objectives on a seasonal and weekly basis.
- Operate reservoirs at rule curves and seek additional flow augmentation volumes from Snake River and Canadian reservoirs to better meet spring and summer flow and velocity objectives.
- Operate John Day reservoir at minimum operating pool during spring and summer as long as barge transport and irrigation needs are met.
- Provide spill to total dissolved gas limits of water quality waivers or biological constraints at all dams, except maximize transportation at Snake River collector projects during lowest (10^{th} percentile) flow years.
- Maintain approximately 50/50 in-river and transportation proportions for spring and summer migrants in the Snake River by optimizing spill and surface-oriented routes of dam passage and transporting fish collected in the turbine screen bypass systems.
- Continue to provide spill and bypass all fish at McNary Dam at all flows during the spring migration period.
- Before reducing full spill, test removable spillway weirs and temporary spillway weirs to ensure they provide equal or better benefits than full spill.
- Establish more rigorous research, monitoring, and evaluation to assure that fish survival is increasing and to inform adaptive management.
- Identify and prepare contingency actions for implementation if necessary to meet fish performance standards linked to survival and recovery requirements of listed fish.

9.4.2 Tributary Hydropower Operations and Configurations

Hydropower development and operations affect the viability of four existing Mid-C steelhead populations in Oregon: Deschutes River Eastside, Deschutes River Westside, Umatilla River and Walla Walla River. The dams are also key factors affecting the potential recovery of now extinct steelhead populations in the Crooked River and Willow Creek systems.

Deschutes River Populations

The following strategies and actions are for the Deschutes Westside, Deschutes Eastside and extinct Crooked River populations. They focus on developing effective downstream collection and passage of steelhead smolts through the Pelton-Round Butte Complex on the Deschutes River. The passage strategy at the complex is to construct a Selective Water Withdrawal (SWW) and a Fish Collection Facility. The SWW is designed to modify flow patterns in the reservoir so that fish will be attracted to the entrance of the facility during their out-migration. The fish will them be enumerated, marked and transported to the lower Deschutes River, to continue their out-migration. The construction of the selective water withdrawal is scheduled for completion in 2009. The SWW will also have an intake near its bottom, so it can draw cold water during summer and fall to mix with warmer surface water. This will maintain appropriate downstream

temperatures in the lower Deschutes River. An adaptive management strategy will continue to be used to implement facility improvements based on monitoring and evaluation with the goal of achieving high passage efficiencies at the barrier.

Strategy 1: Restore sustainable natural steelhead production to blocked habitats in the Deschutes River Westside, Deschutes River Eastside, and the extinct Crooked River populations.

Management actions

1. Develop effective downstream collection and passage for smolts through the Pelton-Round Butte Complex.
2. Improve flow patterns through the reservoir to provide effective juvenile migration.
3. Modify Pelton-Round Butte Complex operating procedures to restore downstream water quality to meet State and Tribal water quality criteria.

Success in re-establishing runs of summer steelhead above Pelton-Round Butte Complex will depend substantially on the degree to which the new SWW and fish collection facility enable the steelhead to migrate effectively from the mouths of tributary streams and past Lake Billy Chinook during their out-migration. Adaptive fish management and improvements to altered streams above LBC will both be important, but effective fish passage through the reservoir will be a necessary prerequisite to any success in establishing runs that can sustain themselves. With this in mind, reintroductions of steelhead will occur in two phases. Phase 1 will emphasize introductions of pathogen-screened juveniles above Pelton-Round Butte Complex, to test the ability of the new SWW facility to change surface currents in LBC and collect out-migrant smolts. Actions taken during Phase 1 will also (1) begin to test recent estimates of fish production potential in habitat above Pelton-Round Butte Complex, (2) examine fish stock performance in the available habitat, (3) continue rehabilitating altered habitats, and (4) produce modest returns of adult fish. When smolt passage through LBC and into the fish collection facility meets agreed-upon measures of success[1], the reintroduction program will transition into Phase 2 in which adults returning to the upper basin (i.e., after rearing as juveniles above Round Butte Dam) are passed upstream and continued releases of pathogen-screened juveniles into the upper basin will use fish of the fittest lineages available. The exact timing and/or duration of shifts toward more or less intense releases of juvenile fish during this second phase of the reintroduction effort may differ for each subbasin.

Reintroduction Phase 1. During Phase 1 of the reintroduction effort for summer steelhead, the numbers of fish released into specific upper basin streams will be based on interactions between

[1] Measures of success include changes in reservoir surface currents, effective migration patterns of radio-tagged smolts (a biological response to the currents), and passage efficacy of about 50 percent for one or more species from one or more arms of the reservoir. The 50 percent reservoir survival target identified in the Settlement Agreement and in Table 4-1 of this Plan was originally intended to be a trigger for constructing permanent downstream passage facilities at Round Butte Dam, not as the single determining factor for permitting upstream adult passage at PRB. Consistent with adaptive management provisions included in the Settlement Agreement the decision to make the transition to upstream adult passage of known-origin fish will be based on numerous indicators and mitigating factors, and will be well-founded on sound biological principles. The indicators will include the 50 percent survival value, a value that modeling by Beamesderfer (2002) suggested was an approximate threshold for population sustainability.

statistical needs of fish passage studies (Skalski and Townsend 2007), habitat capability (Cramer and Beamesderfer 2006), and realistic assumptions about the opportunity to trap smolts after they have been produced in habitats above the reservoir. In the watersheds (Whychus Creek, and/or Crooked River) where it is reasonable to expect that adequate numbers of naturally-reared smolts could be produced, trapped, and marked prior to entering Lake Billy Chinook, fry releases will meet or exceed those estimated to be needed to produce the required numbers of marked naturally produced smolts for reservoir passage tests. Where fry releases into a particular major subbasin appear unlikely to provide enough naturally-produced smolts to meet the statistical demands of fish passage tests, releases will be less intense but sufficient to begin testing habitat suitability, begin evaluating fish performance, and (potentially) to produce small numbers of returning adults.

During Phase I there will also be direct releases into the upper basin of tagged hatchery-produced smolts that have been pathogen-screened. These fish will be given unique marks that can be distinguished from naturally-reared smolts , and released in numbers that will be large enough to meet the statistical demands of reservoir passage tests for smolts leaving each of the three major subbasins tributary to Lake Billy Chinook. Releases of hatchery smolts for reservoir passage tests will either provide information supplemental to that obtained from tests of naturally reared smolts or enable statistically meaningful passage tests where they would otherwise be infeasible.

Each naturally-reared smolt that successfully negotiates Lake Billy Chinook and leaves the upper basin via the SWW facility during Phase 1 will either be given a PIT-tag or will be marked with unique fin clips. The PIT-tags will allow additional data collection on fish as they migrate to and from the ocean. The tag or unique fin clips will allow managers to assure that the fish will (1) avoid directed harvest and therefore experience lower harvest rates as they pass through fisheries when returning as adults, and (2) be identified as having upper basin origins when they arrive as adults at the Pelton Trap. Naturally-reared adults arriving at the trap will be passed upstream during Phase 2.

Reintroduction Phase 2. The criteria for moving from Phase 1 to Phase 2 is when 50% of the smolts captured at one of the reservoir arms migrating through Lake Billy Chinook are subsequently recaptured at the SWW fish collection facility. Once this criteria is reached the reintroduction program will transition into Phase 2. In this phase adult fish returning to the Pelton Trap, after having reared as juveniles above Pelton-Round Butte Complex, will be passed into the upper basin, including those fish that reared in the upper basin during Phase 1. A small fraction of the returnees may be used as broodstock. Natural-origin fish will be used during Phase 2 if possible.

Fish releases above Round Butte Dam during this phase of the program will be intended to develop locally adapted populations, with the numbers of young fish released into specific upper basin areas reflecting information acquired on the developing anadromous runs. As an early approximation, releases of fry during the first fish generation of Phase 2 will be of magnitudes estimated to be sufficient by themselves to produce about 50 percent of the maximum smolt carrying capacity of a particular stream. If the number of returning adults and the anticipated progeny exceeds expectations, the percentage of fry released will be reduced. This first cycle of fry releases during Phase 2 will also be supplemented with releases of hatchery smolts produced

from natural-origin broodstock, if smolts can be produced from an appropriate group of parents. Fry releases after the first fish generation of Phase 2 will diminish as rapidly as can be justified, to avoid a situation in which an extended hatchery supplementation program works against natural selection processes. During Phase 2 of the reintroduction effort, fish releases into the upper basin will be consistent with the suitability and productive capacity of available habitat. If habitat in a particular area proves to have greater capacity than initially predicted, fish releases there might be adjusted upwards, depending on broodstock availability. If habitat has less capacity, greater emphasis will be placed in the near term on habitat rehabilitation efforts and fish releases may be adjusted downward until habitat improves.

Marking of smolts at the SWW facility will continue until disease or other concerns have been addressed sufficiently to allow all adult fish arriving unmarked at the Pelton Trap (those natural-origin fish that are either returning to the upper basin or migrating toward areas other than the spawning locations of their parents) to be passed upstream.

Umatilla River Population
The following strategy and actions address flow and passage problems due to hydrosystem operations and facilities at the Boyd Hydro Project between RM 9-10 on the Umatilla River.

Strategy: Improve hydrosystem operations and facilities at the Boyd Project to reduce impacts.

Management actions
1. If possible, bypass reach flows for the Boyd Hydro Project should be modified to mimic the instream water right.
2. Fish passage facilities associated with the dam should be modified to meet current ODFW and NMFS fish passage standards.
3. Implement timely removal of weir panels from the diversion dam during period of non-operation to facilitate upstream passage.
4. Conduct timely and thorough maintenance of trash racks during periods of non-operation.

Walla Walla River Population
The following strategy and actions improve operations at Twin Reservoirs Hydro Project in the Walla Walla drainage.

Strategy: Improve hydrosystem operations and facilities at Twin Reservoirs Project to reduce impacts.

Management action
1. Conduct an assessment of the fishway at the dam. If the fishway does not meet ODFW standards, then it should be modified to meet standards for passage of juvenile fish.

9.5 Estuarine and Plume Habitat Strategies and Actions

The complex relationships that exist between species and habitat conditions in the Columbia River plume, estuary, and lower mainstem are poorly understood. The Columbia River Estuary

Recovery Plan Module (LCREP 2006) identifies 23 management actions that, together, address the range of threats salmonids in the estuary face including: altered habitat-forming processes; altered habitat structure in the estuary; changes in the food web dynamics; and poor water quality. The Mid-C Expert Panel identified impacts of bird predation in the estuary as a secondary threat in the past and present land use threat category. Based on our guidance, actions in the estuary that provide survival benefits are considered high priority because the benefits would likely be realized by all populations in the Mid-Columbia River steelhead DPS. Actions addressing predation concerns are shown in Section 9.7.

Strategy: Restore degraded estuarine and plume habitats and associated ecological processes.

Management actions
The following management actions that were identified by the LCREP (2006) are considered important to the survival of Mid-C steelhead during their migration and residency in the estuary and plume.

1. Protect intact riparian areas in the estuary and its tributaries and restore riparian areas that are degraded.
2. Modify hydrosystem operations to reduce the effects of reservoir surface heating, or conduct mitigation measures.
3. Adjust the timing, magnitude and frequency of flows (especially spring freshets) entering the estuary and plume to provide better transport of sediments and access to habitats in the estuary, plume, and littoral cell.
4. Remove pile dikes that have low navigational value but high impact on estuary circulation and/or juvenile predation effects.
5. Protect remaining high-quality off-channel habitat from degradation through education, regulation, and fee simple and less-than-fee acquisition.
6. Breach or lower dikes and levees to improve access to off-channel habitats.
7. Identify and implement actions to reduce salmonid predation by pinnipeds.
8. Implement projects to redistribute part of the Caspian tern colony currently nesting on East Sand Island.
9. Implement projects to reduce double-crested cormorant habitats and encourage dispersal to other locations.
10. Identify and reduce industrial, commercial, and public sources of pollutants.
11. Monitor the estuary for contaminants and/or restore contaminated sites.

9.6 Harvest Strategies and Actions

Harvest strategies and actions address threats to Mid-C steelhead from mainstem Columbia River and tributary fisheries. Few steelhead from any Columbia River populations are caught in ocean fisheries under current management regulations.

9.6.1 Mainstem Harvest

We have not proposed any actions related to mainstem harvest, which we considered a secondary threat to Mid-C steelhead. We have, however, identified a strategy that should be adopted within

the management regulation processes to implement actions in those fisheries that pose the most significant threats to Mid-C steelhead in Oregon. New harvest biological opinions will come into effect starting in 2008 and the following strategy should be considered.

Strategy: Manage to maintain current low impact fisheries and reduce harvest-related adverse effects in those fisheries that have significant impacts.

9.6.2 Tributary Harvest

The current level of impact of tributary sport fisheries in all populations is quite low, thus we have concluded that tributary fisheries do not pose a significant threat to viability of any Mid-C populations. Additional harvest management actions are recommended, however, to address threats from the straying of out-of-subbasin hatchery steelhead in the Deschutes River and John Day River populations.

Fifteenmile Creek Population
No additional harvest actions are necessary, as long as current regulations continue to be implemented.

Deschutes River Westside and Eastside Populations
Fishery impacts on adult and juvenile steelhead in the Deschutes River have been minimized under the fishing regimes established in the FMEP. The following harvest strategy addresses threats from out-of-subbasin hatchery steelhead strays.

Strategy: Utilize harvest to reduce the abundance and proportion of stray hatchery spawners.

Management action
1. Develop an educational outreach program to promote the use of selective recreational fisheries to reduce the number of out-of-subbasin hatchery strays. Action is designed to increase the removal of hatchery steelhead in the fisheries by promoting the increased retention of hatchery fish caught in the fisheries. Currently, many anglers release marked hatchery fish that have been hooked and landed. Fisheries managers should encourage retention of hatchery steelhead by developing an education outreach program describing the benefits to the natural populations from the retention of marked hatchery fish.

John Day River Populations
Overall, fishery impacts on adult and juvenile steelhead in the John Day River have been minimized under the fishing regimes established in the FMEP. Harvest is proposed as a tool to address the current threat from out-of-subbasin hatchery steelhead strays.

Strategy 1: Utilize harvest to reduce the abundance and proportion of stray hatchery spawners.

Management action
1. Develop an education outreach program to promote the use of selective recreational fisheries to reduce the number of out-of-subbasin hatchery strays. Action encourages

retention of all hatchery fish caught in the fisheries. Currently, a large number of anglers continue to release marked hatchery fish that have been hooked and landed. Fisheries managers should develop an education outreach program describing the benefits to the natural populations from the retention of marked hatchery fish.

Strategy 2: Reduce catch and release mortality on natural-origin fish.

Management action

1. Promote a voluntary curtailment of fishing at higher water temperatures (above 21° C) as a measure to reduce hook-and-release mortality. Action addresses potential fisheries impacts for steelhead in the John Day River subbasin when water temperatures are over 21° C. This may occur at the opening of the steelhead fishery in September primarily in the lower section of the river below Cottonwood Creek that is open year around.

Strategy 3: Improve quality of harvest and natural-origin fish.

Management action

1. Expand the creel surveys to monitor fisheries effort and catch in the areas from Tumwater upriver to the area deadline. In addition to the effort and catch data, creel surveys could be used to recover tagged hatchery steelhead and as a mechanism to communicate with the public regarding management actions 1 and 2 above. The surveys, in combination with increased marking of Columbia River Basin hatchery steelhead, should provide better data of location of recovery and origin of hatchery strays.

Umatilla River Population

Fisheries are believed to have a relatively small impact on steelhead in the Umatilla River as managed under regulations described in the FMEP and CTUIR regulations. Tributary fisheries are not considered a threat to viability of the Umatilla River steelhead population. Consequently, no additional harvest actions are proposed for the Umatilla River at this time.

Walla Walla River Population

Current fisheries are not considered a threat to viability of the Walla Walla River steelhead population as managed under the current FMEP and CTUIR fishing regulations. Because of the relatively small impact rate of the fisheries, no additional actions are recommended.

9.7 Hatchery Strategies and Actions

Strategies and actions address ecological and genetic effects resulting from current hatchery management programs in and outside the DPS.

9.7.1 Overall Hatchery Strategy and Actions

We are proposing a number of management actions that address impacts to Oregon Mid-C steelhead populations from hatchery programs outside the DPS that are providing the source of out-of-DPS strays. These management actions are common to all Mid-C populations and are therefore presented in this section. Unlike management actions for all the other H's, in some

cases the Sounding Board could not reach consensus on the proposed hatchery actions. We present all the alternatives that were considered and characterize each recommendation as either a consensus or non-consensus recommendation. In addition, we provide information related to concerns expressed by the Sounding Board members who could not support specific recommendations. Many of the proposed actions will require development of agreements within the Columbia Basin decision, management and funding processes, such as, US vs. Oregon, BiOp Remand, and the Lower Snake River Compensation Plan Program.

The Hatchery Scientific Review Group completed a review of Oregon's Mid-C steelhead population hatchery programs and released their recommendations on January 31, 2009 (HSRG 2009). The HSRG report was released after this recovery plan, including proposed management actions, was released for public comment in the Federal Register. We provide a comparison of the HSRG recommendations with the recovery plan proposed actions for each population to assess the degree of consistency.

Strategy: Reduce the uncertainty of origin of hatchery strays and increase ability to recognize hatchery-origin fish.

Management actions

1. Implement a representative coded-wire-tagging program so that all hatchery stocks have adequate CWT groups released on an annual basis. [This will improve the ability to determine origin of strays in all populations. This is a consensus recommendation.]
2. Mark all hatchery steelhead releases in the Columbia River Basin with, at a minimum, an adipose clip or other distinguishing mark. [This action would facilitate recognition of hatchery fish at weirs and on the spawning grounds providing for removal and better hatchery proportion estimates. This is a non-consensus recommendation.]
3. Recommend development of alternative broodstocks that will stray at lower rates for the hatchery programs that contribute significantly to the stray problem. [Currently, ODFW is evaluating an alternative broodstock approach for the Wallowa stock, which strays at high rates, to specifically reduce straying into Mid-C populations. If this alternative broodstock management strategy proves successful it should be considered for other Snake River steelhead hatchery programs. This is a consensus recommendation.]
4. Reduce the proportion of Snake River hatchery smolts that are transported from Lower Granite and Little Goose dams. [Recent evidence from Perry et al. (2006 unpublished data) indicates that transported smolts may stray at significantly higher rates than in-river migrants. There are limited data available to examine the relationship. This is a non-consensus action that the Sounding Board indicated should be examined in more detail when additional data are available.]

9.7.2 Tributary Hatchery Strategies and Actions

Out-of-subbasin hatchery strays were identified as a key threat to a number of Mid-C populations. In addition, hatchery fish escaping and spawning naturally in the Walla Walla population was also identified as a key threat. There is lesser concern regarding the impacts of the Round Butte Hatchery program and the Umatilla Hatchery Program on populations in these subbasins.

Fifteenmile Creek Population

There are no plans to use artificial propagation to support fisheries or enhance natural production in the Fifteenmile Creek subbasin. Consequently, the main hatchery-related threat to the Fifteenmile steelhead population is from out-of-DPS strays. However, since the source of most hatchery fish passing Fifteenmile Creek are summer steelhead, there is little chance of introgression. There was considerable uncertainty in the proportion of hatchery fish in the natural spawner estimates for viability assessment. The Mid-C Expert Panel did not identify this as major risk for Fifteenmile Creek winter and steelhead; however, it could become a factor in the future if improved water quality attracts stray hatchery fish into the subbasin.

Strategy: Reduce uncertainty in abundance and proportion of hatchery strays spawning naturally.

Management action

1. Increase efforts to monitor incidence of hatchery fish on spawning grounds through additional stream surveys.

   Additional surveys would increase the precision of the current estimates. Information gathered would be used to provide a better estimate of the hatchery fraction. This is a consensus recommendation.

The HSRG recommendations are entirely consistent with the proposed actions for the Fifteenmile Creek population.

Deschutes River Eastside Population

Actions are proposed within the Deschutes River subbasin to address hatchery-related threats resulting from stray out-of-subbasin hatchery steelhead.

Strategy 1: Reduce the abundance and proportion of stray hatchery fish that spawn naturally.

Management actions

1. Construct trapping facilities in Buck Hollow and Bakeoven creeks and conduct a study to determine the effects of hatchery strays on production, productivity, and life history. A detailed study proposal has been completed to conduct a control-treatment study in Buck Hollow and Bakeoven. Once the study is completed Facilities can be used to remove strays. This is a consensus recommendation.

2. Improve trapping facilities and expand trapping operations on Trout Creek to trap and remove all strays.

   This is a consensus recommendation.

3. Modify and operate the trap at Sherars Falls to collect and remove out-of-subbasin hatchery fish which will reduce the number of hatchery steelhead that could spawn naturally.

This action has substantial cost and would result in the handling of most of the Deschutes natural-origin fish. In addition, there are considerable social concerns of how best to deal with the trapped strays. The Sounding Board concluded that this action should be reconsidered at a later time after all the other hatchery actions in the Deschutes populations had been implemented and evaluated.

Strategy 2: Reduce uncertainty in abundance and proportion of hatchery strays spawning naturally.

Management action

1. Increase efforts to monitor incidence of hatchery fish on spawning grounds through additional stream surveys.

   Additional surveys would increase the precision of current estimates. This is a consensus recommendation.

   The HSRG recommendations are entirely consistent with the proposed actions for the Deschutes River Eastside population.

Deschutes River Westside Population

Hatchery actions for the Deschutes River Westside population aim to improve the Round Butte Hatchery summer steelhead program and address concerns regarding out-of-subbasin strays. The ICTRT and the Mid-C Expert Panel consider straying of out-of-DPS hatchery steelhead a key threat to steelhead in the Deschutes Westside population. In addition, we identified stray hatchery steelhead as a high risk for the diversity metric in the viability assessment. Strategy 1 and Strategy 2 are specific to the Westside population. Actions in Strategy 3 are proposed to support steelhead reintroduction above the Pelton-Round Butte Complex to restore sustained natural production.

Strategy 1: Reduce the genetic risks associated with the Round Butte Hatchery Program.

Management action

1. Investigate opportunities and risks associated with incorporating naturally produced Deschutes River summer steelhead into the RBH broodstock.

   The current practice of using only known RBH summer steelhead for broodstock has the potential for the RBH program steelhead to diverge from the naturally produced Westside steelhead population. This divergence can lead to potential adverse genetic effects from naturally spawning RBH summer steelhead. Methods to genetically identify Deschutes River origin steelhead will need to be developed to insure that only naturally produced steelhead from within the population are used in the broodstock. This is a consensus recommendation.

Strategy 2: Reduce the abundance and proportion of stray hatchery fish that spawn naturally.

Management action

1. Begin collecting and removing hatchery steelhead at the Shitike Creek Trap.

   The trap is currently used to monitor the reproductive success of hatchery spring Chinook salmon and evaluate bull trout life histories. The trap needs to be modified to support more efficient collection and removal of hatchery steelhead. The current trapping effort is planned to stop in a few years. There are concerns regarding the logistic feasibility and costs of building and operating a more permanent structure. This is a consensus recommendation.

Strategy 3: Restore natural production to blocked areas above Pelton-Round Butte Complex (for both Westside and Crooked River populations).

Management action

1. Develop and implement a comprehensive plan for the reintroduction of steelhead into the upper Deschutes River subbasin above the Pelton-Round Butte Complex.

   Hatchery production will play a crucial role during the initial phases of reintroduction. The hatchery will operate with dual objectives: (1) produce fish for harvest mitigation and (2) produce fish to achieve conservation objectives. Under the conservation objectives, (OAR 635-007-0545(11)), goals associated with reintroduction would aim to meet objectives for supplementation and restoration to areas upstream of the complex.

   Round Butte Hatchery stock steelhead will be used for initial steelhead releases due to their availability and to concerns with impacts of collecting native stock steelhead. Native stock steelhead will be used once it has been determined that passage efficiencies through the complex are suitable. A genetic assessment has been initiated to characterize Deschutes River steelhead and redband trout populations. Results from this work will be used to help identify appropriate broodstock for reintroduction. This approach, including a reduction of hatchery releases as naturally produced fish return, should lead to an adapted and productive natural steelhead stock.

   Steelhead fry or smolt releases will provide the primary means to re-establish adult returns to historical habitats during Phase 1 of reintroduction. Initial efforts to reintroduce steelhead will focus most strongly on productive habitats along Whychus Creek. Whychus Creek once supported steelhead runs in the range of about 500-1,000 adults, and was by far the strongest producer of these fish when passage efforts at Round Butte were abandoned in the late-1960s (ODFW and CTWSRO 2007). No steelhead will be released directly into the mainstem Deschutes River above the complex and in the Metolius subbasin because habitat in these areas is thought to be better suited to resident rainbow trout than to steelhead (Cramer and Beamesderfer 2006). Colonization of this habitat by steelhead, should it occur, will be a consequence of straying by naturally produced fish. Release sites are prioritized for key spawning and rearing areas downstream of significant passage barriers or unscreened surface water diversions.

The first steelhead smolt releases occurred in 2007. These releases were made in anticipation of the new surface intake and collection facilities becoming operational in the spring of 2009. Table 9-6 shows proposed release numbers and locations.

Downstream migrants will be collected and marked before release below the hydropower complex so they can be readily distinguished from unmarked out-of-subbasin strays. Returning adults from the outplants will be specifically identified as upper subbasin origin fish. Adults originating from upper Deschutes habitats will also be differentiated from other in-subbasin or out-of-subbasin stocks through the use of unique fin-clips, PIT tags, or other tags.

A comprehensive monitoring and evaluation plan will be implemented to assess the success of reintroduction and provide the critical information needed to make adaptive management changes.

Crooked River Population

The following strategy and action are designed to restore natural production in the Crooked River population.

Strategy: Restore natural production to blocked areas above Pelton-Round Butte Complex.

Management action

1. Develop and implement a comprehensive plan for the reintroduction of steelhead into the upper Deschutes River subbasin above the Pelton-Round Butte Complex.

   Hatchery production will play a crucial role during the initial phases of reintroduction. The hatchery will operate with dual objectives: (1) produce fish for harvest mitigation and (2) produce fish to achieve conservation objectives. Under the conservation objectives, (OAR 635-007-0545(11)), goals associated with reintroduction would aim to meet objectives for supplementation and restoration to areas upstream of the complex.

   Round Butte Hatchery stock steelhead will be used for initial steelhead releases due to their availability and to concerns with impacts of collecting native stock steelhead. Native stock steelhead will be used once it has been determined that passage efficiencies through the complex are suitable. A genetic assessment has been initiated to characterize Deschutes River steelhead and redband trout populations. Results from this work will be used to help identify appropriate broodstock for reintroduction. This approach, including a reduction of hatchery releases as naturally-produced fish return, should lead to an adapted and productive natural steelhead stock.

   Steelhead fry or smolt releases will provide the primary means to re-establish adult returns to historical habitats during Phase 1 of reintroduction. Initial efforts to reintroduce steelhead will focus on productive habitats in McKay and Ochoco creeks and the mainstem Crooked River between River Mile 51 and River Mile 56. McKay Creek contains some of the better steelhead habitat in the lower Crooked subbasin (i.e., below

Bowman and Ochoco Dams). Release sites are prioritized for key spawning and rearing areas.

Under the present schedule, the first steelhead fry and smolt releases occurred in 2008 and 2009 respectively. These releases were made in anticipation of the new surface intake and collection and handling facilities going operational in the spring of 2009. Table 9-6 shows proposed release numbers and locations.

Downstream migrants will be collected and marked before release into the Deschutes River below the hydropower complex so they can be readily distinguished from unmarked out-of-subbasin strays. Returning adults from the outplants will be specifically identified as upper subbasin origin fish. Adults originating from upper Deschutes habitats will also be differentiated from other in-subbasin or out-of-subbasin stocks through the use of unique fin-clips, PIT tags, or other tags.

A comprehensive monitoring and evaluation plan will be implemented to assess the success of reintroduction and provide the critical information needed to make adaptive management changes.

Table 9-6. Initial estimates of annual releases of summer steelhead to occur within specific areas of the drainage basin upstream of PRBC as the reintroduction effort moves forward. Parental origin (brood) is identified as being Hatchery (H), Mixed (M), or Natural (N; this category includes steelhead parents that are the first-generation, hatchery-reared offspring of natural-origin fish).

Species	Phase of reintroduction	Stream area	Fry		Smolts	
			Brood	Number	Brood	Number
Summer steelhead	Phase 1	Deschutes R.	---	0[a]	---	0[a]
		Whychus Cr.	H	286,000[b]	H	5,000[b]
		Crooked R. system	H	288,000 – 708,000	H	7,500[c]
		All	***H***	***574,000 – 994,000***	***H***	***12,500***
	Phase 2	Deschutes R.	---	0[a]	---	0[a]
		Whychus Cr.	N, M, H	100,000-596,000[d]	W	7,700[d] (one generation)
		Crooked R. system	N, M, H	222,000-1,417,000[d]	W	13,000[d] (one generation)
		All	***N, M, H***	***322,000 - 2,013,000***	***W***	***20,700***

[a] There will be no releases of steelhead directly into the Deschutes R., nor into the Metolius R. system. Habitat in these areas is believed to be better suited to resident than anadromous rainbow trout production (Cramer and Beamesderfer 2006), and colonization of this habitat by steelhead, should it occur, will be a consequence of straying by naturally-produced fish.

[b] Initial annual releases into Whychus Cr. will be intended to supply enough marked smolts (both naturally-produced and hatchery produced) to test fish passage effectiveness downstream through LBC and into the SWW fish collection facility. The releases of fry assume 10 percent of the smolts naturally produced in the stream will be trapped and reach the head of the reservoir bearing detectible marks, and have been increased by 20 percent above the minimum number estimated to be needed for adequate statistical precision in the fish passage tests (238,000). Initial fry releases will also test fish performance in the habitat above PRBC and produce the first generation of adult steelhead to have reared as juveniles in that habitat for about 40 years. Numbers of fry to be released assume smolt production only in suitable habitat below the TSID diversion dam and not above that dam.

[c] Initial annual releases into the Crooked R. system below Prineville will be intended to supply enough marked hatchery smolts to test fish passage effectiveness downstream, and to provide naturally produced smolts that can be marked and pooled with those from Whychus Cr. to potentially make fish passage tests based on naturally-produced smolts more robust. The releases of fry will also be intended to help test fish performance in the habitat above PRBC and to produce returning adults that reared as juveniles in that habitat. As currently envisioned, the scope of steelhead fry releases during Phase 1 will be relatively limited.

[d] Annual releases during Phase 2 will supplement natural fish production associated with returns of adult steelhead that reared as juveniles above PRBC. Releases of fry will initially be of a magnitude estimated to be sufficient by themselves to produce about 50 percent of the maximum number of smolts, including that in areas of Whychus Cr. above the TSID diversion dam, and will diminish through time (note: the percentage will be reduced very early in Phase 2 if the number of returning adults exceeds expectations and there is a potential that fry outplants might otherwise overwhelm the offspring of these adults). There may be exceptions to this basic pattern in the Crooked R. system, however. Actual annual releases of fry will depend on broodstock availability and, in the Crooked R. system early in Phase 2, anticipated post-release environmental conditions. Hatchery produced smolts derived from disease-screened natural-origin parents collected below PRBC will also be released into these areas for a 5-year period, if available, in numbers equivalent to 50 percent of maximum natural smolt production, so that adults returning from the releases can also begin to supplement the developing natural runs. Hatchery support of the natural runs will diminish through time and end as soon as the runs can sustain themselves. Barring unforeseen circumstances, it will not continue for more than three fish generations in a given subbasin before the fish are given an opportunity to sustain themselves without artificial support.

John Day Populations (Lower Mainstem, North Fork, Middle Fork, South Fork, Upper Mainstem)

The following strategy and action address threats to natural spawning steelhead populations in the John Day subbasin from straying hatchery steelhead from outside the subbasin.

Strategy: Reduce uncertainty in abundance and proportion of stray hatchery fish that spawn naturally.

Management action

1. Increase efforts to monitor incidence of hatchery fish on spawning grounds through additional stream surveys and other methods.

   There are currently two types of surveys conducted during steelhead spawning times, index counts and Environmental Monitoring and Assessment Protocol (EMAP) surveys. Index counts are done once and EMAP surveys done at least three times during the spawning time period. Of the two types of surveys conducted, the EMAP surveys provide the best opportunity to document stray hatchery steelhead. However, currently the 50 EMAP surveys are done at the subbasin scale. Better information would be gathered if more surveys were done at the population scale. Additional methods such as kelt trapping could also be used. This is a consensus recommendation.

The HSRG recommendations are entirely consistent with the proposed actions for all five John Day River populations.

Umatilla River Population

Although hatcheries were not identified as a key threat to the Umatilla River steelhead population, several management actions are proposed to reduce the risk of out-of-subbasin strays and the risks associated with ongoing hatchery programs in the subbasin.

Strategy 1: Reduce abundance and proportion of out-of-subbasin strays spawning naturally.

Management action

1. Uniquely mark Umatilla Hatchery steelhead and remove other hatchery strays at Three Mile Falls Dam to limit out-of-subbasin strays from reaching the spawning grounds.

   In recent years, out-of-DPS strays comprised a mean of 4.8% of steelhead returning to TMFD. These strays mostly originate from lower Snake River hatchery programs. Uniquely marking Umatilla hatchery steelhead would allow removal of out-of-subbasin stray steelhead at TMFD and eliminate the potential for outbreeding depression and impaired diversity. Major logistical constraints include the additional costs of applying an identification mark to 150,000 steelhead smolts. In addition, 100% of fish escaping past TMFD would need to be trapped and identified, as opposed to the current practice of enumerating a portion of the run through video analysis of adults swimming past the viewing window in the adult ladder. Due primarily to concerns related to additional stress of handling all fish at TMFD, this is a non-consensus recommendation.

Strategy 2: Re-establish natural production into historically utilized habitats.

Management action

1. Re-establish natural production in Little Butter and Butter creeks (MaSAs) and some minor spawning areas by outplanting adults and/or releasing juveniles into the tributaries after habitat, flow and passage is restored to a level that will support steelhead production.

   The loss of occupancy in the Butter Creek system was identified as a significant spatial structure gap. Re-establishing natural production in these historically occupied areas will lower the risk levels by expanding spatial extent/range and decreasing gaps between spawning areas. Re-establishing spatial extent and reducing gaps will reduce vulnerability to local catastrophes, enhance historical life history diversity, and enhance gene flow and the ability to recolonize extirpated areas. Any effort to re-establish production in formerly occupied areas should follow habitat restoration actions to address passage constraints, loss of instream flow, and degraded water quality and habitat. Once habitat, flow and passage are restored to the point that tributaries can again provide spawning and rearing habitat for steelhead, reintroduction can proceed. The benefits extend to the population in re-establishing the population across its historical range and decreasing gaps between spawning areas. The timeline for this action is dependent on the extent and rate of recovery of degraded habitat and successful removal or alteration of passage impediments. This is a consensus recommendation.

Strategy 3: Reduce the genetic influence of hatchery fish in hatchery broodstock.

Management action

1. Eliminate the use of hatchery produced adults in the broodstock to reduce potential for divergence in genetic and phenotypic traits between hatchery and natural-origin steelhead.

   Sufficient natural-origin adults have been available in all years to meet broodstock needs; however, hatchery fish are used in some years. Implementing this action will eliminate the use of adults that have undergone domestication selection and reduce genetic and phenotypic divergence from the natural-origin stock. A potential downside of this management action would be further reducing the abundance of natural-origin steelhead spawners and increasing abundance of hatchery steelhead on the spawning grounds. This is a non-consensus recommendation.

Strategy 4: Reduce interactions between residual hatchery steelhead and natural steelhead to limit competition with and potential predation on natural steelhead juveniles.

Management action

1. Conduct volitional releases steelhead smolts and remove the fish that do not migrate.

   Reducing interactions between hatchery and natural steelhead reduces the threat that natural juveniles rearing in the Umatilla River will experience reduced survival or

mortality from competition with hatchery smolts. To further reduce competition between natural and hatchery juveniles, smolts remaining in the acclimation ponds after the volitional release period could to retained rather than forced into the Umatilla River. This technique has been used in other subbasins (e.g., Tucannon, Grande Ronde, Imnaha), usually according to guidelines on the sex ratio and numbers of smolts remaining in the acclimation pond. Research on the Tucannon River, Washington demonstrates that juveniles remaining in acclimation ponds after volitional release periods are predominantly male and few exhibit smolt characteristics and that retaining these fish reduced the abundance of residuals in the river (Viola and Schuck 1995). The management action could be implemented at the two existing acclimation facilities on the Umatilla River. This is a non-consensus recommendation due to logistical concerns expressed by Facility operators.

Strategy 5: Reduce potential negative ecological interactions between coho salmon and natural steelhead.

Management action

1. Reduce the number of hatchery coho released in the Umatilla River and relocate releases downstream to areas not currently important for steelhead production.

   Currently, approximately 1.5 million coho salmon smolts are released into the Umatilla River annually from the Pendleton Acclimation Facility. These coho salmon smolts have the potential to compete with juvenile steelhead for prey resources or space. This competition may reduce survival or result in direct mortality of steelhead juveniles, affecting productivity and abundance. Several steps could be taken to reduce potential interactions between coho salmon and steelhead smolts. Actions range from eliminating the Umatilla coho salmon program to changing the numbers, locations or methods of release of coho salmon. Because steelhead rearing habitat occurs downstream of McKay Creek where the colder water released from McKay Reservoir enters the Umatilla River, one potential solution would be to release coho salmon downstream of steelhead rearing habitat in the lower Umatilla River. Pendleton is the most downstream acclimation facility, so implementing this action would require either direct stream releases of coho salmon or construction of another acclimation facility on the lower Umatilla River. If implemented, the action would affect rearing habitat in the lower Umatilla River between Pendleton, where coho salmon are currently released, and the new release location. The largest logistical constraint would be locating and funding a new acclimation facility on the lower Umatilla River. No logistical constraints would exist for directly releasing coho salmon into the lower Umatilla River. There was consensus on reducing the number of coho released annually to at least 1 million. However, changing location of release was not a consensus recommendation.

The HSRG had no recommendations for the Umatilla population and related hatchery programs.

Walla Walla River Population

Several hatchery management actions and proposals to manage and reduce hatchery risks to the Walla Walla summer steelhead population were developed and are presented below. Consensus could not be reached to identify a preferred alternative.

Strategy: Reduce the abundance and proportion of non-local-origin hatchery strays spawning naturally.

Management actions

1. Eliminate adult hatchery strays above Nursery Bridge Dam by resuming trapping operations and removing hatchery fish.

   Removing hatchery strays above NBD would eliminate the threats and resulting diversity risk caused by introgression of hatchery steelhead into the natural population. Sorting and removing hatchery produced adults at NBD would greatly reduce or eliminate these threats. However, resumption of trapping activities would cause handling stress on natural-origin adults and may result in a small amount of mortality. This is a non-consensus recommendation due to concerns of handling natural-origin fish and associated risks.

2. Alter the release strategy of Lyons Ferry Hatchery smolts released into the lower Walla Walla River from direct stream to acclimated releases and implement trap and removal near the acclimation site.

   Changing the release strategy of smolts in the lower Walla Walla River from a direct stream to an acclimated release has the potential to reduce wandering of returning hatchery adults into the upper Walla Walla River. If lower stray rates were realized, it would reduce risks. The action would require construction of an acclimation facility on the lower Walla Walla River to hold smolts in natural stream water before release. While the action would be implemented on the lower Walla Walla River, effects could be realized throughout the subbasin. There was considerable concern expressed about the costs of this action as well as the logistics of separating natural-origin and hatchery-origin fish in the adult trapping component. This is a non-consensus recommendation.

3. Develop local broodstock to replace Lyons Ferry stock for use in the current harvest augmentation program.

   Developing local broodstock for use in the current program would reduce the risks to the natural population because the hatchery fish that stray and spawn naturally would have similar genetic characteristics to the natural fish. However, the initial stages of broodstock development would require mining natural-origin fish from the natural population reducing the effective number of spawners. This is a non-consensus recommendation due to concerns of removing natural-origin fish to initiate the broodstock.

4. Develop local broodstock to replace Lyons Ferry stock and initiate a natural production supplementation program.

   Develop local broodstock from natural-origin fish collected at Nursery Bridge Dam. Move the smolt release location upriver someplace near the Oregon-Washington state line. Allow hatchery fish to intentionally escape into natural production areas and spawn naturally. This action would potentially reduce the genetic risks because hatchery fish would have similar genetic characteristics as natural fish. However, hatchery fish will comprise a much larger proportion of natural spawners than under current scenarios. Considerable concern was expressed about this action due to lack of demonstrated success of supplementation, the number of studies demonstrating negative viability affects of hatchery fish, and the fact that current abundance and productivity are very near viable criteria. This is a non-consensus recommendation.

5. Maintain current Lyons Ferry harvest augmentation program and initiate endemic local broodstock supplementation program in upper mainstem Walla Walla River and Mill Creek.

   This proposal maintains the 100,000 Lyons Ferry direct stream smolt release into the mainstem Walla Walla River. In addition, local broodstock would be collected at Nursery Bridge to initiate a supplementation program. An initial target of 35 pairs would be collected to produce 100,000 smolts annually. The smolt production would be split for release with 50,000 direct stream into Mill Creek and 50,000 direct stream into the upper Walla Walla River near the North Fork. This action would result in an increased proportion of hatchery fish in the natural spawners because of the additional hatchery spawners produced from the endemic supplementation program. The overall benefits and risks to viability are dependent on a number of performance factors for which the outcomes are uncertain. This is a non-consensus recommendation due to concerns of increased hatchery proportions and lack of demonstrated success of supplementation.

Some elements of the HSRG recommendations are consistent with the proposed management actions and some are inconsistent. The HSRG recommended to "Eliminate the annual importation and release of out-of-basin fish and develop within basin adult collection to promote locally adapted hatchery broodstock." Management actions numbers three and four are consistent with this recommendation. The HSRG also recommended "Under any scenario, facilities to acclimate and release juveniles and recapture returning adults will need to be developed." Management actions numbers one and two are consistent with this HSRG recommendation.

Development and implementation of a preferred alternative will require co-manager agreements developed through the Columbia Basin decision processes, such as US v. Oregon, Columbia Basin Fish and Wildlife Program, the Lower Snake River Compensation Plan, as well as, state and tribal planning processes.

9.8 Predation and Competition Strategies and Actions

Predation strategies and actions are discussed below. No actions are currently proposed to address potential competition related threats.

9.8.1 Predation Strategies and Actions

Predation by pinnipeds, birds, and piscivorous fish in the mainstem Columbia River has become a contributing factor affecting the viability of the Mid-Columbia River steelhead DPS. We present the following strategies and management actions to address predation concerns. These include actions from October 2007 Proposed Action for the Federal Columbia River Power System (NOAA Fisheries 2007a), as well as, additional actions being considered that would contribute to improving survival. Presentation of the BiOp proposed actions in no way implies endorsement of the adequacy of the actions for recovery.

Predation by Pinnipeds
The following actions will reduce predation by Pacific harbor seals, Steller sea lions, and California sea lions on salmon and steelhead in the lower Columbia River.

Strategy: Reduce the seasonal abundance of pinnipeds at Bonneville Dam.

Management actions
1. Continue with hazing program at Bonneville Dam to reduce pinniped seasonal abundance and predation near the dam.
2. Provide and improve sea lion excluder devices (SLEDs) to prevent pinnipeds from entering fishways.
3. Maintain acoustic devices to move pinnipeds away from fishway entrances, project facilities, and navigation locks.
4. Pursue authorization under Section 120 of the MMPA to remove problem California sea lions.

Predation by Avian Predators
The following actions are proposed to reduce predation by native bird species, such as Caspian terns and double-crested cormorants, in the Columbia River estuary.

Strategy 1: Relocate Caspian tern colonies in the Columbia River away from corridors that increase the vulnerability of juvenile salmon and steelhead out-migrants.

Management actions (actions in addition to those in the FCRPS proposed actions are presented in italics)
1. Maintain habitat conditions on Rice Island unsuitable or undesirable for nesting terns.
2. Reduce nesting habitat on East Sand Island and relocate most of the Caspian tern colony to areas outside of the Columbia River Subbasin.
3. Develop and implement an avian management plan to address predation from the Caspian tern colony on Crescent Island.
4. Modify dredge spoil disposal practices to avoid creating habitat suitable for Caspian tern nesting.

5. Modify hydropower operations to provide sufficient river flow to decrease travel times and water clarity for migrating juvenile salmonids.
6. Implement rearing practices that would enhance predator avoidance behavior in hatchery salmonids.

Strategy 2: Begin to address predation by double-crested cormorants in the Columbia River estuary and mid-Columbia.

Management actions
1. Continue to conduct research on predation impacts of double-crested cormorants on migrating juvenile salmonids, bioenergetics modeling, and habitat/population management strategies.
2. Develop an avian management plan to address predation by double-crested cormorant colonies on East Sand Island and Foundation Island (mid-Columbia).

Strategy 3: Deny predation opportunities to other avian predators such as California gulls.

Management action
1. Implement and improve deterrent devices and activities (e.g. bird wire, water cannons, hazing) at dams to keep avian predators away from bypass outfalls and other areas of juvenile salmonid concentration.

Predation by Piscivorous Fishes
The following actions are proposed to reduce predation by northern pikeminnow and a wide variety of introduced species (such as walleye, smallmouth bass, and channel catfish) that prey on juvenile salmonids in the Columbia River.

Strategy 1: Continue to implement the NPMP with exploitation rates at 10-20% to maintain reduced predation rates on juvenile salmonids.

Management actions (actions in addition to those in the FCRPS proposed actions are presented in italics)
1. Implement the sport-reward program with increased rewards similar to the enhanced reward structure in 2001 and 2004-2006.
2. Evaluate the effectiveness and relative efficiency of a hook-and-line fishery at select dams on the mainstem Columbia to remove northern pikeminnow in areas inaccessible to sport-reward anglers.

Strategy 2: Begin to address the management of non-indigenous piscivores as a means of reducing predation on juvenile salmonids.

Management actions (actions in addition to those in the FCRPS proposed actions are presented in italics)
1. Organize a workshop to review and evaluate predation by non-indigenous species (consumption rates and abundance), and develop strategies to reduce predation.
2. Implement transplant or removal programs in select areas.

3. Adopt regulatory changes that encourage harvest of target species.
4. Implement hydro-operation changes to reduce recruitment of non-indigenous predators.

9.8.2 Competition Strategies and Actions

As discussed in Section 8, steelhead abundance and capacity in the Deschutes Westside population may be significantly reduced by competition with resident rainbow trout. However, no management actions are proposed because a reduction in steelhead capacity due to resident trout abundance is considered a potential natural interaction effect. If, in the future, additional studies confirm this reduction in capacity in waters with abundant larger rainbow trout, then the abundance criteria for the Deschutes River Westside steelhead should be reevaluated.

Section 10 Management Action Effectiveness

This section presents an analysis of the effects of actions on the performance of Oregon populations in the Mid-Columbia River steelhead DPS. Projected levels of effectiveness in improving abundance and productivity for the actions described in the previous section are analyzed using modeling tools. Results are expressed as changes to population abundance and productivity parameters, as they were defined by the ICTRT for baseline conditions for each population (Section 6). The analysis was performed in sequential steps, first by projecting outcomes for tributary actions alone, then sequentially adding in hatchery fish genetic effects, then types of out-of-subbasin actions, and finally actions to manage stray hatchery fish. Results of each of these steps provide a means of comparing relative benefits of the proposed actions and assessing the overall benefits of the combined actions. We recognize that there is uncertainty associated with many of the input parameters and model assumptions used in our assessment of management action effectiveness. The models we used do not have the capability to characterize statistical certainty. We examined combinations of different temporal response periods, alternative tributary habitat action implementation priority scenarios, and alternative ocean conditions in an attempt to characterize the range of potential population responses to the management actions. The results of our effectiveness analyses should not be viewed as predicted responses, rather as ranges of potential outcomes. We were not able to assess spatial structure/ diversity effectiveness in a quantitive manner. Therefore, we assess the spatial structure/ diversity effectiveness by describing how the specific actions which target gaps will improve status.

The section is presented in four parts:

1. Methods.
2. Results of the abundance/productivity analysis of tributary habitat actions.
3. Results of the abundance/productivity analysis of all other actions by integrating effectiveness across actions, including tributary actions.
4. Results of the spatial structure/diversity effectiveness.

10.1 Methods

We performed our analysis of action effectiveness for abundance and productivity using two modeling platforms that have been widely applied in the Columbia basin: EDT and All-H Analyzer (AHA). These modeling approaches are discussed below. Action effectiveness for spatial structure and diversity was assessed qualitatively by describing the specific actions and how the actions are expected to address the spatial structure/diversity impairments.

10.1.1 Approach

EDT and AHA address different life stages in the life cycle and thus the different limiting factors that affect salmonid population performance (Figure 10-1). We incorporated several refinements to the modeling procedures for each platform as they are usually employed in the region to improve application for our objectives. For EDT, we formulated an auxiliary tool for defining action effectiveness to better ensure that we considered the distinct elements of effectiveness

consistently between actions and subbasins, and we incorporated an implementation timeframe element. For AHA, we disaggregated the life cycle into more segments than used in the standard AHA in order to completely incorporate the effects of habitat conditions in the juvenile life stages following emigration from the subbasin through the adult life stages, until return to the subbasin. We also formulated a module for AHA to provide an efficient way of processing the large number of action combinations—both in tributaries and the mainstem Columbia—of interest to this analysis. In addition, we modified the default settings in AHA for genetic fitness to produce results that appear to be more consistent with how the populations of interest are currently performing.

We used the modeling results to assess relative changes in population performance due to management actions compared to performance under a baseline set of conditions (both within and out of subbasin). We then applied these relative changes to the baseline performance measures as derived empirically for each population by the ICTRT. In applying the results in this way, we assume that each modeling platform provides a useful and appropriate assessment of how actions can be expected to affect performance relative to the baseline. We avoid the question of how well EDT output parameters represent actual performance levels if measured accurately over a sufficient period of time (e.g., as addressed by Rawding 2004[2]).

The EDT model was used to analyze the potential benefits of tributary habitat actions. The model is designed to estimate salmonid population performance based on characteristics of the aquatic habitat (Mobrand et al. 1997; Blair et al. *in press*). While it considers conditions at all life stages—producing population parameters for the entire life cycle—it was originally built to address factors that affect freshwater survival. In the Columbia basin, it has been used to focus on habitat conditions within subbasins, being applied in nearly every subbasin that currently supports anadromous salmonids. It was the principal modeling tool used to formulate many of the recently completed subbasin plans, including those that support the populations in the Mid-Columbia River steelhead DPS. The EDT analyses for these subbasins provide one part of the limiting factors assessment of subbasin habitat conditions described in Section 8 of this plan. The stream reach and habitat characterizations used in those analyses were applied as part of the baseline conditions for the analysis presented herein.[3]

The EDT model is particularly well suited for analyzing effects of habitat actions on salmonid population performance. As part of its setup, it requires characterizations of both historical and existing habitat conditions for all stream reaches used by the population of interest (see Lichatowich et al. 1995). This provides a simple, logical framework for considering the effectiveness of future habitat actions. The Scenario Builder tool, one of the suite of EDT modeling tools, is then used to explicitly define the extent that an action might be expected to

[2] / Rawding (2004) compared EDT model output with observed data for several salmon and steelhead populations in the lower Columbia River. He concluded that spawner-recruit performance results were comparable between observed data and EDT outputs when recruits were measured as smolts (EDT does not incorporate variation in marine survival).

[3] / All of the data inputs completed as part of the subbasin planning process were unchanged for the analysis reported herein with two exceptions. It was discovered that the population age structure for Fifteenmile winter steelhead was incorrect, requiring an update to this input. Secondly, the spawning distributions specified for the Deschutes Eastside and Westside populations were not consistent with those defined by the ODFW steelhead distribution database and ICTRT. These inputs were updated to reflect ODFW and ICTRT information.

move reach-specific habitat characteristics back toward the pre-development state (Thompson et al. *in press*). Scenario Builder also allows for defining actions that represent future watershed development, as would occur over time with human population growth. In this case, the tool can be used to identify the extent that reach characteristics move further away from the pre-development state and toward a fully developed one. This aspect of the tool is used extensively as part of recovery planning in areas where human population growth is rapidly increasing, such as in the Puget Sound region (Thompson et al. *in press*), but it was not applied here. Growth is expected to be relatively slow in the subbasins of interest here and patterns of future development are not well defined. Actions intended to give protection against further habitat loss can be analyzed with Scenario Builder when habitat loss actions are also defined.

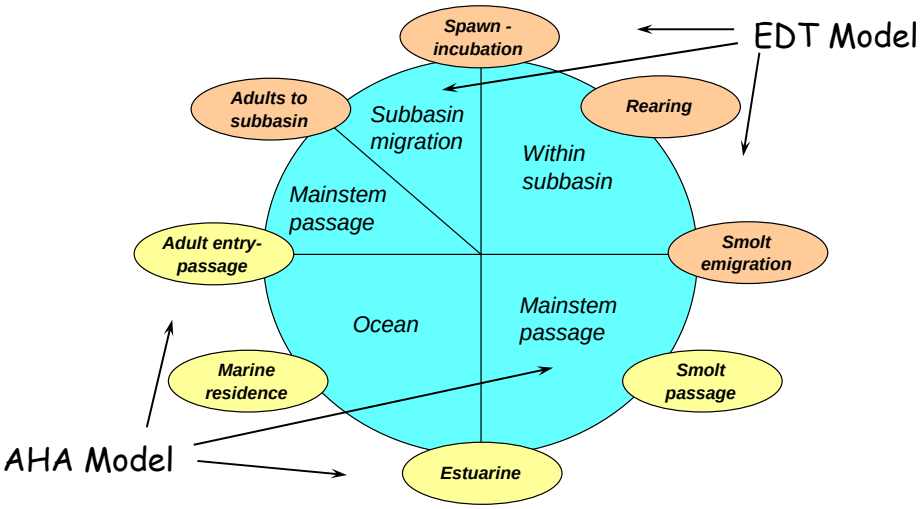

Figure 10-1. Use of EDT and AHA modeling platforms for different segments of steelhead life cycle. The EDT model covers the life stages from adults to subbasin through smolt emigration and AHA covers smolt passage through adult entry.

Four scenarios were modeled using the EDT model, reflecting two priorities for where actions would be implemented at two future times:

1. High priority action areas only at 25 years in the future;
2. High priority action areas only at 100 years in the future;
3. All priority action areas at 25 years in the future; and
4. All priority action areas at 100 years in the future.

Each scenario for each population consisted of a large number of diverse actions aimed at improving habitat conditions for the affected population (see Section 9). In addition to these four scenarios, the Deschutes Westside population was modeled with and without passage at the Pelton-Round Butte Complex to illustrate the added benefit of passage and restoration of natural production in the blocked areas..

The standard output from EDT consists of Beverton-Holt population parameters for smolt yield (leaving subbasin during smolt migration window) and spawners (virgin spawners successfully

spawning). The parameters are productivity (progeny per parent at low density), carrying capacity, and equilibrium abundance (i.e., average). Repeat steelhead spawners are not computed in the model, but repeat spawning is known to be very small (<5%; Busby et al. 1996) for Mid-Columbia steelhead. Parameter values produced for each scenario were used to compute the percent change in the parameter compared to the baseline. We used these relative changes to characterize the potential benefits to population performance corresponding to each scenario. Another EDT output is referred to as life history diversity and is a measure of the distribution of life cycle pathways through time and space determined to be successfully completed within the modeled environment. The model creates a multitude of diverse time-space pathways (or trajectories) through the environment consistent with the species' known life history patterns (incorporating seasonal movement patterns, rates of movement, and age structure), computing life cycle productivity and capacity parameter values for each pathway under each scenario. The percentage of pathways that are able to be completed successfully (i.e., having a productivity ≥1) of the entire set of modeled pathways is reported in the output as the % life history diversity. A value of 100% means that all modeled pathways would be expected to support completed life histories over the entire life cycle. In contrast, for example, a value of 20% would mean that only 20% of the pathways would support successful life histories—indicating that 80% of the pathways encountered such poor conditions for survival at some times or places (or were blocked by barriers) that life history condition was not possible. Typically, modeling of the undeveloped environment (historical condition) produces values for this metric at or near 100%. Modeling of severely degraded environments yields values much reduced—in severe cases <20% of the pathways might be successful. A large reduction in this metric compared to the undeveloped state usually means that significant portions of habitat no longer support sustainable production and, in the case of steelhead, older aged life history patterns have become less productive. The underlying concept of the metric is that it will reflect a real change in diversity of life history pathways relative to the undeveloped state that can be supported under the habitat conditions being modeled. Applying it to action analysis, if the current condition scenario yields a value of 20% for this metric, then how much does the metric change under a prospective action scenario? In this case, a large increase in the metric associated with an action scenario would mean that a significant expansion has occurred in life history distribution with improved habitat.

We report the results for this life history diversity metric to reflect only one aspect of how life history diversity would be expected to change due to an action set. The ICTRT is concerned about life history diversity at a larger scale than represented in the EDT measure, where patterns of distribution, movement, and age structure are considered. The EDT metric is not an equivalent measure, even though it reflects all of these higher scale patterns to some extent. We are currently exploring how information from the EDT results can be summarized to reflect changes in these patterns at the ICTRT criteria scale as a result of tributary actions.

The relative restoration benefit is determined by comparing current conditions to restored conditions resulting from implementation of proposed tributary habitat actions. We assessed restoration benefit for two scenarios for each population: 1) priority 1 actions only after 100 years; and 2) priorities 1 and 2 actions after 100 years.

The relative restoration benefit was determined based on the ranking of the amount of change in the consideration of all three previously decribed population performance measures (abundance,

productivity, diversity). All reaches or geographic areas were assigned a rank based on the change for each performance measure. The reach with the largest change was assigned higher values unless there was a tie. The three performance measure ranks for each reach were then summed and a simple average was computed. The reaches were then re-ranked so that the reach with the lowest average was giving a value of 1 (highest restoration benefit); all other reaches were assigned higher values.

Following the completion of the integrated ranking procedure, reaches were grouped and placed into four categories including: high, moderate, low, or very low, restoration benefit. The very low restoration benefit category includes reaches where zero restoration benefit is achieved. Results of the restoration benefit analyses are presented in maps in this section, as well as, in tables in Appendix H.

The AHA model was used to link the analyses of tributary habitat actions to prospective recovery actions involving hatchery fish and the mainstem Columbia River and to explore a few simple alternative ocean assumptions. The output from EDT, expressed in terms of Beverton-Holt population parameters, was an input to the AHA model. The AHA model was developed to give managers a tool for examining different ways of balancing habitat restoration, hatchery practices, harvest, and hydroelectric facilities operation (Mobrand – Jones & Stokes Associates 2005). It is particularly adapted to addressing the effects of hatchery operations, having been created by the Hatchery Scientific Review Group[4] to consider genetic interactions between hatchery and natural stocks. Model features incorporate theoretical concepts about these interactions based on Ford (2002) and Lynch and O'Hely (2001), and as further discussed by Mobrand et al. (2005).

Linking the two models provides a way of assessing benefits measured at the end of the life cycle for a wide range of potential actions, regardless of what life stage an action affects. The AHA platform integrates the effects of various types of actions over the full life cycle (Figure 10-2A). The output from AHA, also expressed as Beverton-Holt population parameters, represents the expectation for population performance when all actions are integrated together. Here, these parameters were then converted to the percent change in each parameter value compared to baseline conditions and multiplied by the ICTRT's baseline population measures to compute expected ICTRT-equivalent parameter values reflecting the effects of all actions (Figure 10-2B). The two parameters of interest here are population intrinsic productivity (recruits per spawner at low population density) and equilibrium spawner abundance. These parameters, whether estimated by EDT/AHA modeling or empirically as done by the ICTRT, are identical in meaning though they can differ in actual value for the same population due simply to different ways of estimation. Therefore, a conversion to an "ICTRT parameter equivalent" was necessary to allow for a direct comparison of output to the ICTRT baseline values. It was concluded that this simple multiplication procedure is the appropriate mathematical conversion to compute the change in ICTRT parameter values from EDT/AHA output.

[4] / The Hatchery Scientific Review Group is an independent scientific panel established and funded by Congress to provide an autonomous and credible evaluation of hatchery reform as part of the Hatchery Reform Project. The objective of the HSRG is to assemble, organize, and apply the best available scientific information and to provide guidance to the policymakers and technical staff who are implementing hatchery reform. The project is being applied in most areas of the Pacific Northwest, including within the Columbia Basin.

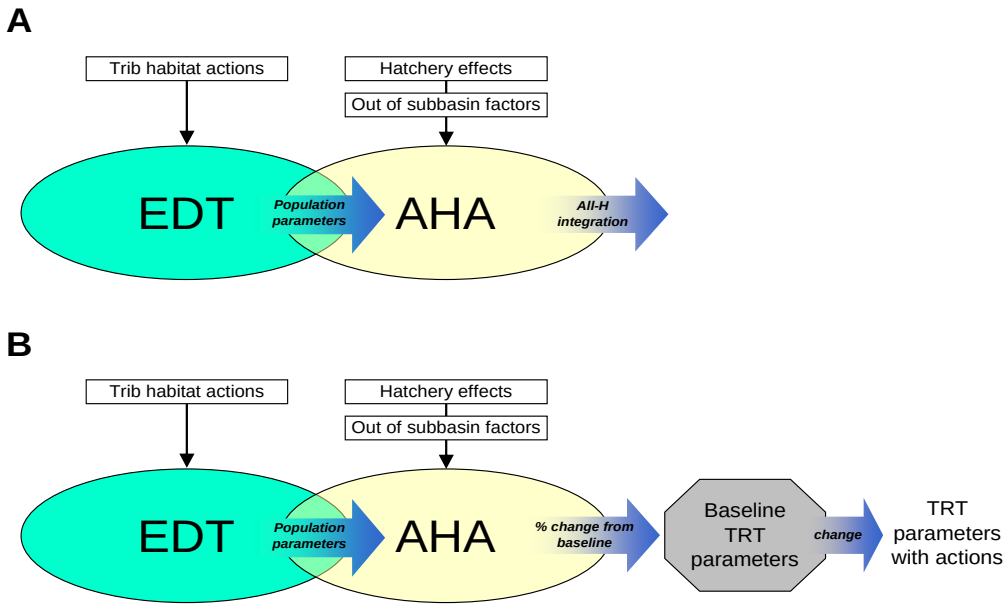

Figure 10-2. Action integration components.

The AHA model is principally used in the region to help evaluate hatchery programs and makes broad comparisons involving other strategy types. In the analysis presented herein, a strong focus is placed on integrating actions that not only involve hatcheries and out-of-subbasin actions, but detailed subbasin habitat restoration plans. The standard AHA model uses a simplified approach in integrating across such a range of actions by treating the effects of out-of-subbasin actions on population productivity and capacity as multipliers on parameter values produced by EDT, hence it assumes simple multiplicative effects. In doing so, effects of performance parameters for the final life stages (pre-spawning and spawning) are not fully incorporated, which can bias spawner estimates from the model high.[5] Therefore, the AHA platform was modified by first disaggregating output into life stage segments as described in Beverton and Holt (1957) and Mousalli and Hilborn (1986), then linking AHA inputs to the appropriate segment and re-computing end of spawning population parameters by reaggregating across the full life cycle (Mobrand et al. 1997). This modification provided a way of producing essentially unbiased parameter estimates.[6]

[5] / All life stages affect the performance of a salmonid population when measured at the end of the life cycle. Both habitat quality and quantity can affect fish performance during each life stage, and therefore, also affect population performance measured at the completion of the life cycle (end of spawning). Hence, benefits of actions affecting intermediate life stages, such as outmigrating smolts or returning adults within the mainstem Columbia River, do not proportionally translate into performance benefits when measured at the end of spawning in the subbasins. This is clearly evident in examining the Beverton-Holt function disaggregated into life stage segments.

[6] / The AHA model is to be updated formally to address this computational need (Lars Mobrand, personal communication). The procedure used in our analysis involved the use of a supplemental EDT output called the Hits file, which contains detailed results for each life history trajectory. These results were disaggregated to life stage, then used to compute weighted average performance parameter values for each life stage. This step was necessary for just the baseline model run, giving an analytical reference that could then be used to compute final adult life stage values for each action scenario.

A set of scenarios was modeled using AHA representing baseline conditions, current conditions, and combinations of actions aimed at tributary habitat, mainstem Columbia River factors, and hatchery fish management. Baseline conditions represent average conditions for the migration years 1980 to 2001 which represents the time period that recruit-per-spawner data were used for the ICTRT viability assessments. Current conditions are intended to generally reflect recent years (2002 to 2006) measures implemented for mainstem Columbia hydrosystem predation, estuary, and harvest. The benefits of these actions are not represented in the baseline abundance and productivity estimates. Population parameter estimates derived by the ICTRT in Section 6 reflect baseline conditions. Prospective actions to be taken in the mainstem Columbia River and estuary that were modeled include:

- Predator management – aimed at reducing predation rates caused by avian and northern pikeminnow;
- Downstream juvenile passage improvements – measures to improve survival at each of the mainstem dams;
- Columbia estuary habitat improvements – measures to enhance habitat conditions within the Columbia estuary; and
- Harvest – regulatory measures to reduce or hold harvest impacts in the mainstem Columbia River to current levels.

Scenarios were run in a stepwise fashion, starting with baseline, then current conditions, then adding in actions sequentially, each being added to the previous scenario. The effects of hatchery steelhead programs on genetic fitness—hence performance—of natural-origin fish were incorporated for each scenario using AHA.

Actions that would control the number of stray hatchery fish in subbasins where feasible were modeled as part of another set of scenarios. In this case, the full set of scenarios aimed at tributary habitat and mainstem factors was modeled with and without these actions.

The effects of potential changes in marine survival were also modeled with a few alternatives. All of the scenarios described above were modeled using an average marine survival rate corresponding to the average during both the baseline and current periods. We then modeled two more scenarios, which consisted of all actions combined, using marine survival rates set to +/- 25% of the average applied to the other scenarios. This range is consistent with how average marine survival appears to vary between periods of years for Mid-Columbia River steelhead.[7] These results are intended to reflect outcomes of implementing recovery actions under alternative possible future marine survival regimes that might either decline or improve compared to the baseline average.

As noted previously, we formulated a module for AHA that enabled us to efficiently analyze the various combinations of tributary and mainstem action scenarios, in conjunction with hatchery management actions.

[7] / Inter annual variability in marine survival can be incorporated into AHA but estimates of population parameters are then made in a way that represents the average marine survival over the years used in modeling. We simplified the analysis by just applying an average marine survival to represent the modeled outcome within a period of years.

Table 10-1 lists the various combinations of actions and effects that were modeled for each population using AHA.

Table 10-1. Combinations of actions and effects modeled for each steelhead population using the AHA model. See text for definitions of baseline and current. Action groups are listed in columns, corresponding to where they would be implemented. Hatchery effects are those associated with modeled changes in genetic fitness of natural-origin fish due to hatchery strays. Codes are: B – baseline condition, C – current condition, B/C – baseline/current condition (assumed to be the same for both), A – actions implemented.

Scenario	Tributary		Mainstem Columbia				Ocean
	Trib habitat	Hatch effects	Pred control	Hydro pass	Est habitat	Harv regs	Marine surv
Baseline	B/C	B/C	B	B	B	B	B/C
Current	B/C	B/C	C	C	C	C	B/C
Trib habitat actions	A	B/C	C	C	C	C	B/C
Mainstem actions	A	B/C	A	C	C	C	B/C
- add more	A	B/C	A	A	C	C	B/C
- add more	A	B/C	A	A	A	C	B/C
- add more	A	B/C	A	A	A	A	B/C
Hatch fish actions	A	A	A	A	A	A	B/C
Alter marine surv	A	A	A	A	A	A	+/- 25%

In addition to these scenarios, the Deschutes Westside population was modeled with and without passage at the Pelton-Round Butte Complex to illustrate the added benefit of providing passage and re-establishing natural production.

10.1.2 Tributary Habitat Effectiveness

Details of how action effectiveness was modeled are described below.

Non-Passage Actions
The EDT Scenario Builder tool is used to capture assumptions about the effectiveness of an action in altering attributes of habitat within a river system. EDT habitat characterizations consist of ratings of 46 environmental attributes (flow, sediment, temperature, etc.) that describe the conditions of each stream reach delineated within a river system (see Lestelle et al. 2004). The characterizations are meant to represent an average state of conditions within a time period, i.e., current period, pre-development period, or a future period corresponding to the outcome of one or more habitat actions.

The Scenario Builder can be inefficient and awkward to use with large numbers of actions, multiple watersheds, large numbers of stream reaches, and multiple time lags in evaluating action effects. This can result in inconsistencies in how actions are defined with respect to their effectiveness. To minimize potential inconsistencies, an auxiliary tool (Action Mapper) was formulated for this project to define effectiveness through a set of systematic steps for all actions. The tool—built in Excel—helped ensure that action effectiveness was being formulated

consistently across populations by providing more transparency in defining effectiveness assumptions and giving improved documentation.

A total of 93 distinct actions within eight strategy types were assembled from Section 9 into a library of actions for processing. (Aspects of some actions overlapped with others, which required some consideration in assigning effectiveness values to reduce redundancy and overestimation of action benefits.) The action library is listed in Table 10-2 showing which actions were applied in each of the five subbasins. Although we summarize the library at the subbasin scale, actions are actually applied at the individual population scale, as well as, all areas downstream of the population boundary in the subbasin that are used for rearing and migration.

The Action Mapper was used to derive the effectiveness values for all action-stream reach-attribute combinations applicable to the analysis, which were then loaded into the Scenario Builder for input into EDT. The derivation consisted of two parts:

1. Part 1 - Mapping the precise geographic distributions of stream reaches that would be affected by the actions within each population, and
2. Part 2 - Quantitatively defining the various elements used to compose action effectiveness in the analysis.

The steps associated with each part provided a consistent process for deriving effectiveness values for each action.

Table 10-2. Tributary habitat actions modeled in each subbasin.

Strategy and action	Fifteenmile	Deschutes	John Day	Umatilla	Walla Walla
1. Protect/conserve ecological processes					
Land acquisition/conservation	x	x	x	x	x
Protect rare functioning habitats	x	x	x		x
BMPs to conserve eco processes	x	x	x	x	x
Cooperative Agreements		x	x		
Special mgmt designations		x	x		
Increase wild-scenic status			x		
Protect access to key habitats			x		
Public lands protection				x	x
Waterway setbacks				x	x
Enforce floodplain regs				x	x
Natural Area Overlay Zone				x	x
Legislate priority areas				x	x
Outreach to users and managers			x		
2. Restore fish passage blocked/impaired by barriers					
Barrier removal	x	x	x	x	x
Add irrigation screening	x	x	x	x	x
Improve irrigation screening	x	x	x	x	x
Pelton Round Butte passage		x			
Reduce push up dams			x		
Fish ladder construction			x	x	x
Maintain passage facilities				x	x
3. Maintain and restore floodplain connectivity and function					
Reconnect floodplain	x	x	x		x
Reconnect side channels	x	x	x		x
Reintroduce beaver	x	x	x		
Manage beavers					x
Restore wet meadows			x		
Dike removal				x	x
4. Restore degraded and maintain properly functioning channel structure/complexity					
Restore natural channel form	x	x	x	x	x
Large wood enhancement	x	x	x	x	x
Add structure	x	x			
Stabilize streambanks	x	x	x	x	x
Build pool weirs				x	x
BMP bridge maintenance					x
LWD education					x
5. Restore riparian condition and LWD recruitment					
Restore riparian communities	x	x	x	x	x
Improve grazing practices	x	x	x	x	x
Eradicate invasive plants	x	x			
Fencing	x	x		x	x
Off-stream livestock watering	x	x			
Riparian plantings	x				
Increase riparian shading		x			
No cultivation buffer zones				x	x
Maintain RHCAs on USFS lands				x	
Remove riparian roads				x	x
Riparian protection					x

Strategy and action	Fifteenmile	Deschutes	John Day	Umatilla	Walla Walla
6. Restore natural hydrograph components					
Ag water conservation	x	x	x	x	
Improve irrigation conveyance	x	x	x		x
Orchard Ridge/Wolf Run	x				
Urban conservation	x				
Convert water rights	x	x	x	x	x
Regulate water withdrawals	x	x	x	x	x
Other nat hydrograph measures	x	x	x	x	x
Water retention structures		x			
Increase pool habitat (beav ponds)			x		
Floodplain aquifer recharge			x		
Enhance hyporheic flows					x
Recharge shallow aquifers					x
Aquifer storage & recovery					x
Umatilla Basin Project Phase I and II				x	
Umatilla Basin Project Phase III				x	
ISWRs				x	x
H2O rights transfer downstream				x	x
Water storage investigate					x
No new H2O appropriation					x
Criteria for new H2O appropriation					x
7. Improve degraded water quality					
Manage irrigation return flow	x	x	x		
Measures to improve DO	x	x			
Reduce chemical pollution	x	x	x		
Implement Ag WQP	x	x			
Other water quality measures	x	x	x	x	x
TMDL monitoring	x	x	x		
Increase riparian shading			x		
Reduce mine discharge toxicants			x		
Animal feeding BMPs			x		
Point source pollution controls				x	x
H2O quality mgmt plans				x	x
Pest mgmt plans for fruit growers					x
Municipal stormwater mgmt					x
Waterway alteration permitting					x
Permitting for H2O quality activities					x
8. Restore upland processes to reduce erosion					
Convert till farming	x	x	x		
Convert to perennial crops	x	x			
Implement IFPnet plans	x				
BMPS to reduce soil erosion	x	x			
Remove junipers		x			
Restore native upland plants		x	x	x	x
Improve/remove forest roads		x	x	x	x
Reforest/fuels management		x			
Upland demo projects			x	x	x
Invasive plant mgmt & junipers			x		
BMPs on land uses			x	x	x
Remove noxious weeds					x
CREP & CCRP buffers					x
Outreach to upland users					x

Part 1 for deriving action effectiveness asks: *What stream reaches will be affected by each of the actions?* The stream system in each of the five subbasins is delineated into a large number of reaches in EDT, each reach being precisely defined in how it is connected both upstream and downstream. In addition, reaches are aggregated into population units using the ICTRT population boundaries. The number of reaches in each subbasin that actions could potentially affect is listed below:

Subbasin	No. reaches
Fifteenmile	49
Deschutes	206
John Day	1,158
Umatilla	331
Walla Walla	220
Total	1,964

The planning teams identified the stream, and in many cases portions of streams, where each action would be targeted. They also designated which streams, or portions thereof, would be given high priority (priority 1) for action implementation or a lower priority (priority 2) for treatment (see Section 9).

Some actions would involve the direct manipulation of conditions within a stream reach, such as by riparian fencing along the reach, while others would act in areas removed from the stream (such as in the uplands) but would then affect reaches draining the affected area. In both cases, there would be one or more stream reaches affected within an area of highest influence by the action, with the potential for a dispersal of effects then moving downstream to other reaches. The Action Mapper was used to map the assumed distribution of effects associated with each action, as streams and reaches designated for action implementation were described in Section 9. A linear form of mapping is used in how reaches are shown arranged in the tools, lending itself to doing this task efficiently. For many actions, effects were assumed to not continue downstream beyond the area of direct influence due to the many factors that would need to be taken into account, such as other influences affecting downstream conditions. Generally, actions meant to affect flow and the hydrograph were extended downstream the furthest, as these actions would presumably be designed for that purpose.

The second part of deriving action effectiveness consisted of explicitly defining distinct elements—or factors—that are used to compose the overall effectiveness value applied in the analysis. Five elements of action effectiveness were recognized (Figure 10-3), each acting as a scalar to determine how effective an action would be in moving an attribute's current baseline rating back toward the undeveloped state. Combined, these scalars produce the realized effectiveness $REffect$ for action i, at lag time t, for attribute a used in modeling the action as follows:

$$REffect_{i,t,a} = Effect_i \times Intensity_i \times Lag_{i,t} \times Schedule_{i,t} \times Attribute_{a,i}$$

where $Effect_i$ is the potential effectiveness of action *i*

$Intensity_i$ is a scalar for defining the scale at which action *i* is to be applied

$Lag_{i,t}$ is a scalar that defines how much of the potential effectiveness of action *i* will be achieved at time *t* in the future (25 or 100 years in the future)

$Schedule_{i,t}$ is a scalar that defines an implementation schedule effect, i.e., whether implementation is delayed to some point in the future, whereby the amount of the potential effectiveness of action *i* would be reduced at time *t* in the future (25 or 100 years out)

$Attribute_{a,i}$ is a scalar that defines whether the potential effectiveness of action *i* for attribute *a* is the full amount (scalar of 1) or reduced due to an attribute effect. A scalar of 0 would indicate that the attribute is not affected by action *i*.

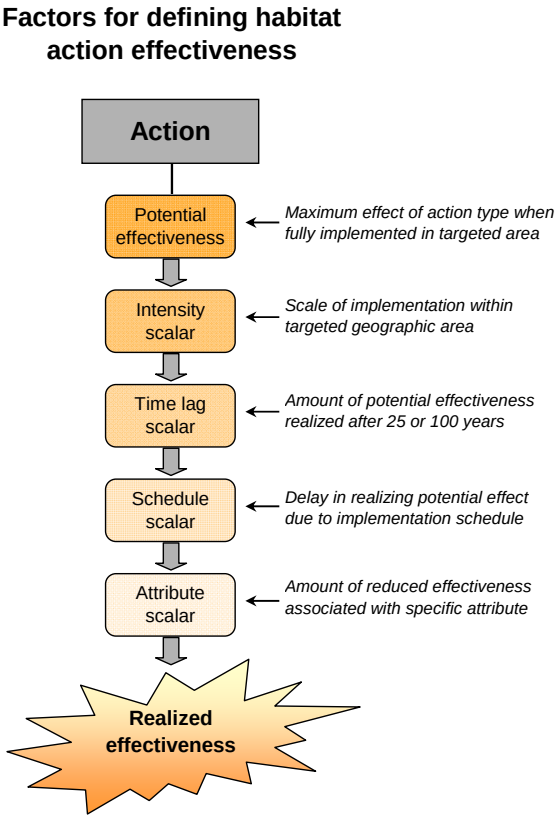

Figure 10-3. Action effectiveness elements.

An action's potential effectiveness ($Effect_i$) identifies the magnitude of effect that might reasonably be expected when the action would be implemented as fully as feasible within a geographic area. For example, how much of a stream reach 5 miles in length might reasonably be treated with a riparian restoration action (called Restore Riparian Communities in Table 10-2) if the action was focused on that reach—and, in turn, to what extent would the action restore attributes largely tied to the riparian condition in the pre-altered state? If the action remained in effect until its full benefit was to be realized—for this action perhaps 100 years—what would be its measured effectiveness at that time? In this case, we could reasonably argue that the full 5 miles could be treated and that after 100 years certain attributes (e.g., temperature, wood loading) might be restored completely (100%) to their pre-altered state. We assumed for the riparian restoration action a somewhat more conservative assumption—for this action, we applied an effectiveness value of 80%.

The potential effectiveness defines the maximum, yet reasonable, extent of effectiveness that might occur for the action of that type. Considering this aspect of an action's effectiveness provides a straightforward way of identifying a base effectiveness, to which the other scalars can then be applied. The potential effectiveness value assigned to each action is an assumption, since there are usually limited empirical data for defining the value with high degree of certainty. The assignment of effectiveness values to actions in recovery planning is often done through a team effort, either by consensus or as an average of values from different individuals (Mobrand Biometrics Inc 2003; Thompson et al. *in press*). Here, in this recovery planning process, the values were developed by one person using values from many previous efforts and who has facilitated a wide variety of team-oriented approaches in the Pacific Northwest.[8] This provided a consistent means of assigning effectiveness values for the entire set of actions considered across the five subbasins. To simplify the task of assigning potential effectiveness values, selections were made from 6 different levels, ranging between no effect to very high (Table 10-3) (See Appendix H for details).

Table 10-3. Potential effectiveness levels assigned to actions.

Effectiveness level	Definition	Effect
1	Very high	0.80
2	Moderately high	0.56
3	Moderate	0.32
4	Low	0.08
5	Negligible	0.01
6	No effect	0.00

[8] / Effectiveness modeling here was performed by Larry Lestelle, one of the principal architects of EDT, who has facilitated numerous EDT analyses in many watersheds of the Pacific Northwest. The perspective gained and actual effectiveness values used in those recovery planning efforts, in which the extent and causes of habitat degradation were assessed from pre-development conditions, gave an informed, consistent way of considering effectiveness of moving habitat conditions back toward their prior state.

The intensity scalar ($Intensity_i$) defines the average scale at which an action would actually be expected to be applied to the areas identified for treatment. In most cases, we would not expect actions to be applied at the maximum extent possible, given constraints imposed by land ownership patterns, various on-going land uses, and costs. The planning teams identified streams, and in many cases portions of streams, where specific actions would be targeted. They did not identify the extent that the actions would be applied within each of the targeted streams.

Continuing with the example of a five-mile reach where a riparian action would be applied, what portion of the reach would actually be expected to be treated? It would be reasonable to expect that some reaches might be treated in their entirety, while others would be treated at a much lower rate due to land ownership issues or other constraints imposed by on-going land uses. Actual project planning for implementing the tributary habitat actions will involve identification of opportunities and constraints and closely working with local stakeholders and planning entities.

Lacking some detailed planning information, we assigned an assumed level of intensity for each action, depending on action type and our understanding of how such actions have been implemented in the past. Initially, we considered varying the intensity scalar by the size of the subbasin (less intensity to larger subbasins). However, the larger subbasins also support multiple steelhead populations. We concluded that the analysis should be comparable between populations and applied identical intensity values between subbasins for the same action. Differences in how the actions would be applied in actuality are assumed to be reflected in the distributions of actions identified by the planning teams. To simplify the task of assigning intensity values, we chose from five different levels of intensity, ranging between negligible to very high (Table 10-4)(See Appendix H for details.)

Table 10-4. Intensity levels assigned to actions.

Intensity level	Definition	Scalar
1	Very high	0.85
2	High	0.40
3	Moderate	0.15
4	Low	0.05
5	Negligible	0.02

The lag scalar ($Lag_{i,t}$) defines how much of the potential effectiveness of an action will be achieved after a period of some number of years into the future. The full effectiveness of some actions would be realized immediately upon implementation (e.g., barrier removal), while others would require a lengthy time period to realize full effectiveness, such as riparian restoration. Two time lags were analyzed: 25 and 100 years into the future. All actions were assumed to be fully effective (lag scalar = 1) after 100 years, whereas the scalar was <1 at 25 years for those actions requiring a longer period to achieve full effectiveness. (See Appendix H for details.) Actions that would mature in effectiveness over time are those associated with maturing of

native vegetation, channel and floodplain reformation and stabilization, and the gradual restoration of more normative hydrographs as best management practices are instituted and realized.

The implementation schedule scalar ($Schedule_{i,t}$) defines how the schedule for implementing an action—relative to what might be considered year 0 of a recovery program—would affect realized effectiveness in either year 25 or year 100 of the program. Use of this scalar in the analysis recognizes that the recovery programs will be long-term in implementation due to their very extensive scope. Only a small fraction of the program can be expected to be implemented in the first year of the program. The scalar accounts for the reduced number of years an action might be operating between year 0 of the program and year 25 or year 100 considered in the analysis. The scalar $Schedule_{i,t}$ can be computed as:

$$Schedule_{i,t} = \frac{Y_t - Y_{imp}}{Y_t}$$

where Y_t is the number of years in the future of interest, here either 25 or 100 years

Y_{imp} is the year number into the program when action *i* is implemented.

If, for example, an action's potential effectiveness is 80% with a lag scalar of 50% at year 25, but it is implemented in year 10 of the program instead of year 0, then it's realized effectiveness in year 25 would be (ignoring intensity and attribute scalars):

Potential effectiveness	0.8
Lag scalar at 25 years	0.5
Schedule scalar at year 25	=15/25 = 0.6
Realized effectiveness at 25 years	= 0.8 x 0.5 x 0.6
	= 0.24

The planning teams for each subbasin generally identified how many years it would take before each action could be expected to be fully implemented in the subbasin. Actions were classified as being implemented immediately or in the short term (taking between 0-3 years from the start of the program to fully implement), or over an intermediate term (taking 4-14 years from program start to complete), or over a longer term (taking 15-25 years to complete). We approximated the implementation year for each action by taking the midpoint of the appropriate interval of years for completing the action and dividing by two (hence the median year by when half of the action would be expected to have begun).

The attribute scalar ($Attribute_{a,i}$) defines whether the potential effectiveness of an action will be the full amount (scalar = 1) or reduced due to an attribute effect. Some actions will have no effect on some attributes (scalar = 0). For each action, attributes were identified as being affected or not affected. We assigned the scalar to be 1 for any attribute that would be affected except for those that characterize some aspect of sediment, flow, and temperature. We set the

scalar for these to be 0.75, recognizing that these attributes are broadly affected by watershed conditions and can be more difficult to influence than attributes driven mainly by site-specific conditions. It is noted, however, that the distributions of many actions were identified by the planning teams to extend well into the headwater areas of streams. (See Appendix H for details.)

The example shown above is extended below to include all of the scalars, here shown with a moderate intensity of application as applied to the attribute maximum water temperature:

Potential effectiveness	0.8
Intensity scalar	0.15
Lag scalar at 25 years	0.5
Schedule scalar at year 25	0.6
Temperature attribute scalar	0.75
Realized effectiveness at 25 years	= 0.8 x 0.15 x 0.5 x 0.6 x 0.75
	= 0.027

In this example, the resulting realized effectiveness is calculated to be 0.027, meaning here that in the affected stream reach the maximum water temperature rating would be moved 2.7% of the distance between the current and the pre-altered ratings.[9]

Fish Passage Actions

The planning teams identified actions to provide for fish passage at sites known or assumed to be full or partial physical barriers to fish migration. Restoration of fish passage at each of these sites was modeled if the barrier had been identified and incorporated into the EDT database when the reach characterization was completed during the subbasin planning process. In some cases, these barriers had not been incorporated. In those instances, our analysis assumed that the problem had already been resolved.[10] Except in the case of the Pelton-Round Butte Complex in the Deschutes system, we modeled passage actions as providing full (100%) passage for both upstream and downstream migrations.

The Pelton-Round Butte Complex is the most significant barrier to fish migration addressed in the analysis. Passage around this hydro-electric project on the mainstem Deschutes River was terminated in 1968, blocking anadromous fish from returning to major spawning areas in that river. Work is currently underway to restore both upstream and downstream passage at the

[9] / To illustrate the effect, the current condition for maximum water temperature within a stream reach might have a rating of 3.5, which is equivalent to peak temperatures reaching 22-25 C on multiple occasions during a month. If the historic temperature—given what can reasonably be assumed about riparian condition, wet meadows, flow, etc—was much cooler, here having a rating of 1.0 meaning that temperatures normally did not exceed 16 C during the month, then the action would result in a rating of 3.43 ((3.5 – 1) x (1 – 0.027) + 1= 3.43), a very slight improvement from the current condition. The ratings for each attribute are used in the EDT rules to compute survival effects by life stage and species (see Lestelle et al. 2004).

[10] / We left the reach characterizations intact as they had been formulated during the subbasin planning process. If a barrier had not been incorporated in that process, it suggests that a passage problem had already been rectified at the time that the planning process was performed or there is uncertainty about the true state of the potential barrier. Regardless, our modeling in such case was performed assuming that a barrier did not exist if it had not been identified in the EDT database.

facilities. Uncertainty exists about how effective passage will be due to the nature of conditions within Lake Billy Chinook. In our analysis, we applied passage assumptions provided by Don Ratliff with Portland General Electric (personal communication), listed below:

Upstream passage effectiveness	99%
Downstream passage effectiveness	75%

As part of the action to restore passage at the Pelton-Round Butte Complex, we also incorporated an option to restore passage at water diversion sites within Whychus Creek. This aspect had not been explicitly called for in actions provided by the planning team. However, Whychus Creek provides the greatest amount of potential spawning habitat for the Deschutes Westside steelhead population upstream of the Pelton-Round Butte Complex—it is logical to assume that barriers in that stream would be addressed.

10.1.3 All-H Integration Across Life Cycle

The AHA model was used to incorporate potential effects of hatchery programs on the genetic fitness of the naturally-produced populations.

Genetic Fitness Effects
The AHA model incorporates key concepts and assumptions about the effects of genetic interactions between hatchery and natural fish built on the work of Lynch and O'Hely (2001) and Ford (2002), with further development of those ideas by geneticists working with the Hatchery Scientific Review Group (Mobrand – Jones & Stokes 2005). Fitness is computed in the model using Ford's (2002) modeling equations.

Ford (2002) used a quantitative genetic model to examine how the combined effects of selection in two environments, hatchery and wild, can influence the distribution of a phenotypic trait and the fitness of a salmon population. The model incorporates assumptions about the strength of selection in hatchery and wild environments, the rate of exchange between the two populations, the maximum reproductive rates of the population in each environment, and the duration of hatchery influence. Modeling results showed that when the hatchery population is closed to gene flow from the natural population, even low levels of gene flow from the hatchery population to the natural population will shift the natural population's mean phenotype so that it approaches the optimal phenotype in the hatchery. If the hatchery population receives gene flow from the natural population, such as by incorporating natural fish into the brood stock, the shift in the natural population's mean phenotype is reduced. While the fitness consequences of such shifts depended on model assumptions, a decline of over 30% in fitness occurred over a broad range of parameter values. When selection was assumed to be relatively strong, the fitness of the natural population was reduced by 80% or more if the hatchery population was closed to immigration from the natural population. The natural population was protected from such fitness decline only when gene flow from the hatchery to the natural population approached zero. Weaker selection produced less dramatic fitness loss, but even very weak selection could produce large reductions in fitness if the hatchery population was closed to immigration from the natural population.

The HSRG concluded (Mobrand et al. 2005) on the basis of AHA modeling that stray hatchery-origin fish from genetically-segregated populations can have a significant genetic influence on natural-origin populations after several generations when their proportion of the total naturally spawning population exceeds 5%. Consequently, they have recommended that hatchery-origin spawners from segregated programs not be allowed to exceed 5% of the natural-origin spawners as an upper-limit guideline. The HSRG is using the AHA model to evaluate potential genetic interactions between hatchery and natural fish associated with hatchery programs in much of the Pacific Northwest, including within the Columbia Basin. In most cases, the model is applied using the HSRG's default parameter settings for the model (Lars Mobrand, personal communication).

In examining genetic effects associated with default model settings, we concluded that one modification was needed. The default setting for what Ford (2002) defines as the optimal trait value in the hatchery environment results in a rapid and severe decline in the natural-origin population's fitness (recruits per spawner) as the proportion of strays exceeds about 5% (dashed line in Figure 10-4). As the proportion of strays continues to increase, equilibrium fitness bottoms out at approximately 20% of the natural-origin population unaffected by strays. (The dashed line in Figure 10-4 corresponds to the line in Ford's Figure 3A associated with a theta of -20, which can be seen there as having a very severe effect relative to other possibilities.) We find this level of severity to be unrealistic as it would have already caused extinction to several Mid-C steelhead populations. Lars Mobrand (personal communication) reports that the HSRG has reached the same conclusion, though they address these by truncating the effect on fitness at 50%, which they suggest is a likely worst case effect. Truncation in this manner results in a very precipitous decline in fitness at relatively low levels of strays, then an abrupt floor on fitness effect when 50% is reached. The 50% effect occurs with about 7-8% of the natural spawning population consisting of strays.

We assume that a 50% floor on fitness effect is reasonable and have applied it in our modeling. However, we modified the optimal trait value in the hatchery such that a floor of 50% would be attained while providing for a smooth transition across a relatively wide range of strays (solid line in Figure 10-4). This setting for the hatchery optimal trait value also provides a less precipitous decline in fitness though it still results in a very strong effect when strays are 10% or more of the naturally spawning population.

In our analysis of genetic effects of hatchery fish, we applied the AHA model primarily to consider interactions of stray hatchery fish with the natural-origin populations being analyzed. The average proportions of strays in the naturally spawning populations for the baseline and current time periods used in the analysis are identified in Appendix B in the spawner composition SS/D metric for each population. These proportions would decline with increased natural-origin run sizes for scenarios involving tributary habitat actions, since numbers of strays would be unchanged.

Prospective actions to manage the numbers of strays were analyzed for the two Deschutes populations. Although there are no significant proposed actions to reduce strays in the John Day River populations, we do plan to model reductions in the future for reference information. The numbers of strays in the natural spawning populations would be reduced to 5% of the number

entering the spawning areas, such as by using weirs. We assumed that the ratio of Round Butte hatchery strays to out-of-DPS hatchery strays would remain unchanged from the baseline ratios. The number of strays that enter a subbasin could increase above baseline levels, however, due to improved survival in the mainstem Columbia River associated with actions to improve survival.

We also used the model to incorporate genetic effects for the within-population hatchery program associated with the ten populations analyzed, that being the Umatilla supplementation hatchery program. Potential genetic effects of that program were incorporated into our analysis by using the modeling inputs for the program as being applied by the HSRG.

We used the default parameter settings in AHA to analyze fitness except as noted above.

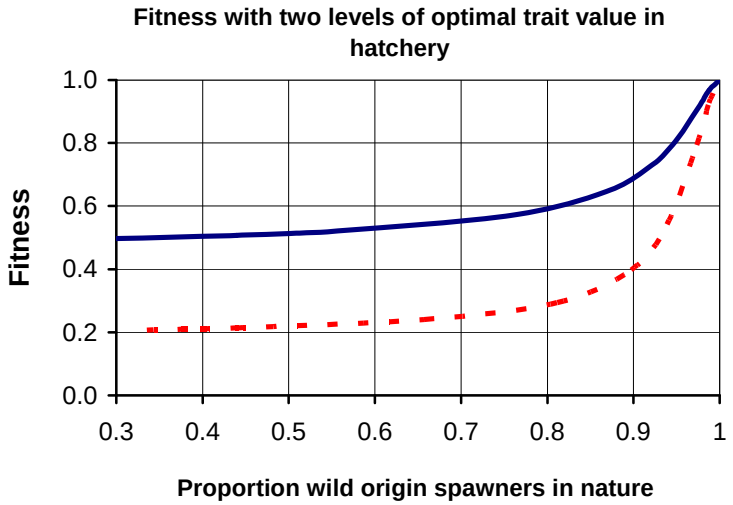

Figure 10-4. Change in fitness in relation to proportion of strays used in AHA modeling. Dashed line represents the default AHA settings based on Ford (2002). The solid line represents the relationship used for modified AHA in these analyses.

Out-of-Subbasin Factors and Actions

Out-of-subbasin actions were modeled using projected survival improvements as presented in Table 10-5. Projected survival improvements are consistent with values given in the most recent Biological Opinion issued by NOAA Fisheries on October 30, 2007. Use of the BiOp survival improvement values in no way implies endorsement of the validity of the estimates or the adequacy of the actions for recovery. At this time, the BiOp survival improvement estimates for the hydrosystem, predation, and estuary actions are the only estimates available for these proposed actions.

Scenarios were run in a stepwise fashion, starting with baseline, then current condition, then adding in actions sequentially, each being added to the previous scenario. The effects of hatchery steelhead programs on genetic fitness—hence performance—of natural-origin fish were incorporated for each scenario using AHA.

Table 10-5. Out-of-subbasin survival improvements for Mid-C steelhead populations. Improvement factors are expressed as multipliers on survival and are derived as ratios of estimated survival in one period divided by the previous period.

Mainstem river survival factor	Affected populations	Current/base ratio	Future/current
Hydro			
1 dam	Fifteenmile	1.031	1.002
2 dam	Deschutes	1.064	1.051
3 dam	John Day, Umatilla	1.103	1.100
4 dam	Walla Walla	1.143	1.122
Predation			
Avian	All	0.997	1.034
Pikeminnow	All	1.000	1.010
Estuary	All	1.003	1.057
Harvest	All	1.040	1.000

10.2 Analysis of Tributary Habitat Action Effectiveness

Results of the tributary action analysis are presented for each population below. Changes in performance measures associated with each action scenario are presented for intrinsic productivity, equilibrium (or average) abundance, and life history diversity, as these metrics were described earlier in this section.

For each population, the following results are presented in tabular and/or graphic form:

- Summary of level of action coverage, reporting
  - Stream miles within the subbasin relevant to the population
  - Number of actions applied;
  - Cumulative miles of stream potentially affected by all actions (ignoring intensity of application);
  - Ratio of cumulative miles potentially affected by stream miles relevant to population;
  - Average action effectiveness applied, weighted by the number of stream miles potentially affected per each action;
  - Average adjusted effectiveness, weighted by the number of stream miles potentially affected, where effectiveness is adjusted for all scalars (such as intensity of treatment) except the attribute scalar (therefore the actual adjusted effectiveness is lower for some attributes); and
- Summary of estimated percent changes in population performance for each population due to the tributary habitat actions for each scenario; and
- Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions. Habitat potential here is assumed to be equal to the population performance that would have occurred associated with the pre-

development condition in the subbasin. Performance for habitat potential is computed with baseline (i.e., post-development) out-of-subbasin conditions in place; and

- Maps illustrating geographic areas that are currently in protected status (wilderness areas, proposed wilderness areas, and municipal watersheds, USFS 2009 personal communication); stream reaches where priority 1 and priorities 1 and 2 protection actions are proposed; and, restoration benefits from priority 1 and priorities 1 and 2 restoration actions for all reaches.

Genetic effects to populations due to hatchery-origin fish spawning with natural-origin fish are not considered in this part of the analysis. Genetic effects are incorporated as part of the all-H integration.

10.2.1 Fifteenmile Creek Winter Steelhead

Level of Action Coverage

The level of treatment coverage by habitat actions in the Fifteenmile subbasin is greater than for any of the coverage amounts for the other populations analyzed. The ratios of cumulative miles potentially affected by actions to total stream miles available exceed 20 for both Priority 1 and Priority 1 & 2 scenarios. The adjusted weighted average action effectiveness values show that actual treated areas would be far less than suggested by these ratios, however. The reader should note that the cumulative miles affected by the actions include stream miles outside the population's boundaries as defined by spawning distribution—encompassing miles within the migration corridor and downstream rearing areas down to the confluence of the subbasin with the mainstem Columbia River. Table 10-6 summarizes tributary habitat action coverage and average action effectiveness values applied to the Fifteenmile Creek winter steelhead population.

Table 10-6. Summary of tributary habitat action coverage and average action effectiveness values applied to the Fifteenmile Creek winter steelhead population. Total stream miles are those modeled in EDT. Cumulative miles affected are the total miles targeted for actions without considering intensity of treatment by actions. Average potential and adjusted effectiveness values are weighted by stream miles targeted by each action. Average adjusted action effectiveness values incorporate all action scalars except the attribute scalar.

Population:	Fifteenmile Creek	
Total stream miles in subbasin:	134	
	Priority 1	Priority 1 & 2
No. of actions:	39	39
Cum miles affected by actions:	2,799	2,987
Ratio cum miles affected to total miles:	20.9	22.4
Weighted ave potential action effectiveness 1/:	0.253	0.270
Weighted ave adjusted action effectiveness 1/:	0.050	0.051

1/ Weighted by stream miles affected per action

Projected Changes to Population Performance

Estimated percent changes in population performance of Fifteenmile Creek winter steelhead from tributary actions are shown in tables 10-7 and 10-8, and figures 10-5 and 10-6. Estimated increases in population performance resulting from tributary habitat actions are relatively large for each performance measure for both 25 and 100 year scenarios (Figure 10-5). Between 50-70% of habitat potential (i.e., historical potential) for both abundance and productivity is estimated to be achieved for the four scenarios considered (Figure 10-6). Nearly 100% of habitat potential would be achieved as expressed by the life history diversity metric. It should be noted that these measures of performance for this part of the analysis do not include any loss in performance that might be associated with genetic fitness loss due to strays (fitness loss is assumed to be zero for this population).

Table 10-7. Estimated percent changes in population performance of Fifteenmile Creek winter steelhead due to tributary habitat actions.

Performance measure	Scenario	Time period lag	
		25 yr	100 yr
Abundance	Priority 1	108%	134%
	Priority 1 & 2	119%	147%
Productivity	Priority 1	48%	90%
	Priority 1 & 2	55%	100%
Diversity index	Priority 1	166%	175%
	Priority 1 & 2	180%	185%

Table 10-8. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to Fifteenmile Creek winter steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin. Performance for habitat potential is computed with baseline (i.e., post-development) out-of-subbasin conditions in place.

Performance measure	Scenario	Time period		
		Base/Curr	25 yr	100 yr
Abundance	Baseline	32%		
	Priority 1		67%	75%
	Priority 1 & 2		70%	79%
Productivity	Baseline	35%		
	Priority 1		52%	67%
	Priority 1 & 2		55%	71%
Diversity index	Baseline	34%		
	Priority 1		91%	95%
	Priority 1 & 2		96%	98%

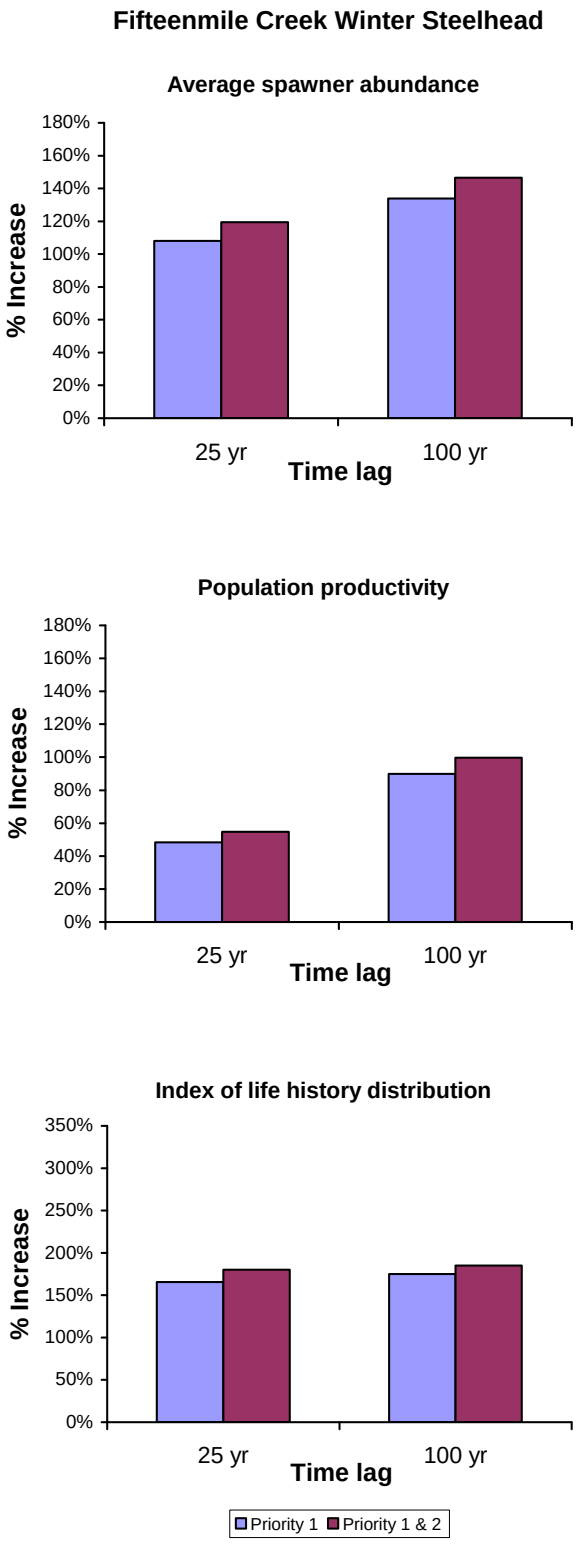

Figure 10-5. Estimated percent changes in population performance of Fifteenmile Creek winter steelhead due to tributary habitat actions.

Figure 10-6. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to Fifteenmile Creek winter steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin.

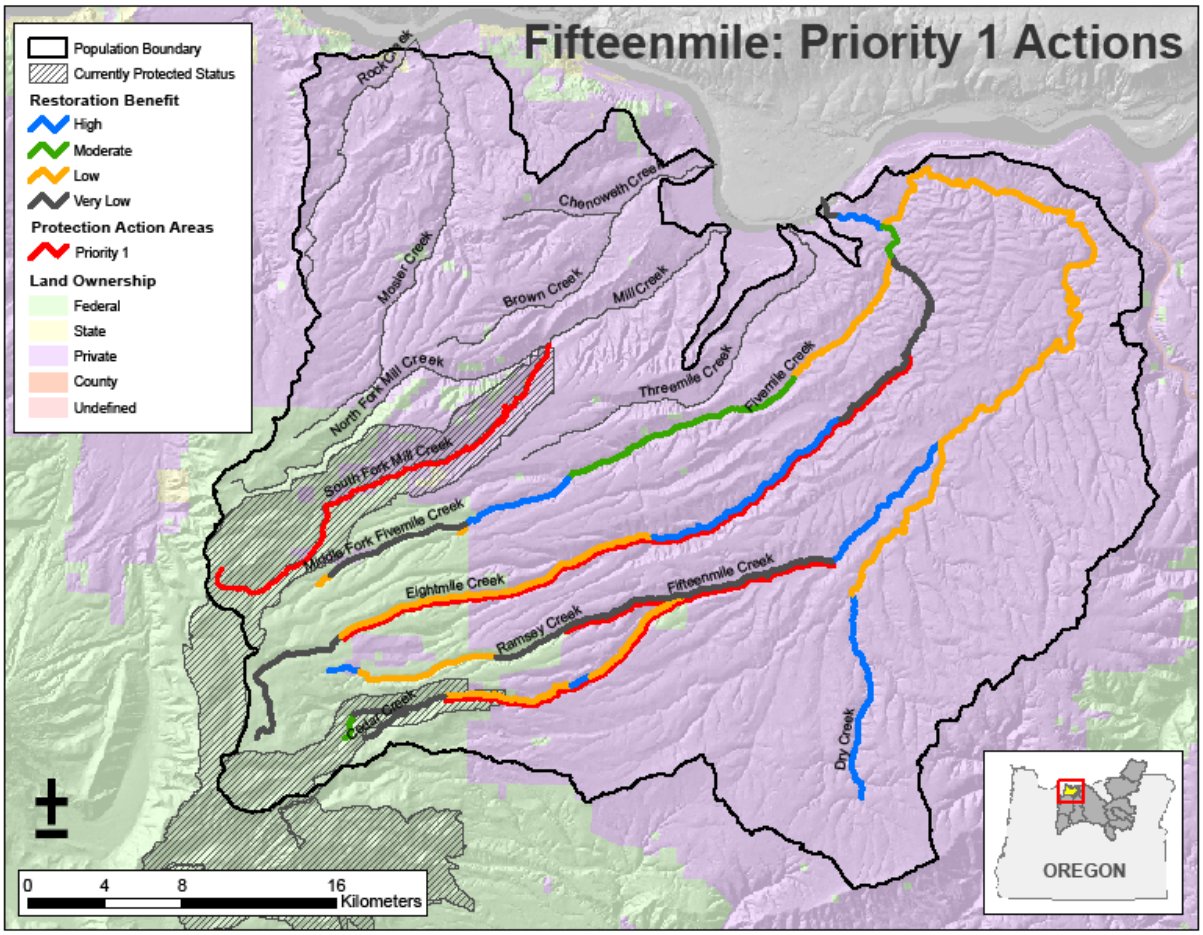

Figure 10-7. Map of the Fifteenmile Creek steelhead population showing geographic areas that are currently in protected status, reaches identified as high priority for proposed protection management actions, and relative restoration benefit from high priority (priority 1) proposed restoration actions for all reaches. Restoration benefits are only shown for the Fifteenmile Creek watershed because no effectiveness modeling was completed for the other watersheds in the population.

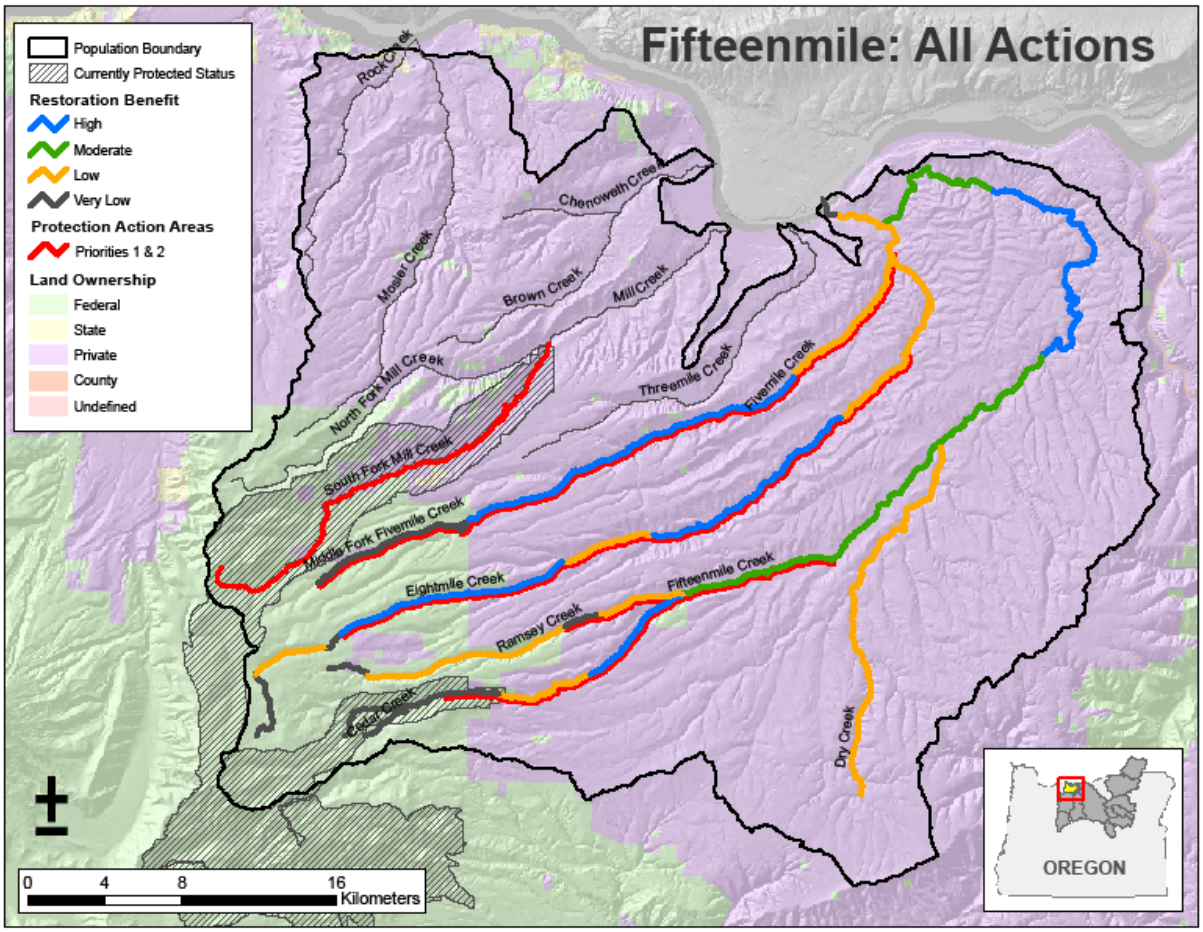

Figure 10-8. Map of the Fifteenmile Creek steelhead population showing geographic areas that are currently in protected status, reaches identified for proposed protection management actions (priority 1 and priority 2), and reaches with high, moderate, low and very low restoration benefit from all (priority 1 and priority 2) proposed restoration actions. Restoration benefits are only shown for the Fifteenmile Creek watershed because no effectiveness modeling was completed for the other watersheds in the population.

10.2.2 Deschutes River Eastside Summer Steelhead

Level of Action Coverage

The level of treatment coverage by habitat actions for the Deschutes River Eastside population is comparable to the coverages applied to most of the other Oregon Mid-C steelhead populations. The ratios of cumulative miles potentially affected by actions to total stream miles available are approximately 10 for both Priority 1 and Priority 1 & 2 scenarios. The adjusted weighted average action effectiveness values show that actual treated areas would be far less than suggested by these ratios, however. The reader should note that the cumulative miles affected by the actions include stream miles outside the population's boundaries as defined by spawning distribution—encompassing miles within the migration corridor and downstream rearing areas down to the confluence of the subbasin with the mainstem Columbia River. Table 10-9 summarizes tributary habitat action coverage and average action effectiveness values applied to the Deschutes River Eastside summer steelhead population.

Table 10-9. Summary of tributary habitat action coverage and average action effectiveness values applied to the Deschutes River Eastside summer steelhead population. Total stream miles are those modeled in EDT. Cumulative miles affected are the total miles targeted for actions without considering intensity of treatment by actions. Average potential and adjusted effectiveness values are weighted by stream miles targeted by each action. Average adjusted action effectiveness values incorporate all action scalars except the attribute scalar. Effectiveness values shown apply to the entire Deschutes subbasin.

Population:	Deschutes River Eastside	
Total stream miles in Deschutes subbasin:	802	
	Priority 1	Priority 1 & 2
No. of actions:	38	38
Total stream miles Eastside:	360	360
Cum miles affected by actions:	3,363	4,145
Ratio cum miles affected to total miles:	9.3	11.5
Weighted ave potential action effectiveness 1/:	0.136	0.170
Weighted ave adjusted action effectiveness 1/:	0.038	0.043

1/ Value shown is for entire Deschutes subbasin; weighted by stream miles affected per action

Projected Changes to Population Performance

Estimated percent changes in population performance of Deschutes River Eastside summer steelhead from tributary actions are shown in tables 10-10 and 10-11, and figures 10-9 and 10-10. Estimated increases in population performance resulting from tributary habitat actions are relatively large for both 25 and 100 year scenarios (Figure 10-9). Between approximately 50-70% of habitat potential (i.e., historical potential) for abundance is estimated to be achieved for the four scenarios considered (Figure 10-10). The amount of habitat potential reached in productiviy is somewhat less, roughly between 25-45% of potential. These results indicate that

the habitat actions would have a greater effect on habitat quantity, since abundance is affected by both the quantity and quality of habitat, and productivity is primarily affected by habitat quality. Increases in water flow and opening of fish passage barriers would tend to affect habitat quantity more than quality characteristics on the whole. The largest amount of habitat potential regained by the actions would occur for the life history diversity measure. This measure of diversity reflects how much of the habitat could support sustainable life histories. The increase in diversity indicates that habitat quality and removal of barriers is sufficient to result in a substantial expansion of sustainable distribution within the geographic area of interest.

It should be noted that these measures of performance for this part of the analysis do not include any loss in performance that might be associated with genetic fitness loss due to strays.

Table 10-10. Estimated percent changes in population performance of Deschutes River Eastside summer steelhead due to tributary habitat actions.

Performance measure	Scenario	Time period lag	
		25 yr	100 yr
Abundance	Priority 1	69%	107%
	Priority 1 & 2	102%	139%
Productivity	Priority 1	48%	98%
	Priority 1 & 2	79%	143%
Diversity index	Priority 1	137%	188%
	Priority 1 & 2	174%	219%

Table 10-11. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to Deschutes River Eastside summer steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin. Performance for habitat potential is computed with baseline (i.e., post-development) out-of-subbasin conditions in place.

Performance measure	Scenario	Time period		
		Base/Curr	25 yr	100 yr
Abundance	Baseline	28%		
	Priority 1		48%	58%
	Priority 1 & 2		57%	67%
Productivity	Baseline	18%		
	Priority 1		27%	36%
	Priority 1 & 2		32%	44%
Diversity index	Baseline	25%		
	Priority 1		60%	73%
	Priority 1 & 2		69%	80%

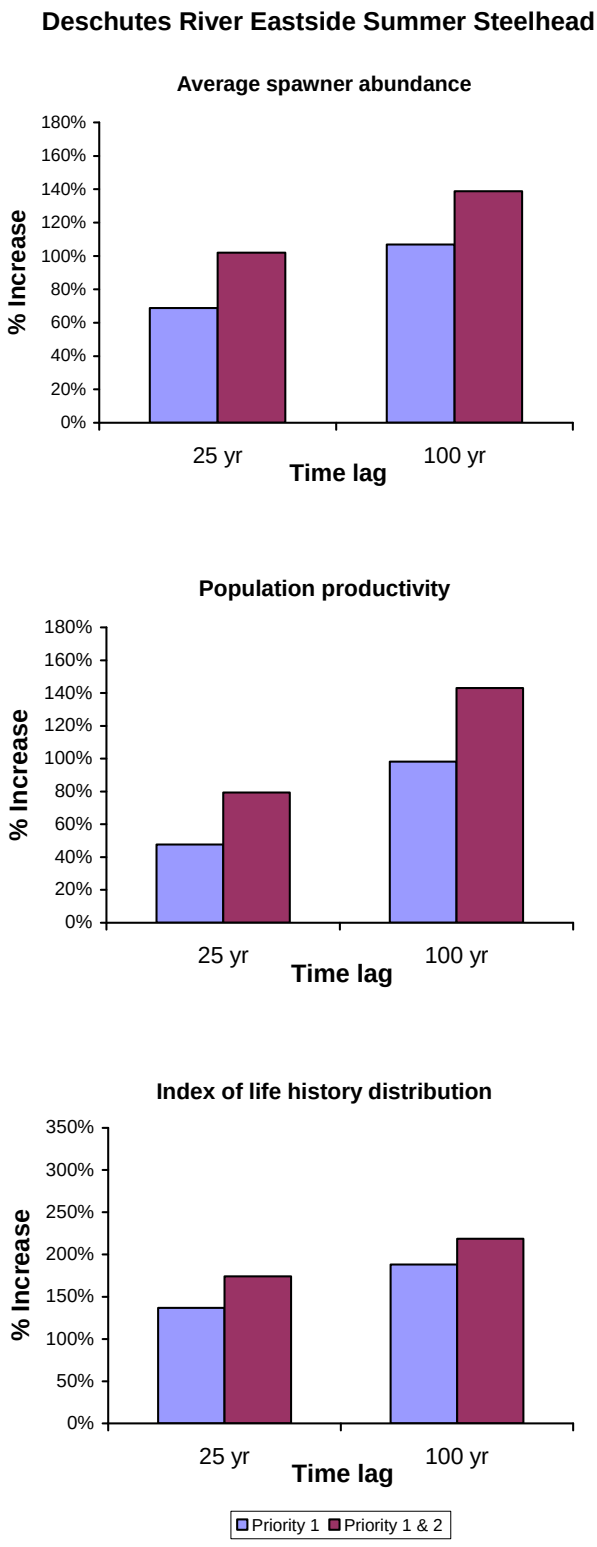

Figure 10-9. Estimated percent changes in population performance of Deschutes River Eastside summer steelhead due to tributary habitat actions.

Figure 10-10. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to Deschutes River Eastside summer steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin.

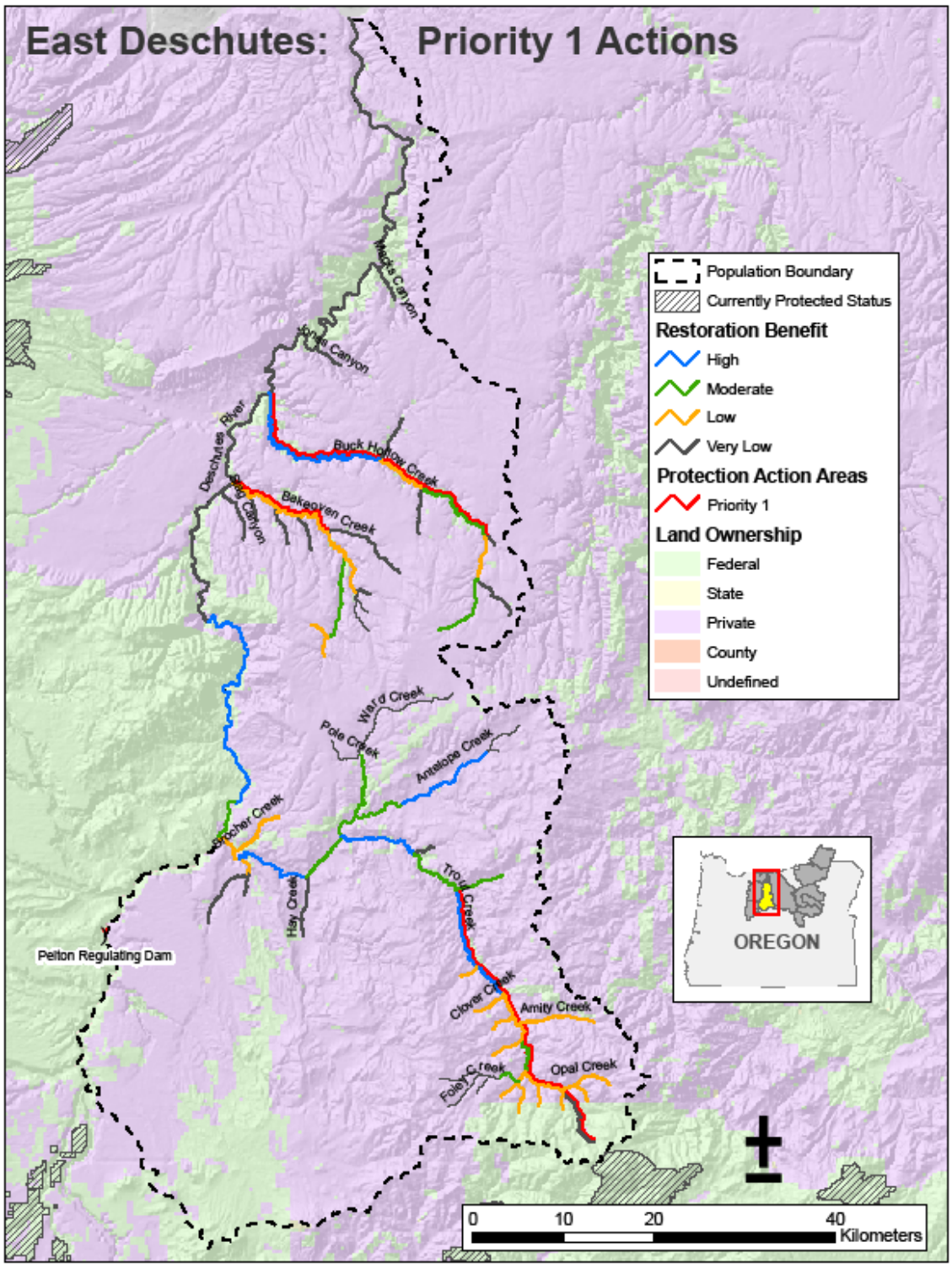

Figure 10-11. Map of the Deschutes River Eastside steelhead population showing geographic areas that are currently in protected status, reaches identified as high priority for proposed protection management actions, and relative restoration benefit from high priority (priority 1) proposed restoration actions for all reaches.

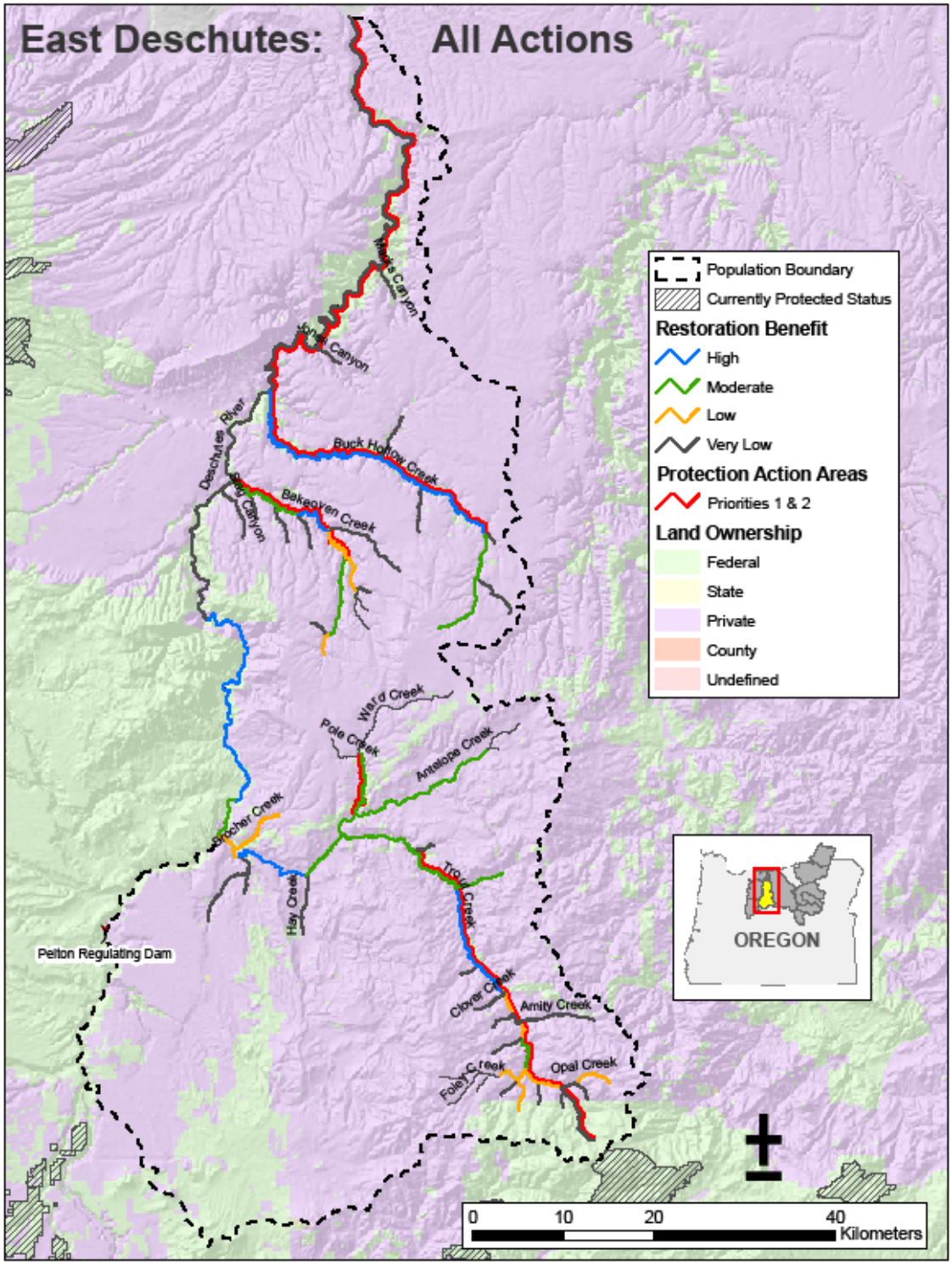

Figure 10-12. Map of the Deschutes River Eastside steelhead population showing geographic areas that are currently in protected status, reaches identified for proposed protection management actions (priority 1 and priority 2), and reaches with high, moderate, low and very low restoration benefit from all (priority 1 and priority 2) proposed restoration actions.

10.2.3 Deschutes River Westside Summer Steelhead

Level of Action Coverage

The level of treatment coverage by habitat actions for the Deschutes River Westside population is comparable to the coverages applied to most of the other Oregon Mid-C steelhead populations. The ratios of cumulative miles potentially affected by actions to total stream miles available are approximately 10 or slightly greater for both Priority 1 and Priority 1 & 2 scenarios. The adjusted weighted average action effectiveness values show that actual treated areas would be far less than suggested by these ratios, however. The reader should note that the cumulative miles affected by the actions include stream miles outside the population's boundaries as defined by spawning distribution—encompassing miles within the migration corridor and downstream rearing areas down to the confluence of the subbasin with the mainstem Columbia River. Table 10-12 summarizes tributary habitat action coverage and average action effectiveness values applied to the Deschutes River Westside summer steelhead population.

Table 10-12. Summary of tributary habitat action coverage and average action effectiveness values applied to the Deschutes River Westside summer steelhead population. Total stream miles are those modeled in EDT. Cumulative miles affected are the total miles targeted for actions without considering intensity of treatment by actions. Average potential and adjusted effectiveness values are weighted by stream miles targeted by each action. Average adjusted action effectiveness values incorporate all action scalars except the attribute scalar. Effectiveness values shown apply to the entire Deschutes subbasin.

Population:	Deschutes River Westside	
Total stream miles in Deschutes subbasin:	802	
	Priority 1	Priority 1 & 2
No. of actions:	38	38
Total stream miles in Westside:	442	442
Cum miles affected by actions:	4,341	5,935
Ratio cum miles affected to total miles:	9.8	13.4
Weighted ave potential action effectiveness 1/:	0.136	0.170
Weighted ave adjusted action effectiveness 1/:	0.038	0.043

1/ Value shown is for entire Deschutes subbasin; weighted by stream miles affected per action

Projected Changes to Population Performance

Estimated percent changes in population performance of Deschutes River Westside summer steelhead from tributary actions are shown in tables 10-13 and 10-14, and figures 10-13 and 10-14. Estimated increases in population performance resulting from tributary habitat actions are modest for both 25 and 100 year scenarios in the absence of passage at the Pelton-Round Butte Complex (Figure 10-13). Estimated increases in spawner abundance associated with habitat actions are <20%, even after 100 years of action maturation. Estimated increases in productivity are larger, being between 35-55% greater at the 100 year time period in the absence of passage.

Increases in the life history diversity metric are smaller (<12%). With passage at Pelton-Round Butte Complex (and including passage at barriers in Whychus Creek), performance measures for abundance and life history diversity are markedly increased. In contrast, productivity is reduced slightly when passage occurs. A reduction in productivity can occur with passage due either to the opening of poorer quality habitat than below the barrier or to a toll on survival associated with fish passing the barrier. In this case, the slight drop in survival is apparently due to migration survival loss associated with passage (juvenile passage effectiveness was assumed to be 75%).

Without fish passage at Pelton-Round Butte Complex, less that 50% of the habitat potential (i.e., historical potential) for abundance is estimated to be achieved for the four scenarios considered (Figure 10-14). The amounts of potential for these scenarios are only slightly greater than the baseline level. These modest increases toward regaining lost habitat potential, given the extent of actions being applied, suggest that much of the historical potential that existed historically downstream of Pelton-Round Butte is already being achieved. This further suggests that one or more other factors are constraining the actual population's performance besides that determined by habitat condition. One factor, loss in genetic fitness due to hatchery strays, is addressed as part of the All-H integration later in this section. We hypothesize that a second factor is interaction with the resident life history form of *O. mykiss*. Our analysis, including both our detailed tributary action assessment and the All-H integration, does not address how the resident form of *O. mykiss*, may be constraining the performance of the anadromous population.

Table 10-13. Estimated percent changes in population performance of Deschutes River Westside summer steelhead due to tributary habitat actions. Results are shown with and without passage at the Pelton-Round Butte Complex. The passage scenarios also include passage at water diversion barriers on Whychus Creek.

Performance measure	Scenario	No passage		Passage	
		Time period lag			
		25 yr	100 yr	25 yr	100 yr
Abundance	Priority 1	5%	12%	50%	59%
	Priority 1 & 2	10%	17%	58%	68%
Productivity	Priority 1	22%	36%	19%	32%
	Priority 1 & 2	33%	54%	31%	50%
Diversity index	Priority 1	7%	10%	67%	70%
	Priority 1 & 2	9%	11%	69%	71%

Table 10-14. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to Deschutes River Westside summer steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin. Performance for habitat potential is computed with baseline (i.e., post-development) out-of-subbasin conditions in place. Results are shown with and without passage at the Pelton-Round Butte Complex. Passage scenarios include passage at diversions in Whychus Creek.

Performance measure	Scenario	No passage			Passage		
		Time period					
		Base/Curr	25 yr	100 yr	Base/Curr	25 yr	100 yr
Abundance	Baseline	43%			43%		
	Priority 1		45%	48%		64%	68%
	Priority 1 & 2		47%	50%		68%	72%
Productivity	Baseline	46%			46%		
	Priority 1		57%	63%		55%	61%
	Priority 1 & 2		62%	71%		61%	69%
Diversity index	Baseline	52%			52%		
	Priority 1		56%	57%		87%	88%
	Priority 1 & 2		57%	58%		88%	89%

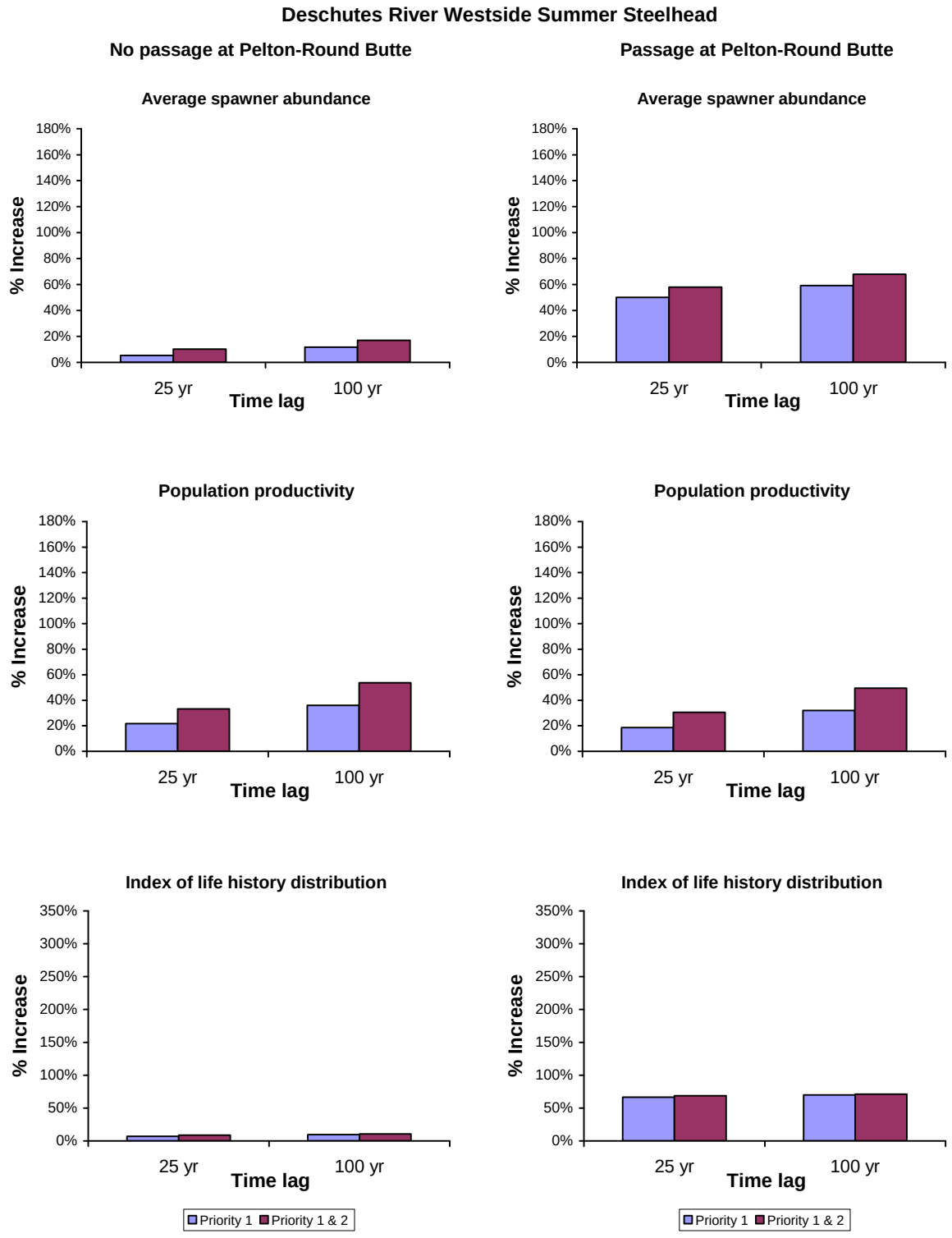

Figure 10-13. Estimated percent changes in population performance of Deschutes River Westside summer steelhead due to tributary habitat actions with and without passage at the Pelton-Round Butte Complex. Passage also includes passage at diversion barriers on Whychus Creek.

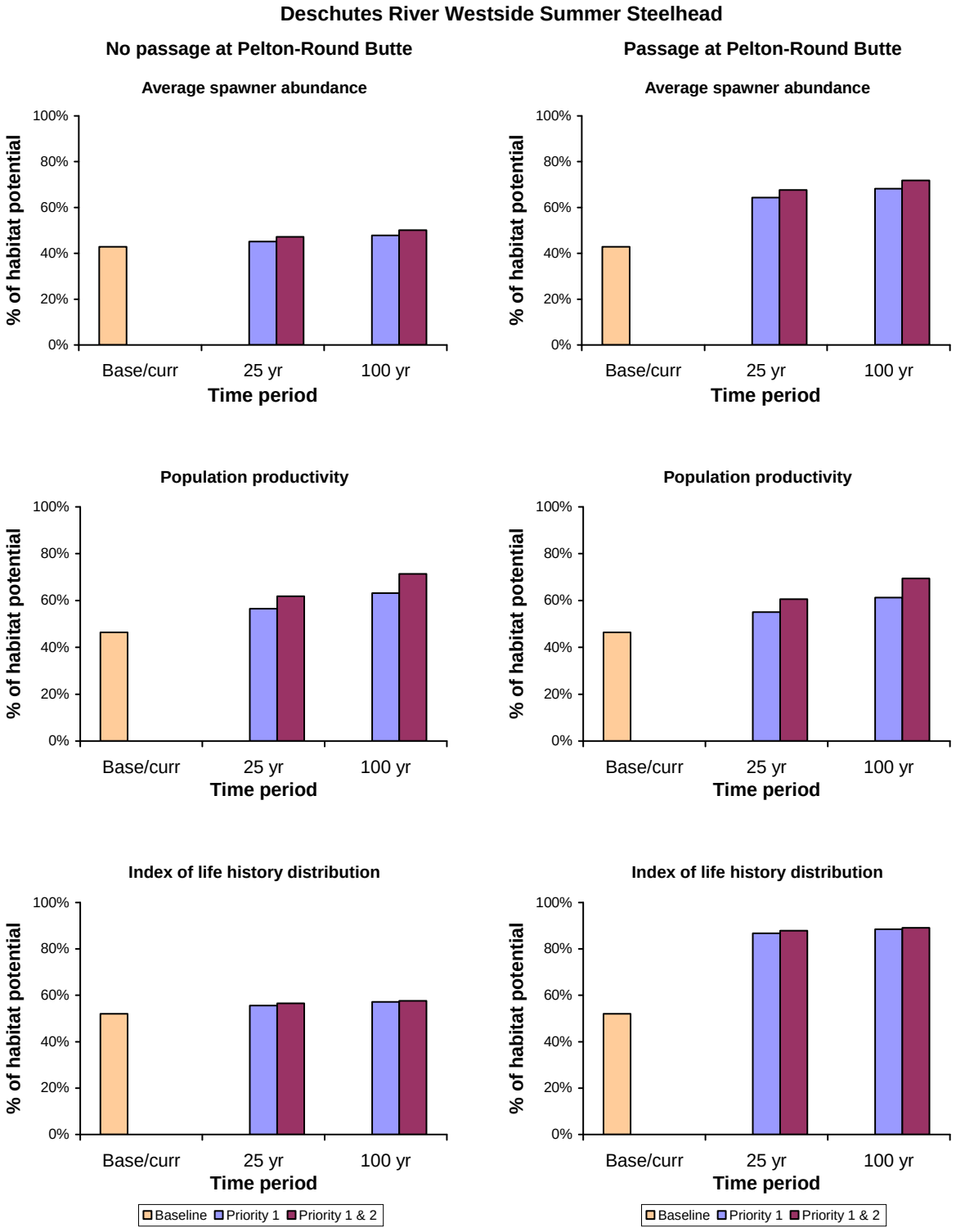

Figure 10-14. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to Deschutes River Westside summer steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin. Results are shown with and without passage at Pelton-Round Butte Complex and Whychus Creek.

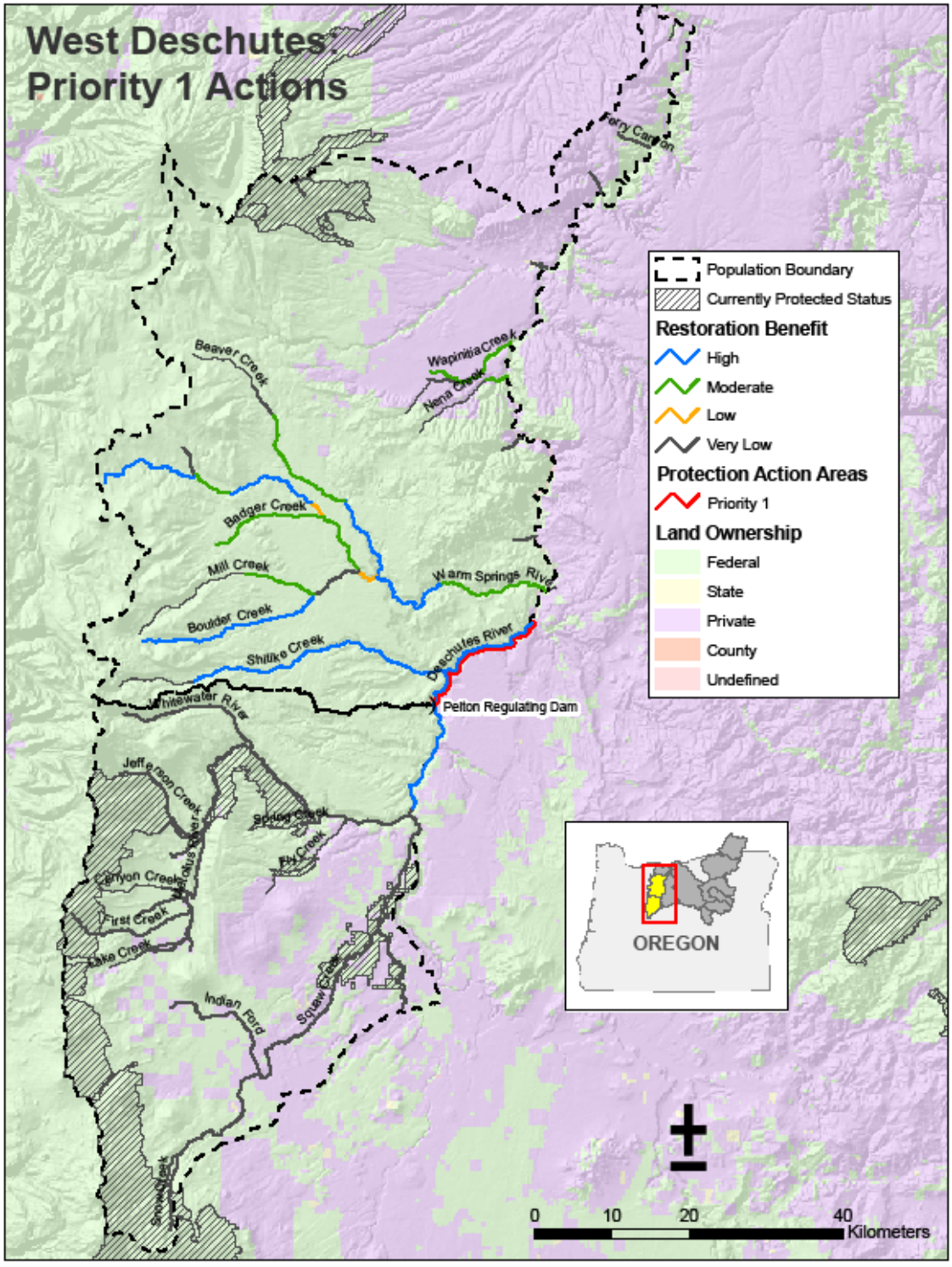

Figure 10-15. Map of the Deschutes River Westside steelhead population showing geographic areas that are currently in protected status, reaches identified as high priority for proposed protection management actions, and relative restoration benefit from high priority (priority 1) proposed restoration actions for all reaches.

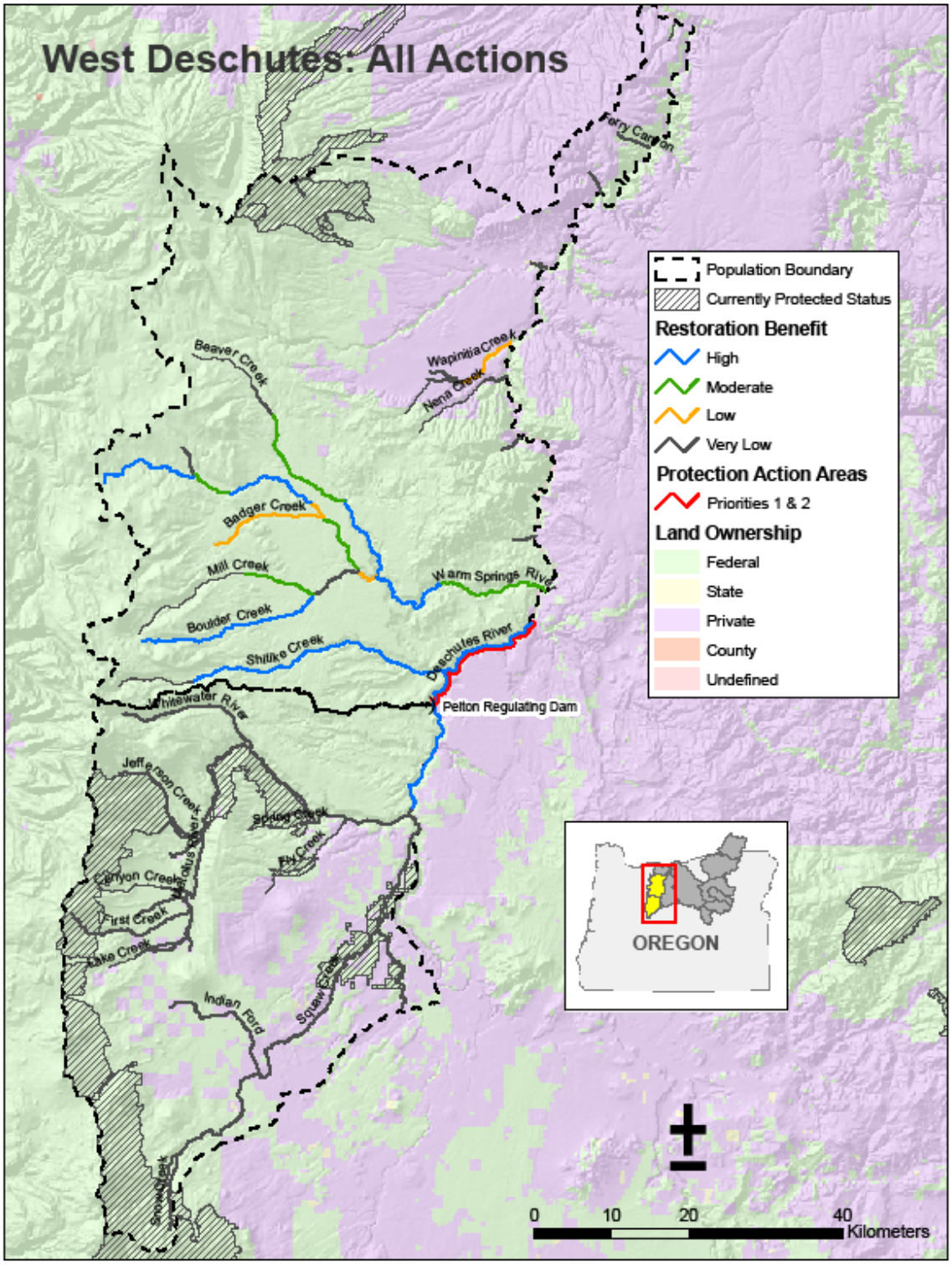

Figure 10-16. Map of the Deschutes River Westside steelhead population showing geographic areas that are currently in protected status, reaches identified for proposed protection management actions (priority 1 and priority 2), and reaches with high, moderate, low and very low restoration benefit from all (priority 1 and priority 2) proposed restoration actions.

10.2.4 Lower Mainstem John Day River Summer Steelhead

Level of Action Coverage

The level of treatment coverage by habitat actions for the Lower Mainstem John Day River population is comparable to the coverages applied to most of the other Oregon Mid-C steelhead populations. The ratios of cumulative miles potentially affected by actions to total stream miles available are approximately 10 or less for Priority 1 and Priority 1 & 2 scenarios. The adjusted weighted average action effectiveness values show that actual treated areas would be far less than suggested by these ratios, however. The reader should note that the cumulative miles affected by the actions include stream miles outside the population's boundaries as defined by spawning distribution—encompassing miles within the migration corridor and downstream rearing areas down to the confluence of the subbasin with the mainstem Columbia River. Table 10-15 summarizes tributary habitat action coverage and average action effectiveness values applied to the Lower Mainstem John Day River summer steelhead population.

Table 10-15. Summary of tributary habitat action coverage and average action effectiveness values applied to the Lower Mainstem John Day River summer steelhead population. Total stream miles are those modeled in EDT. Cumulative miles affected are the total miles targeted for actions without considering intensity of treatment by actions. Average potential and adjusted effectiveness values are weighted by stream miles targeted by each action. Average adjusted action effectiveness values incorporate all action scalars except the attribute scalar. Effectiveness values shown apply to the entire John Day subbasin.

Population:	Lower Mainstem John Day River	
Total stream miles in John Day subbasin:	2,936	
	Priority 1	Priority 1 & 2
No. of Lower John Day actions:	37	37
Total stream miles in Lower John Day:	1,026	1,026
Cum miles affected by LowJD actions:	7,825	10,789
Ratio cum miles affected to total LowJD miles:	7.6	10.5
Weighted ave potential action effectiveness 1/:	0.145	0.146
Weighted ave adjusted action effectiveness 1/:	0.034	0.032

1/ Value shown is for entire John Day subbasin; weighted by stream miles affected per action

Projected Changes to Population Performance

Estimated percent changes in population performance of Lower Mainstem John Day River summer steelhead from tributary actions are shown in tables 10-16 and 10-17, and figures 10-17 and 10-18. Estimated increases in population performance resulting from tributary habitat actions are relatively moderate to large, depending on the performance measure (Figure 10-17). The smallest percentage increases occur for productivity. Even with these increases, performance for both productivity and abundance achieve only approximately 30-40% of habitat potential

with actions. Amounts of potential for the baseline are only approximately 20% or less for these metrics. (Figure 10-18). The largest amount of habitat potential regained by the actions would occur for the life history diversity measure. Between 40-60% of potential associated with this metric would be achieved with habitat actions. The life history diversity metric reflects how much of the habitat could support sustainable life histories. An increase in diversity indicates that habitat quality and removal of barriers (when present) is sufficient to result in a substantial expansion of sustainable distribution within the geographic area of interest.

It should be noted that these measures of performance for this part of the analysis do not include any loss in performance that might be associated with genetic fitness loss due to strays.

Table 10-16. Estimated percent changes in population performance of Lower Mainstem John Day River summer steelhead due to tributary habitat actions.

Performance measure	Scenario	Time period lag	
		25 yr	100 yr
Abundance	Priority 1	64%	113%
	Priority 1 & 2	97%	177%
Productivity	Priority 1	24%	57%
	Priority 1 & 2	28%	83%
Diversity index	Priority 1	76%	121%
	Priority 1 & 2	143%	192%

Table 10-17. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to Lower Mainstem John Day River summer steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin. Performance for habitat potential is computed with baseline (i.e., post-development) out-of-subbasin conditions in place.

Performance measure	Scenario	Time period		
		Base/Curr	25 yr	100 yr
Abundance	Baseline	13%		
	Priority 1		21%	28%
	Priority 1 & 2		26%	36%
Productivity	Baseline	23%		
	Priority 1		28%	36%
	Priority 1 & 2		29%	42%
Diversity index	Baseline	23%		
	Priority 1		40%	50%
	Priority 1 & 2		55%	66%

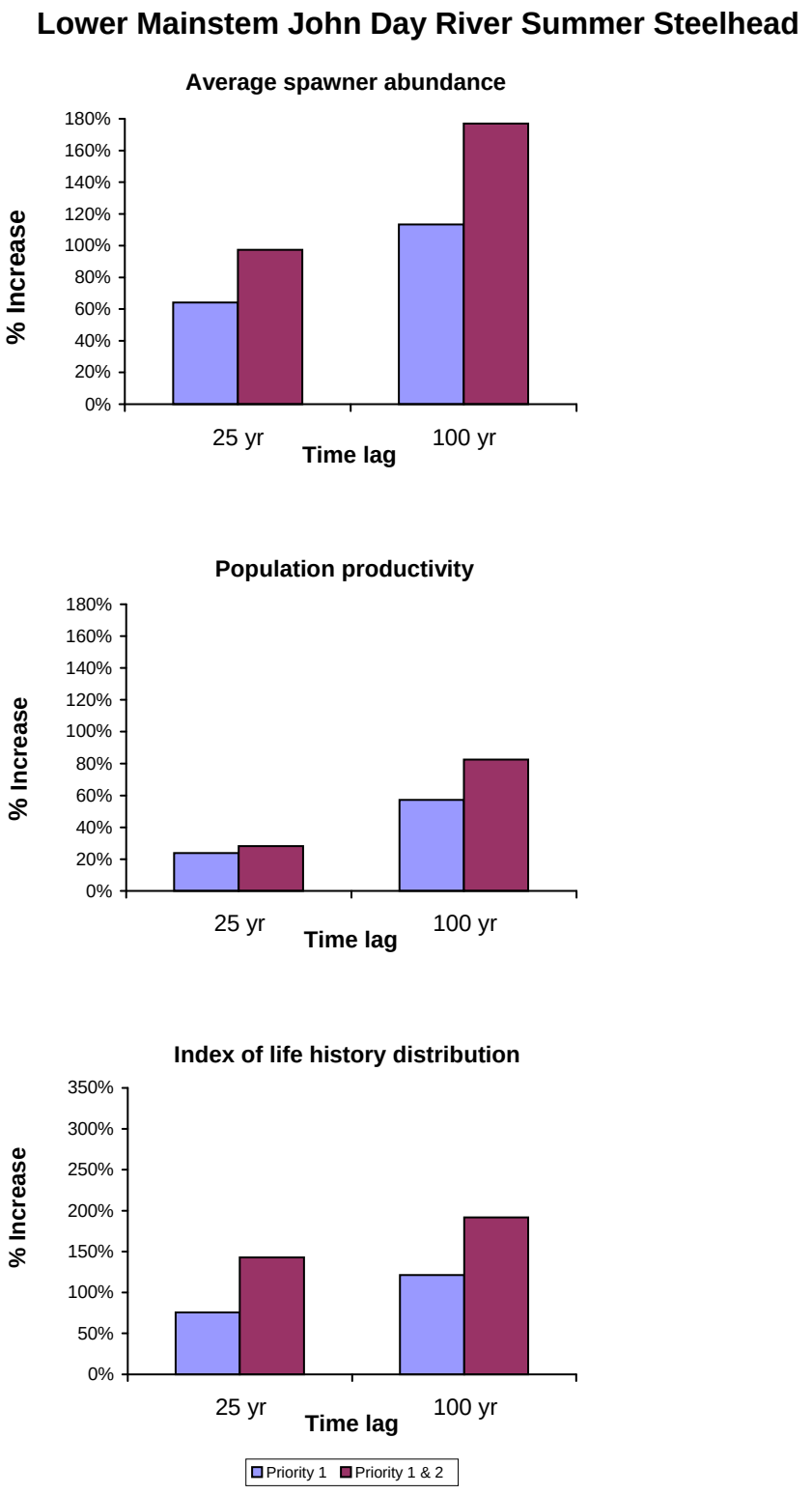

Figure 10-17. Estimated percent changes in population performance of Lower Mainstem John Day River summer steelhead due to tributary habitat actions.

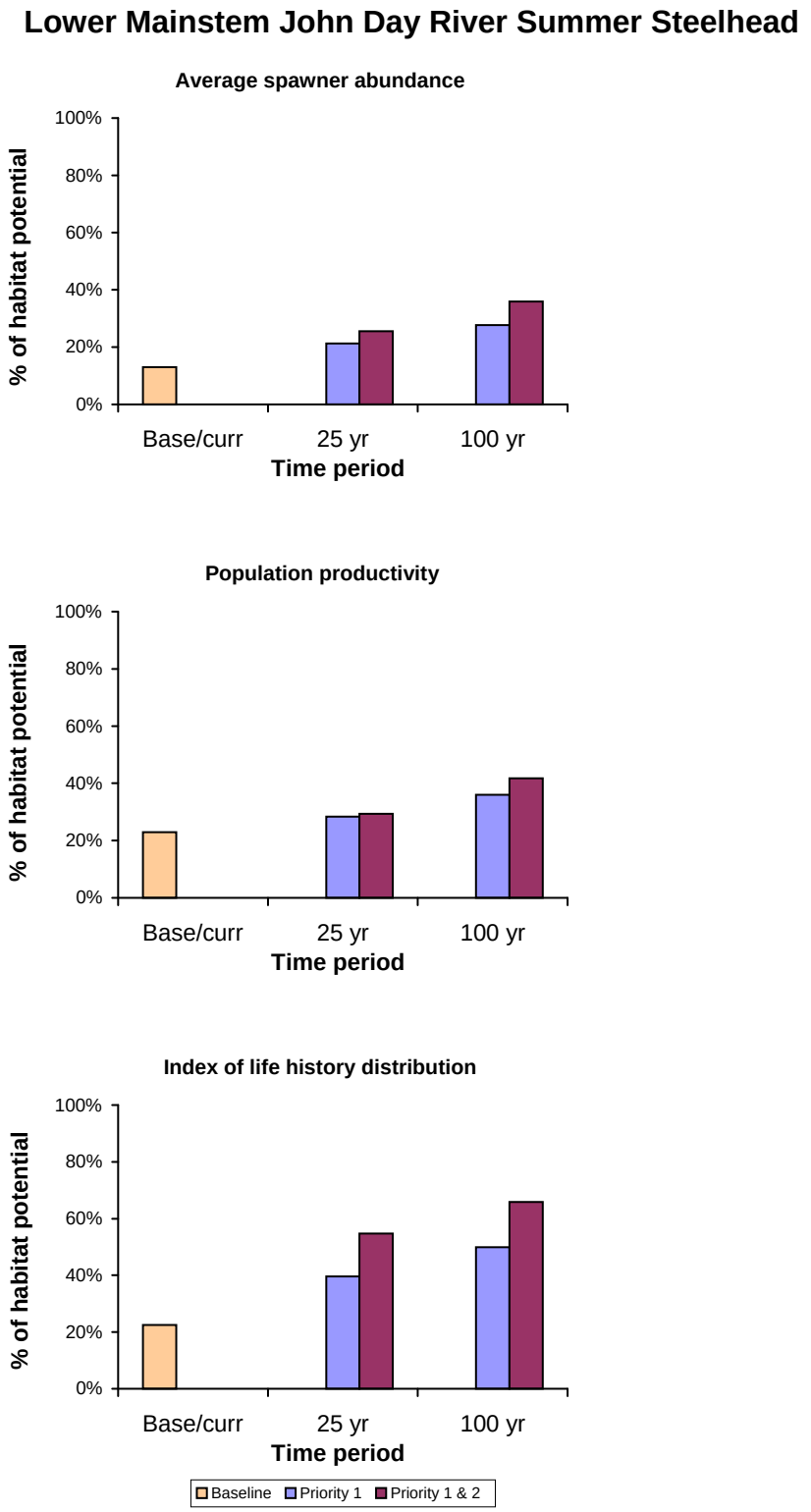

Figure 10-18. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to Lower Mainstem John Day River summer steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin.

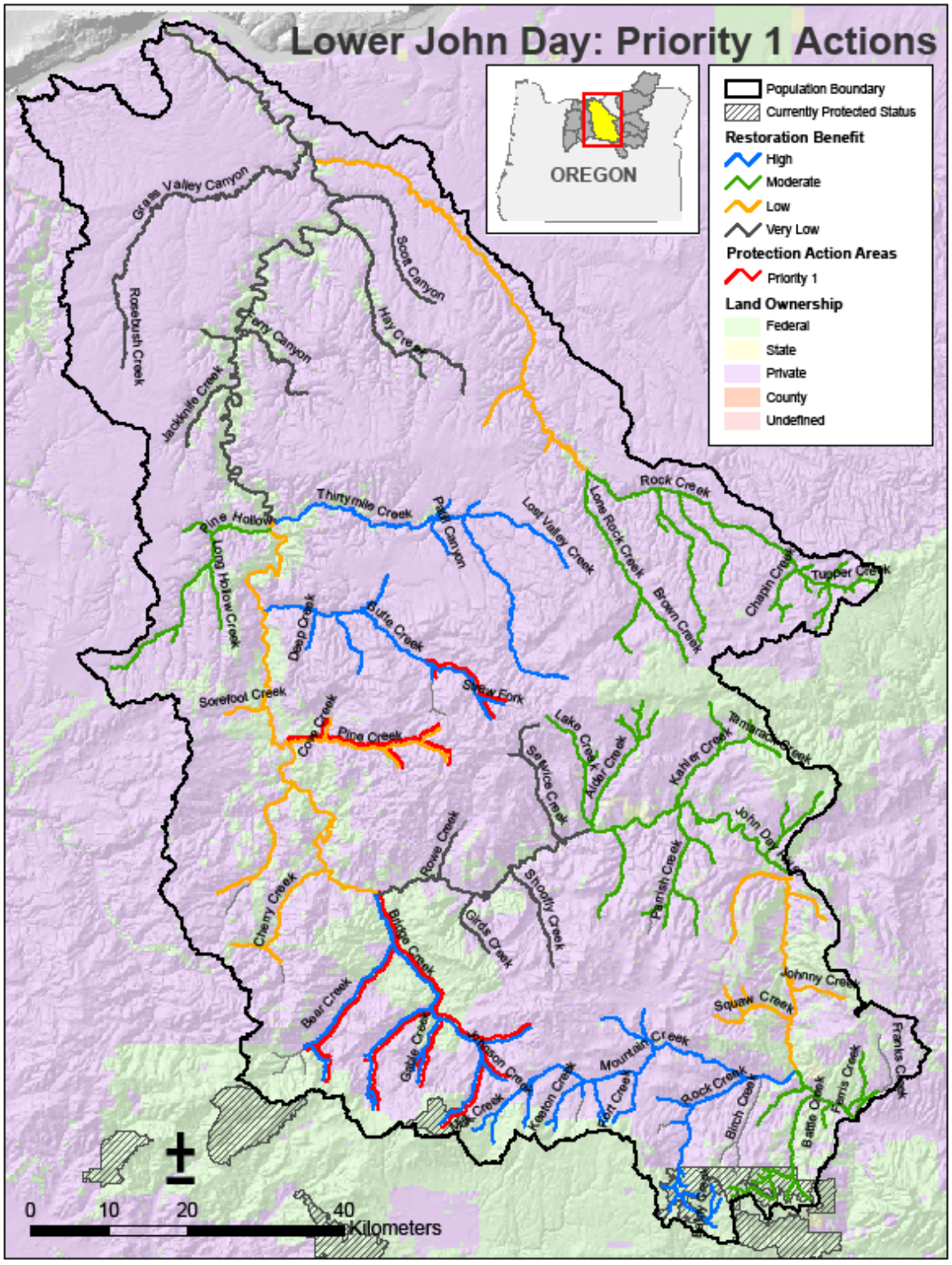

Figure 10-19. Map of the Lower Mainstem John Day River steelhead population showing geographic areas that are currently in protected status, reaches identified as high priority for proposed protection management actions, and relative restoration benefit from high priority (priority 1) proposed restoration actions for all reaches.

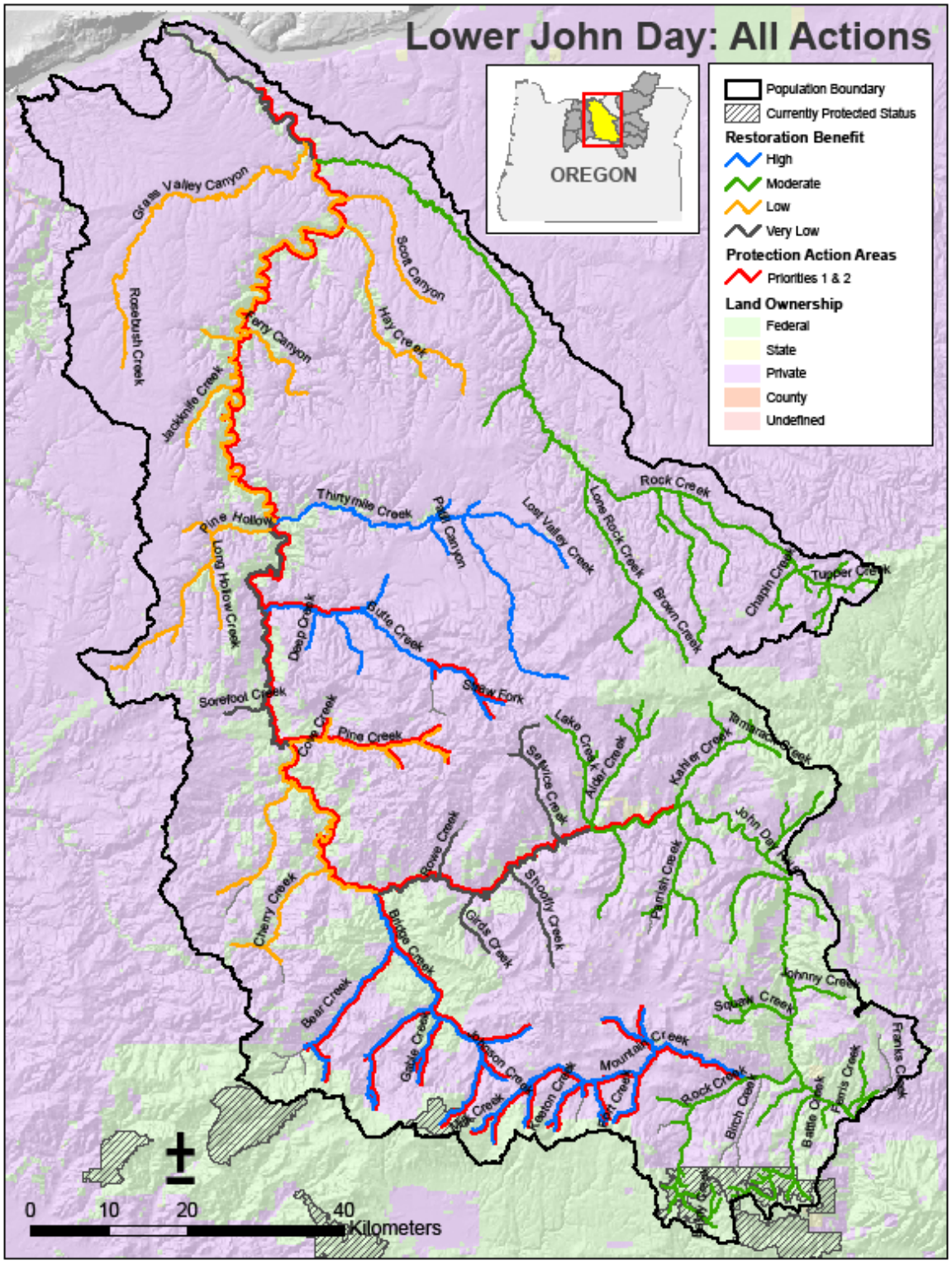

Figure 10-20. Map of the Lower Mainstem John Day River steelhead population showing geographic areas that are currently in protected status, reaches identified for proposed protection management actions (priority 1 and priority 2), and reaches with high, moderate, low and very low restoration benefit from all (priority 1 and priority 2) proposed restoration actions.

10.2.5 North Fork John Day River Summer Steelhead

Level of Action Coverage

The level of treatment coverage by habitat actions for the North Fork John Day River population is least in the range of coverages applied to the other Oregon Mid-C steelhead populations. The ratios of cumulative miles potentially affected by actions to total stream miles available are in the range of 5-6 for Priority 1 and Priority 1 & 2 scenarios. One reason for low coverage in this geographic area is due to the presence of the North Fork Wilderness Area. The adjusted weighted average action effectiveness values also show that actual treated areas well less than values suggested by these ratios. The reader should note that the cumulative miles affected by the actions include stream miles outside the population's boundaries as defined by spawning distribution—encompassing miles within the migration corridor and downstream rearing areas down to the confluence of the subbasin with the mainstem Columbia River. Table 10-18 summarizes tributary habitat action coverage and average action effectiveness values applied to the North Fork John Day River summer steelhead population.

Table 10-18. Summary of tributary habitat action coverage and average action effectiveness values applied to the North Fork John Day River summer steelhead population. Total stream miles are those modeled in EDT. Cumulative miles affected are the total miles targeted for actions without considering intensity of treatment by actions. Average potential and adjusted effectiveness values are weighted by stream miles targeted by each action. Average adjusted action effectiveness values incorporate all action scalars except the attribute scalar. Effectiveness values shown apply to the entire John Day subbasin.

Population:	North Fork John Day River	
Total stream miles in John Day subbasin:	2,936	
	Priority 1	Priority 1 & 2
No. of North Fork John Day actions:	38	38
Total stream miles in North Fork John Day:	942	942
Cum miles affected by NFJD actions:	4,881	5,401
Ratio cum miles affected to total NFJD miles:	5.2	5.7
Weighted ave potential action effectiveness 1/:	0.145	0.146
Weighted ave adjusted action effectiveness 1/:	0.034	0.032

1/ Value shown is for entire John Day subbasin; weighted by stream miles affected per action

Projected Changes to Population Performance

Estimated percent changes in population performance of North Fork John Day River summer steelhead from tributary actions are shown in tables 10-19 and 10-20, and figures 10-21 and 10-22. Estimated increases in population performance resulting from tributary habitat actions are relatively moderate for this population (Figure 10-21). Amounts of habitat potential for the abundance and productivity performance measures reach approximately 45-55%. Amounts of

potential for the baseline for these performance measures are approximately 35-40% (Figure 10-22).

It should be noted that these measures of performance for this part of the analysis do not include any loss in performance that might be associated with genetic fitness loss due to strays.

Table 10-19. Estimated percent changes in population performance of North Fork John Day River summer steelhead due to tributary habitat actions.

Performance measure	Scenario	Time period lag	
		25 yr	100 yr
Abundance	Priority 1	23%	39%
	Priority 1 & 2	26%	44%
Productivity	Priority 1	15%	29%
	Priority 1 & 2	18%	35%
Diversity index	Priority 1	20%	32%
	Priority 1 & 2	23%	35%

Table 10-20. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to North Fork John Day River summer steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin. Performance for habitat potential is computed with baseline (i.e., post-development) out-of-subbasin conditions in place.

Performance measure	Scenario	Time period		
		Base/Curr	25 yr	100 yr
Abundance	Baseline	36%		
	Priority 1		44%	50%
	Priority 1 & 2		45%	52%
Productivity	Baseline	39%		
	Priority 1		45%	50%
	Priority 1 & 2		46%	53%
Diversity index	Baseline	66%		
	Priority 1		79%	87%
	Priority 1 & 2		81%	89%

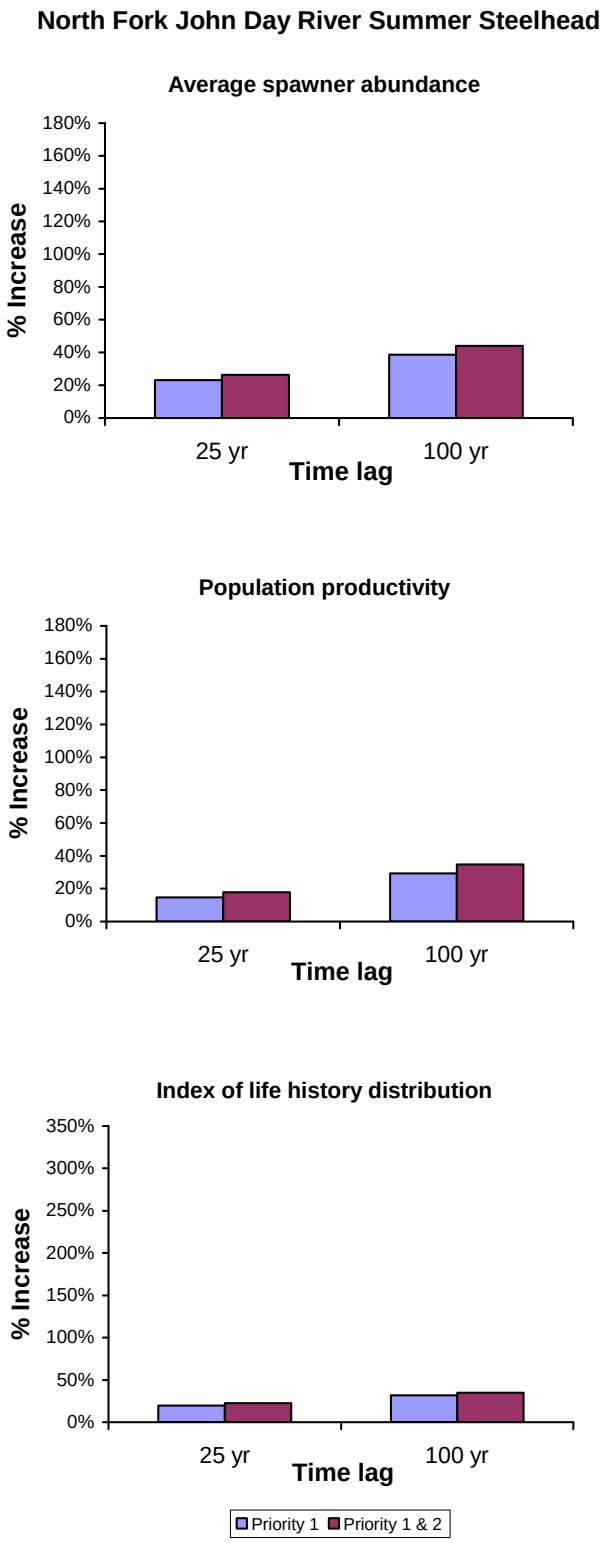

Figure 10-21. Estimated percent changes in population performance of North Fork John Day River summer steelhead due to tributary habitat actions.

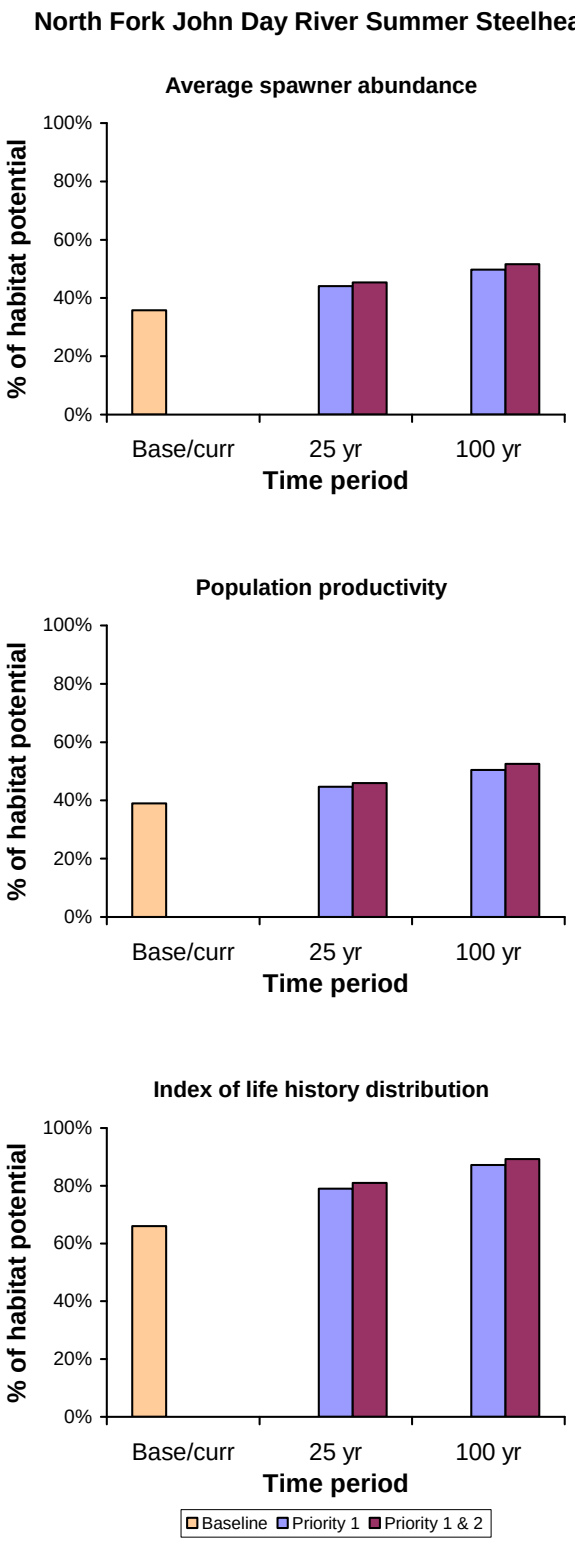

Figure 10-22. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to North Fork John Day River summer steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin.

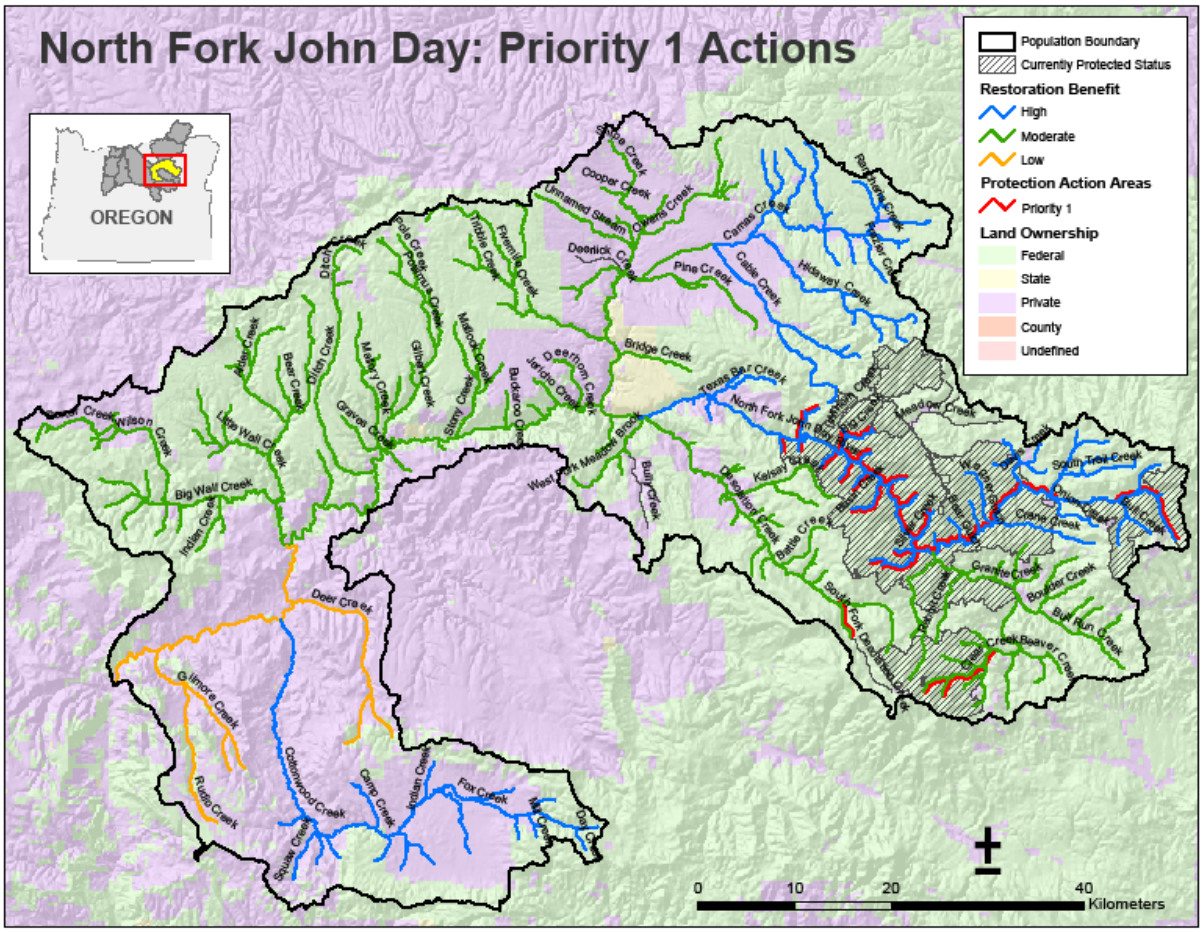

Figure 10-23. Map of the North Fork John Day River steelhead population showing geographic areas that are currently in protected status, reaches identified as high priority for proposed protection management actions, and relative restoration benefit from high priority (priority 1) proposed restoration actions for all reaches.

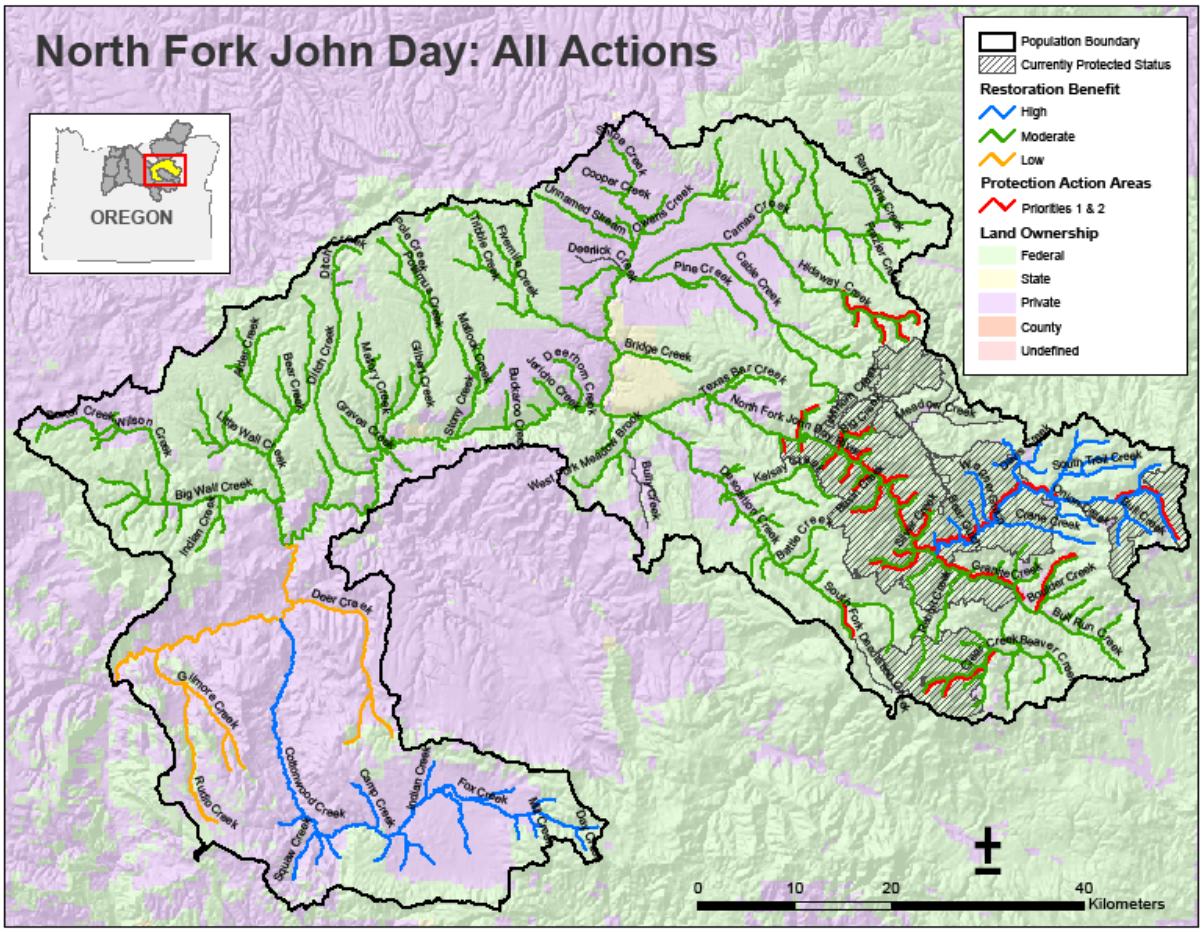

Figure 10-24. Map of the North Fork John Day River steelhead population showing geographic areas that are currently in protected status, reaches identified for proposed protection management actions (priority 1 and priority 2), and reaches with high, moderate, low and very low restoration benefit from all (priority 1 and priority 2) proposed restoration actions.

10.2.6 Middle Fork John Day River Summer Steelhead

Level of Action Coverage

The level of treatment coverage by habitat actions for the Middle Fork John Day River population is on the lower end of the range of coverages applied to the other Oregon Mid-C steelhead populations. The ratios of cumulative miles potentially affected by actions to total stream miles available are in the range of 7-9 for Priority 1 and Priority 1 & 2 scenarios. The adjusted weighted average action effectiveness values show that actual treated areas would be far less than suggested by these ratios, however. The reader should note that the cumulative miles affected by the actions include stream miles outside the population's boundaries as defined by spawning distribution—encompassing miles within the migration corridor and downstream rearing areas down to the confluence of the subbasin with the mainstem Columbia River. Table 10-21 summarizes tributary habitat action coverage and average action effectiveness values applied to the Middle Fork John Day River summer steelhead population.

Table 10-21. Summary of tributary habitat action coverage and average action effectiveness values applied to the Middle Fork John Day River summer steelhead population. Total stream miles are those modeled in EDT. Cumulative miles affected are the total miles targeted for actions without considering intensity of treatment by actions. Average potential and adjusted effectiveness values are weighted by stream miles targeted by each action. Average adjusted action effectiveness values incorporate all action scalars except the attribute scalar. Effectiveness values shown apply to the entire John Day subbasin.

Population:	Middle Fork John Day River	
Total stream miles in John Day subbasin:	2,936	
	Priority 1	Priority 1 & 2
No. of Middle Fork John Day actions:	36	36
Total stream miles in Middle Fork John Day:	380	380
Cum miles affected by MFJD actions:	2,806	3,441
Ratio cum miles affected to total MFJD miles:	7.4	9.1
Weighted ave potential action effectiveness 1/:	0.145	0.146
Weighted ave adjusted action effectiveness 1/:	0.034	0.032

1/ Value shown is for entire John Day subbasin; weighted by stream miles affected per action

Projected Changes to Population Performance

Estimated percent changes in population performance of Middle Fork John Day River summer steelhead due to tributary actions are shown in tables 10-22 and 10-23, and in figures 10-25 and 10-26. Estimated increases in population performance resulting from tributary habitat actions are relatively moderate for this population (Figure 10-25). Amounts of habitat potential for the abundance and productivity performance measures with actions reach approximately 40-55%.

Amounts of potential for the baseline for these performance measures are approximately 30-35% (Figure 10-26).

It should be noted that these measures of performance for this part of the analysis do not include any loss in performance that might be associated with genetic fitness loss due to strays.

Table 10-22. Estimated percent changes in population performance of Middle Fork John Day River summer steelhead due to tributary habitat actions.

Performance measure	Scenario	Time period lag	
		25 yr	100 yr
Abundance	Priority 1	33%	57%
	Priority 1 & 2	40%	67%
Productivity	Priority 1	34%	65%
	Priority 1 & 2	40%	75%
Diversity index	Priority 1	19%	25%
	Priority 1 & 2	24%	31%

Table 10-23. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to Middle Fork John Day River summer steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin. Performance for habitat potential is computed with baseline (i.e., post-development) out-of-subbasin conditions in place.

Performance measure	Scenario	Time period		
		Base/Curr	25 yr	100 yr
Abundance	Baseline	32%		
	Priority 1		42%	50%
	Priority 1 & 2		44%	53%
Productivity	Baseline	33%		
	Priority 1		44%	54%
	Priority 1 & 2		46%	57%
Diversity index	Baseline	72%		
	Priority 1		86%	90%
	Priority 1 & 2		90%	94%

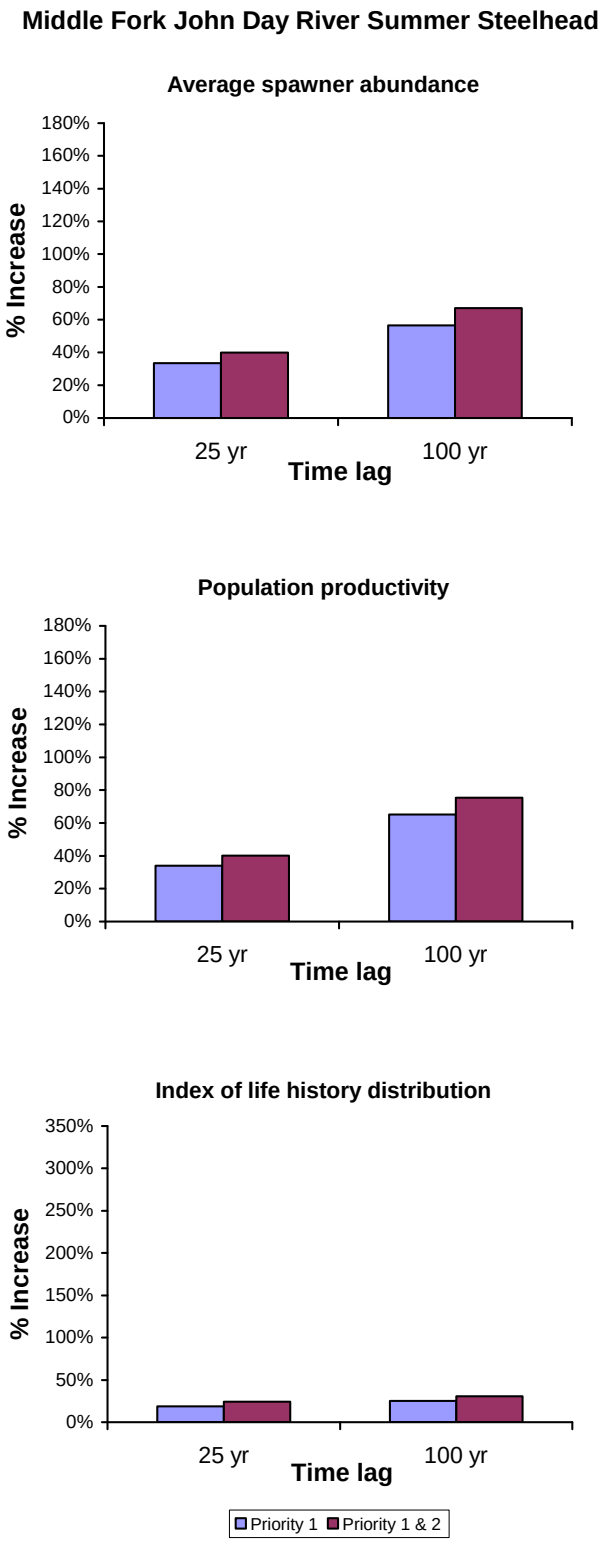

Figure 10-25. Estimated percent changes in population performance of Middle Fork John Day River summer steelhead due to tributary habitat actions.

Figure 10-26. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to Middle Fork John Day River summer steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin.

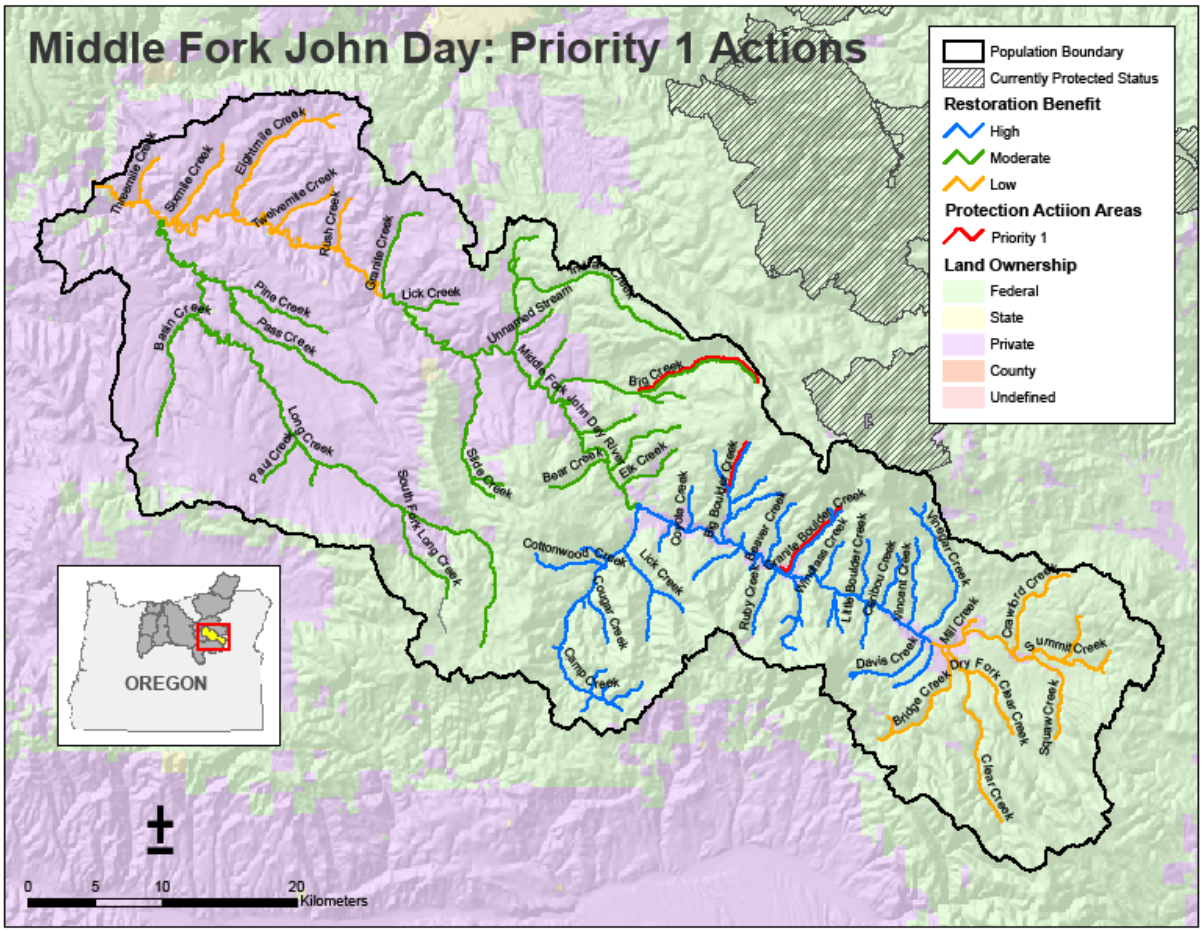

Figure 10-27. Map of the Middle Fork John Day River steelhead population showing geographic areas that are currently in protected status, reaches identified as high priority for proposed protection management actions, and relative restoration benefit from high priority (priority 1) proposed restoration actions for all reaches.

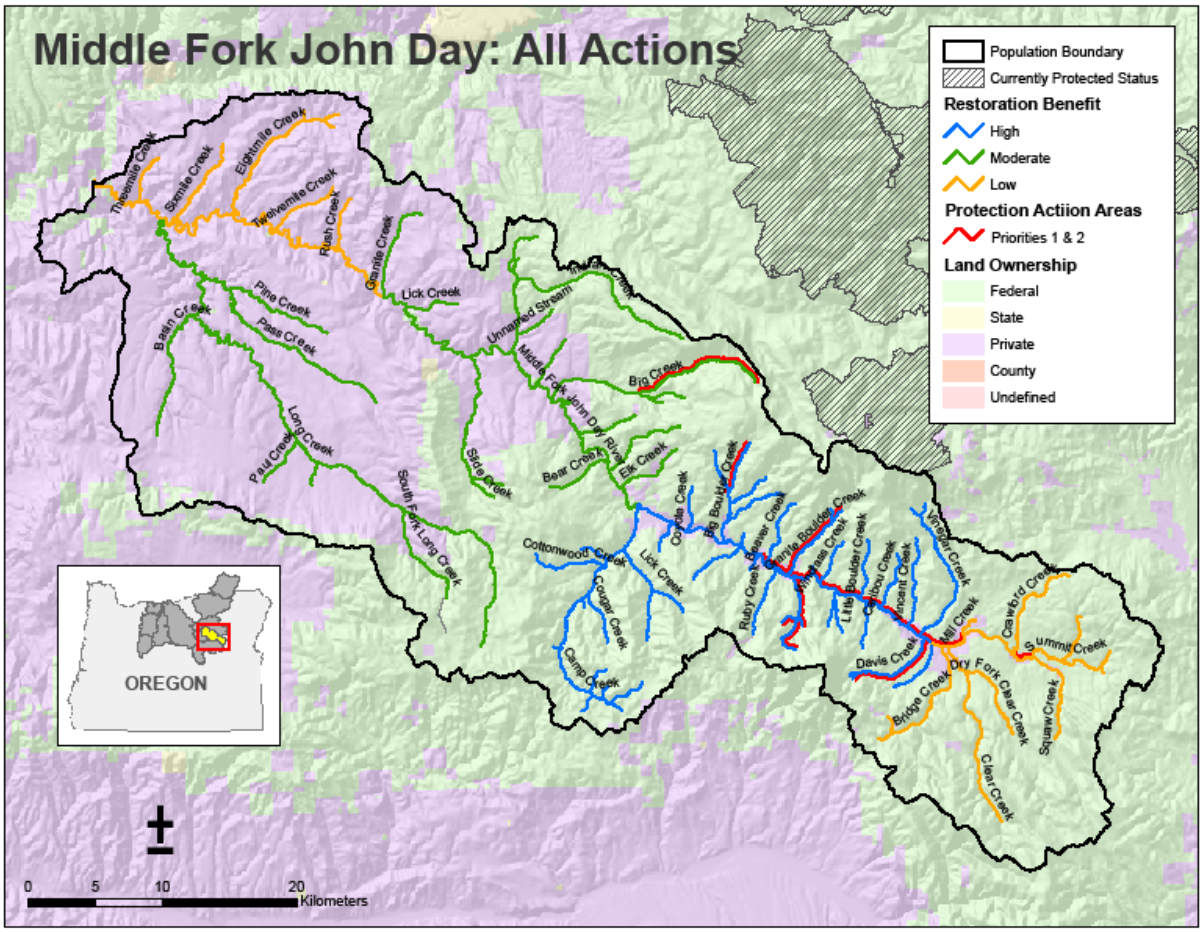

Figure 10-28. Map of the Middle Fork John Day River steelhead population showing geographic areas that are currently in protected status, reaches identified for proposed protection management actions (priority 1 and priority 2), and reaches with high, moderate, low and very low restoration benefit from all (priority 1 and priority 2) proposed restoration actions.

10.2.7 South Fork John Day River Summer Steelhead

Level of Action Coverage

The level of treatment coverage by habitat actions for the South Fork John Day River population is on the lower end of the range of coverages applied to the other Oregon Mid-C steelhead populations. The ratios of cumulative miles potentially affected by actions to total stream miles available are in the range of 7-9 for Priority 1 and Priority 1 & 2 scenarios. The adjusted weighted average action effectiveness values show that actual treated areas would be far less than suggested by these ratios, however. The reader should note that the cumulative miles affected by the actions include stream miles outside the population's boundaries as defined by spawning distribution—encompassing miles within the migration corridor and downstream rearing areas down to the confluence of the subbasin with the mainstem Columbia River. Table 10-24 summarizes tributary habitat action coverage and average action effectiveness values applied to the South Fork John Day River summer steelhead population.

Table 10-24. Summary of tributary habitat action coverage and average action effectiveness values applied to the South Fork John Day River summer steelhead population. Total stream miles are those modeled in EDT. Cumulative miles affected are the total miles targeted for actions without considering intensity of treatment by actions. Average potential and adjusted effectiveness values are weighted by stream miles targeted by each action. Average adjusted action effectiveness values incorporate all action scalars except the attribute scalar. Effectiveness values shown apply to the entire John Day subbasin.

Population:	South Fork John Day River	
Total stream miles in John Day subbasin:	2,936	
	Priority 1	Priority 1 & 2
No. of South Fork John Day actions:	36	36
Total stream miles in South Fork John Day:	173	173
Cum miles affected by SFJD actions:	1,211	1,468
Ratio cum miles affected to total SFJD miles:	7.0	8.5
Weighted ave potential action effectiveness 1/:	0.145	0.146
Weighted ave adjusted action effectiveness 1/:	0.034	0.032

1/ Value shown is for entire John Day subbasin; weighted by stream miles affected per action

Projected Changes to Population Performance

Estimated percent changes in population performance of South Fork John Day River summer steelhead from tributary actions are shown in tables 10-25 and 10-26, and figures 10-29 and 10-30. Estimated increases in population performance resulting from tributary habitat actions are relatively small to moderate for this population (Figure 10-29), depending on performance measure. Amounts of habitat potential for the abundance and productivity performance measures with actions reach approximately 40-55%. Amounts of potential for the baseline for these

performance measures are approximately 30-35% (Figure 10-30). Small increases were projected for the life history diversity metric.

It should be noted that these measures of performance for this part of the analysis do not include any loss in performance that might be associated with genetic fitness loss due to strays.

Table 10-25. Estimated percent changes in population performance of South Fork John Day River summer steelhead due to tributary habitat actions.

Performance measure	Scenario	Time period lag	
		25 yr	100 yr
Abundance	Priority 1	19%	35%
	Priority 1 & 2	26%	45%
Productivity	Priority 1	16%	32%
	Priority 1 & 2	21%	45%
Diversity index	Priority 1	14%	21%
	Priority 1 & 2	18%	23%

Table 10-26. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to South Fork John Day River summer steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin. Performance for habitat potential is computed with baseline (i.e., post-development) out-of-subbasin conditions in place.

Performance measure	Scenario	Time period		
		Base/Curr	25 yr	100 yr
Abundance	Baseline	42%		
	Priority 1		50%	57%
	Priority 1 & 2		53%	61%
Productivity	Baseline	37%		
	Priority 1		43%	49%
	Priority 1 & 2		45%	53%
Diversity index	Baseline	79%		
	Priority 1		90%	96%
	Priority 1 & 2		93%	97%

Figure 10-29. Estimated percent changes in population performance of South Fork John Day River summer steelhead due to tributary habitat actions.

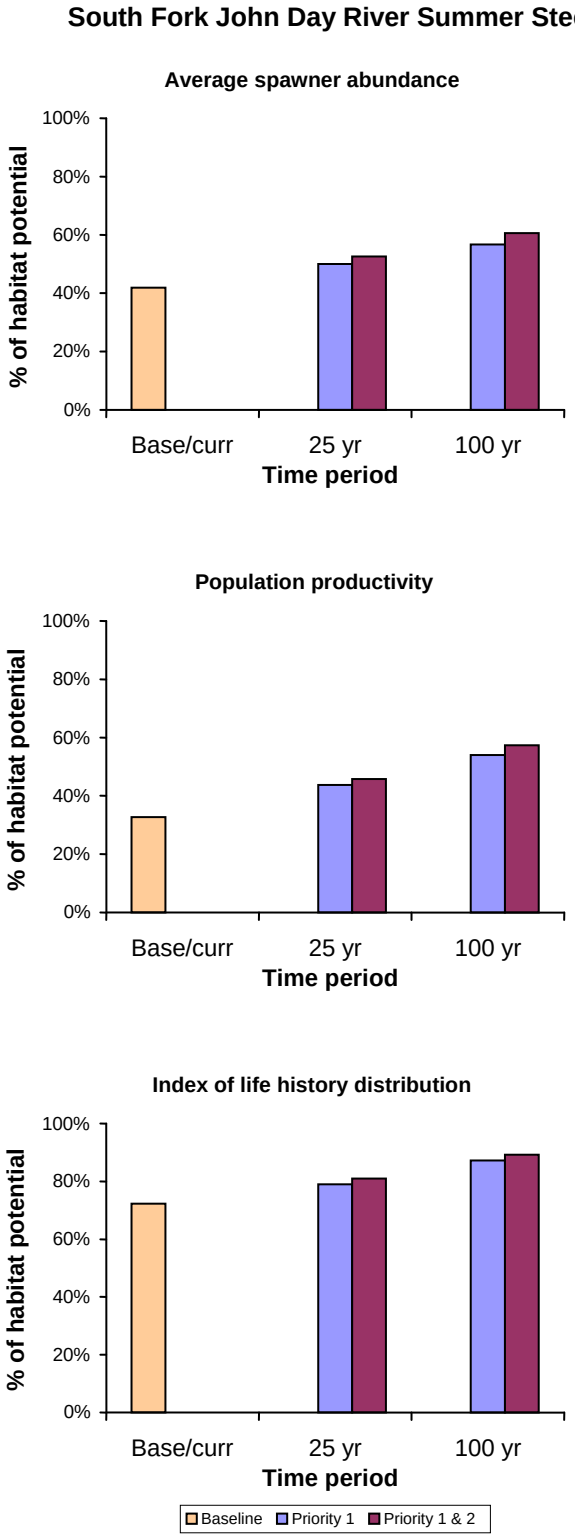

Figure 10-30. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to South Fork John Day River summer steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin.

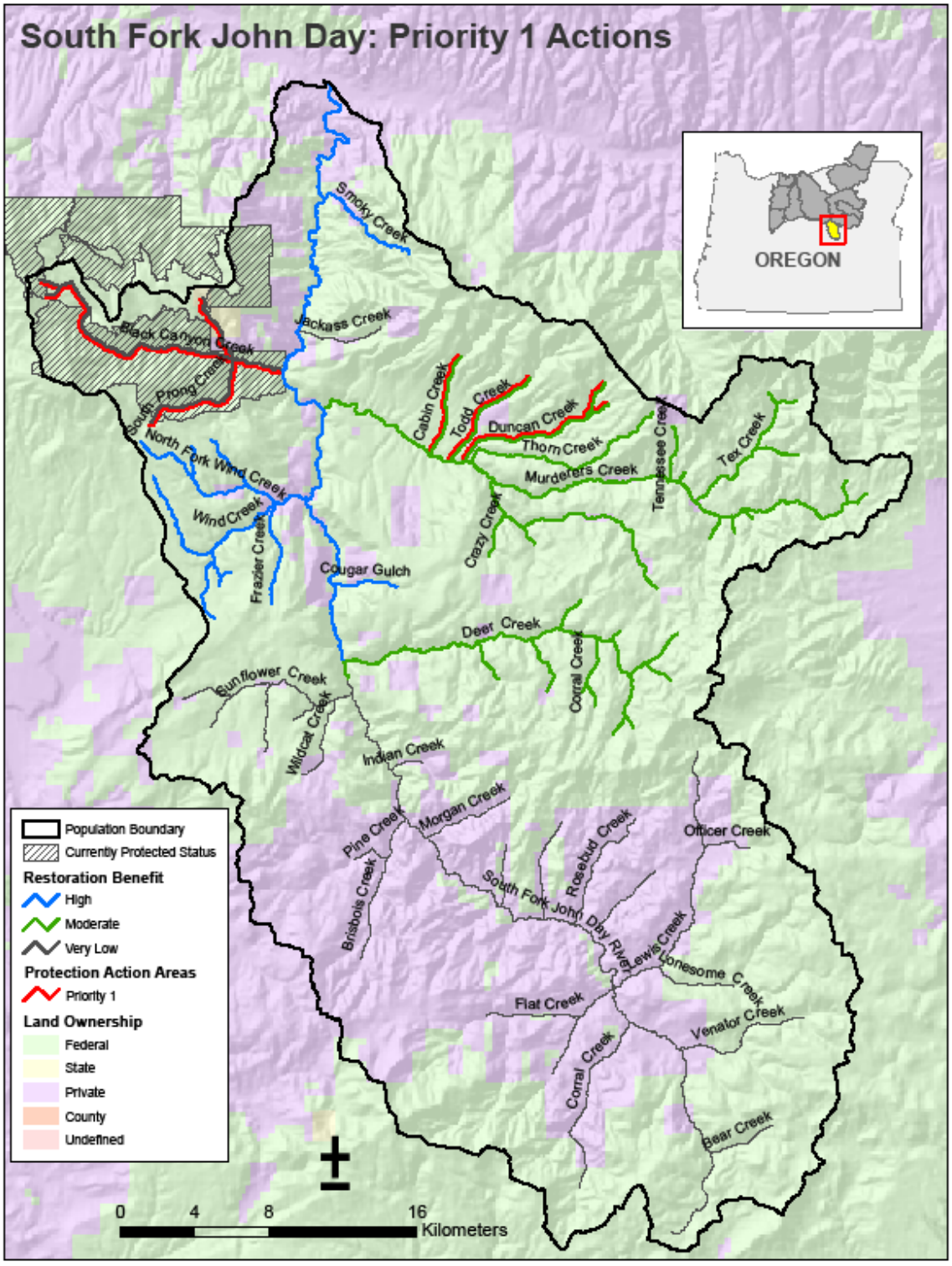

Figure 10-31. Map of the South Fork John Day River steelhead population showing geographic areas that are currently in protected status, reaches identified as high priority for proposed protection management actions, and relative restoration benefit from high priority (priority 1) proposed restoration actions for all reaches.

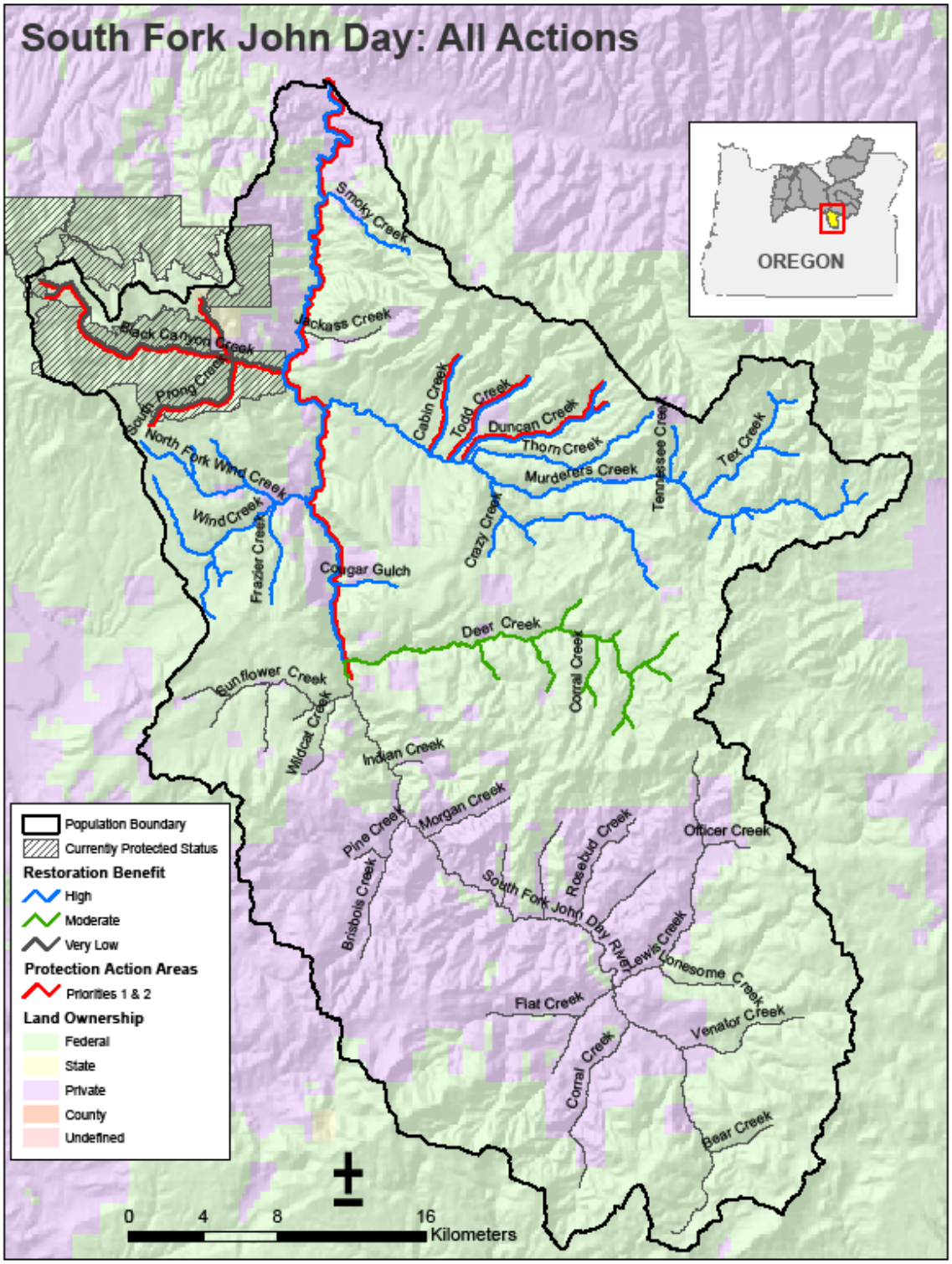

Figure 10-32. Map of the South Fork John Day River steelhead population showing geographic areas that are currently in protected status, reaches identified for proposed protection management actions (priority 1 and priority 2), and reaches with high, moderate, low and very low restoration benefit from all (priority 1 and priority 2) proposed restoration actions.

10.2.8 Upper Mainstem John Day River Summer Steelhead

Level of Action Coverage

The level of treatment coverage by habitat actions for the Upper Mainstem John Day River population is on the lower end of the range of coverages applied to the other Mid-Columbia Oregon steelhead populations. The ratios of cumulative miles potentially affected by actions to total stream miles available are in the range of 7-10 for Priority 1 and Priority 1 & 2 scenarios. The adjusted weighted average action effectiveness values show that actual treated areas would be far less than suggested by these ratios, however. The reader should note that the cumulative miles affected by the actions include stream miles outside the population's boundaries as defined by spawning distribution—encompassing miles within the migration corridor and downstream rearing areas down to the confluence of the subbasin with the mainstem Columbia River. Table 10-27 summarizes tributary habitat action coverage and average action effectiveness values applied to the Upper Mainstem John Day River summer steelhead population.

Table 10-27. Summary of tributary habitat action coverage and average action effectiveness values applied to the Upper Mainstem John Day River summer steelhead population. Total stream miles are those modeled in EDT. Cumulative miles affected are the total miles targeted for actions without considering intensity of treatment by actions. Average potential and adjusted effectiveness values are weighted by stream miles targeted by each action. Average adjusted action effectiveness values incorporate all action scalars except the attribute scalar. Effectiveness values shown apply to the entire John Day subbasin.

Population:	Upper Mainstem John Day River	
Total stream miles in John Day subbasin:	2,936	
	Priority 1	Priority 1 & 2
No. of Upper John Day actions:	36	36
Total stream miles in Upper John Day:	415	415
Cum miles affected by UpJD actions:	3,064	4,032
Ratio cum miles affected to total UpJD miles:	7.4	9.7
Weighted ave potential action effectiveness 1/:	0.145	0.146
Weighted ave adjusted action effectiveness 1/:	0.034	0.032

1/ Value shown is for all actions in the John Day subbasin; weighted by miles affected per action

Projected Changes to Population Performance

Estimated percent changes in population performance of Upper Mainstem John Day River summer steelhead from tributary actions are shown in tables 10-28 and 10-29, and figures 10-33 and 10-34. Estimated increases in population performance resulting from tributary habitat actions are relatively moderate to large, depending on the performance measure (Figure 10-33). With these increases, performance for both productivity and abundance achieve only approximately 35-55% of habitat potential (Figure 10-34).

It should be noted that these measures of performance for this part of the analysis do not include any loss in performance that might be associated with genetic fitness loss due to strays.

Table 10-28. Estimated percent changes in population performance of Upper Mainstem John Day River summer steelhead due to tributary habitat actions.

Performance measure	Scenario	Time period lag	
		25 yr	100 yr
Abundance	Priority 1	37%	61%
	Priority 1 & 2	74%	110%
Productivity	Priority 1	23%	46%
	Priority 1 & 2	51%	92%
Diversity index	Priority 1	38%	51%
	Priority 1 & 2	89%	94%

Table 10-29. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to Upper Mainstem John Day River summer steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin. Performance for habitat potential is computed with baseline (i.e., post-development) out-of-subbasin conditions in place.

Performance measure	Scenario	Time period		
		Base/Curr	25 yr	100 yr
Abundance	Baseline	24%		
	Priority 1		33%	39%
	Priority 1 & 2		42%	51%
Productivity	Baseline	27%		
	Priority 1		34%	40%
	Priority 1 & 2		42%	53%
Diversity index	Baseline	44%		
	Priority 1		61%	66%
	Priority 1 & 2		83%	85%

Figure 10-33. Estimated percent changes in population performance of Upper Mainstem John Day River summer steelhead due to tributary habitat actions.

Figure 10-34. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to Upper Mainstem John Day River summer steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin.

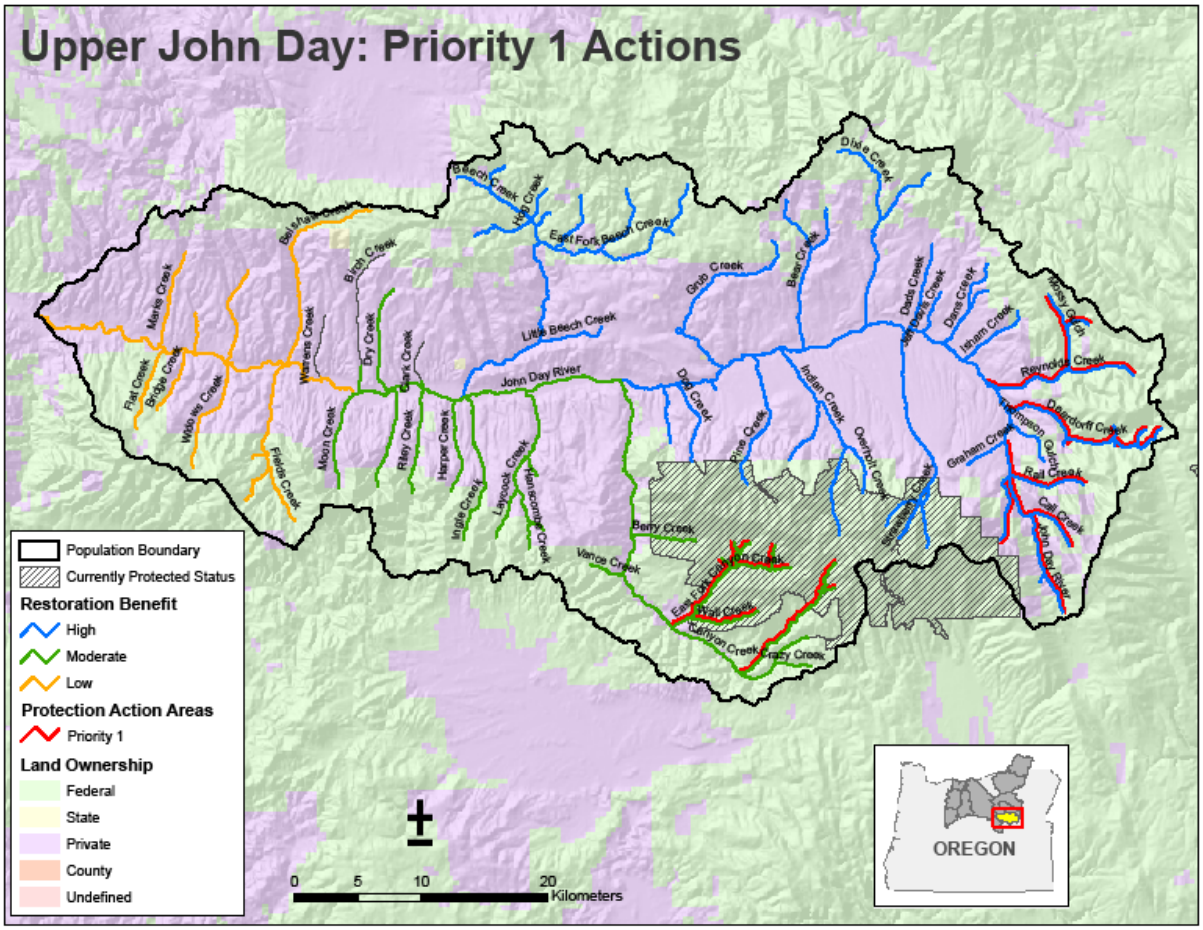

Figure 10-35. Map of the Upper Mainstem John Day River steelhead population showing geographic areas that are currently in protected status, reaches identified as high priority for proposed protection management actions, and relative restoration benefit from high priority (priority 1) proposed restoration actions for all reaches.

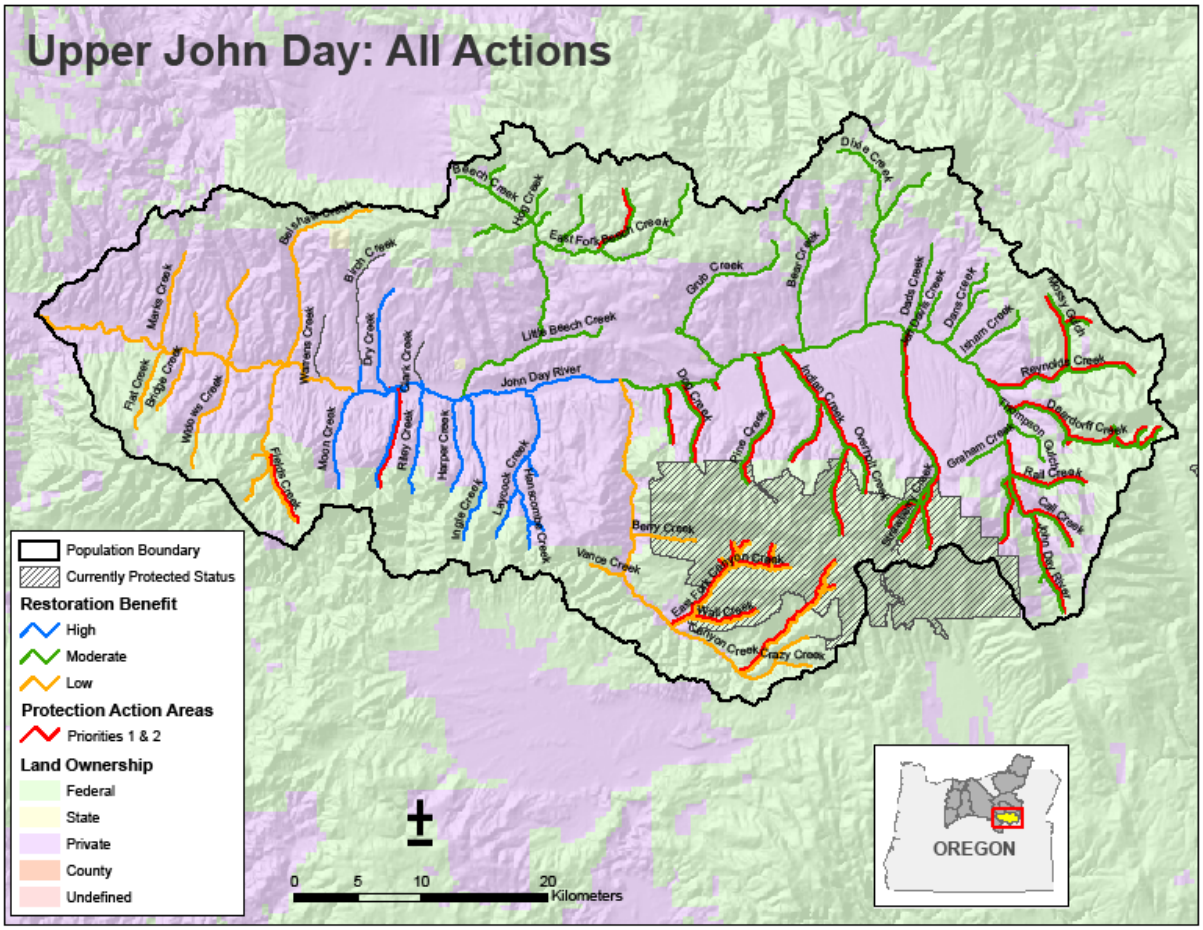

Figure 10-36. Map of the Upper Mainstem John Day River steelhead population showing geographic areas that are currently in protected status, reaches identified for proposed protection management actions (priority 1 and priority 2), and reaches with high, moderate, low and very low restoration benefit from all (priority 1 and priority 2) proposed restoration actions.

10.2.9 Umatilla River Summer Steelhead

Level of Action Coverage

The level of treatment coverage by habitat actions for the Umatilla River population is on the upper end of the range of coverages applied to the other Oregon Mid-C steelhead populations. The ratios of cumulative miles potentially affected by actions to total stream miles available are in the range of 13-14 for Priority 1 and Priority 1 & 2 scenarios. The adjusted weighted average action effectiveness values show that actual treated areas would be far less than suggested by these ratios, however. The reader should note that the cumulative miles affected by the actions include stream miles outside the population's boundaries as defined by spawning distribution—encompassing miles within the migration corridor and downstream rearing areas down to the confluence of the subbasin with the mainstem Columbia River. Table 10-30 summarizes tributary habitat action coverage and average action effectiveness values applied to the Umatilla River summer steelhead population.

Table 10-30. Summary of tributary habitat action coverage and average action effectiveness values applied to the Umatilla River summer steelhead population. Total stream miles are those modeled in EDT. Cumulative miles affected are the total miles targeted for actions without considering intensity of treatment by actions. Average potential and adjusted effectiveness values are weighted by stream miles targeted by each action. Average adjusted action effectiveness values incorporate all action scalars except the attribute scalar.

Population:	Umatilla River	
Total stream miles in subbasin:	681	
	Priority 1	Priority 1 & 2
No. of actions:	38	38
Cum miles affected by actions:	9,055	9,664
Ratio cum miles affected to total miles:	13.3	14.2
Weighted ave potential action effectiveness 1/:	0.255	0.247
Weighted ave adjusted action effectiveness 1/:	0.048	0.046

1/ Weighted by stream miles affected per action

Projected Changes to Population Performance

Estimated percent changes in population performance of Umatilla River summer steelhead due to tributary habitat actions are shown in tables 10-31 and 10-32, and figures 10-37 and 10-38. Estimated increases in population performance resulting from tributary habitat actions are relatively moderate to large, depending on the performance measure (Figure 10-37). The increase in productivity is less for Priority 1 & 2 actions (i.e., all actions) compared to just Priority 1 actions. This is the result of a Priority 2 action opening habitat blocked by a barrier—habitat upstream of the barrier is relatively low in quality. The effect is that productivity is reduced while overall habitat capacity, hence spawner abundance, is increased (more habitat open to be used).

Between approximately 45-70% of habitat potential (i.e., historical potential) for abundance, productivity, and the life history diversity measure is estimated to be achieved for the four scenarios considered (Figure 10-38).

It should be noted that these measures of performance for this part of the analysis do not include any loss in performance that might be associated with genetic fitness loss due to strays.

Table 10-31. Estimated percent changes in population performance of Umatilla River summer steelhead due to tributary habitat actions.

Performance measure	Scenario	Time period lag	
		25 yr	100 yr
Abundance	Priority 1	67%	93%
	Priority 1 & 2	82%	112%
Productivity	Priority 1	71%	116%
	Priority 1 & 2	62%	101%
Diversity index	Priority 1	53%	72%
	Priority 1 & 2	61%	96%

Table 10-32. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to Umatilla River summer steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin. Performance for habitat potential is computed with baseline (i.e., post-development) out-of-subbasin conditions in place.

Performance measure	Scenario	Time period		
		Base/Curr	25 yr	100 yr
Abundance	Baseline	28%		
	Priority 1		46%	53%
	Priority 1 & 2		51%	59%
Productivity	Baseline	28%		
	Priority 1		48%	61%
	Priority 1 & 2		46%	57%
Diversity index	Baseline	36%		
	Priority 1		56%	63%
	Priority 1 & 2		59%	71%

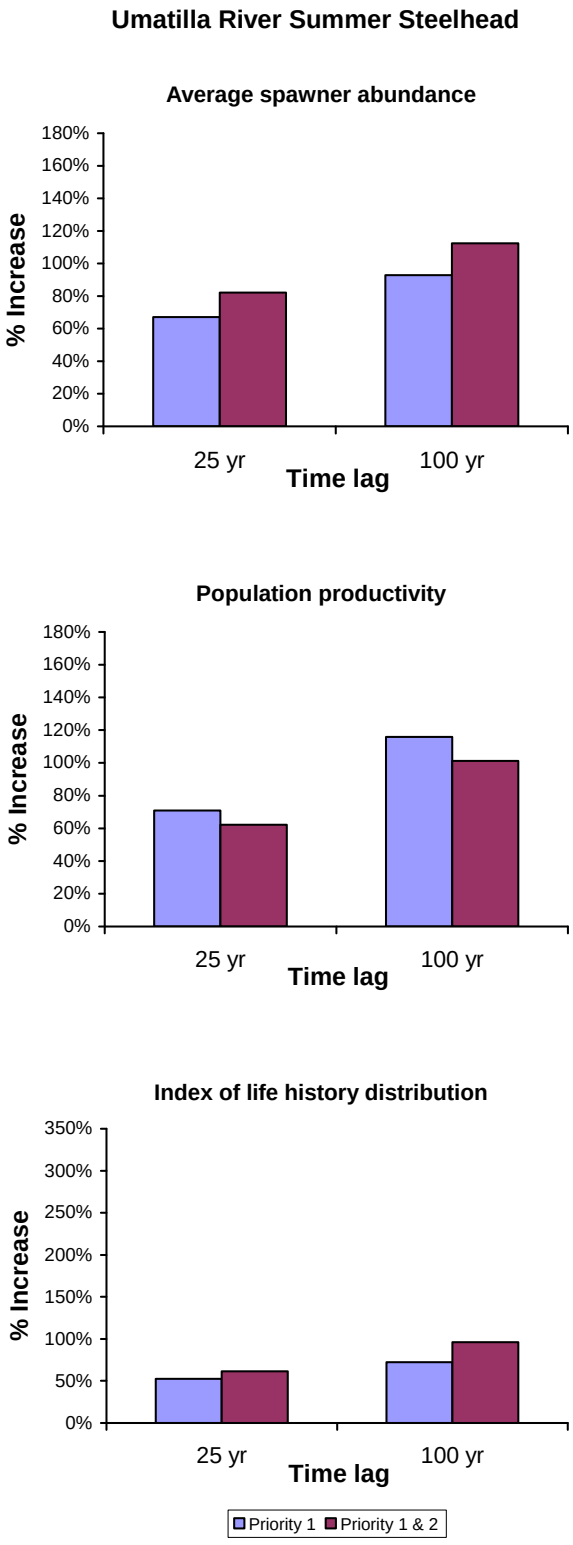

Figure 10-37. Estimated percent changes in population performance of Umatilla River summer steelhead due to tributary habitat actions.

Figure 10-38. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to Umatilla River summer steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin.

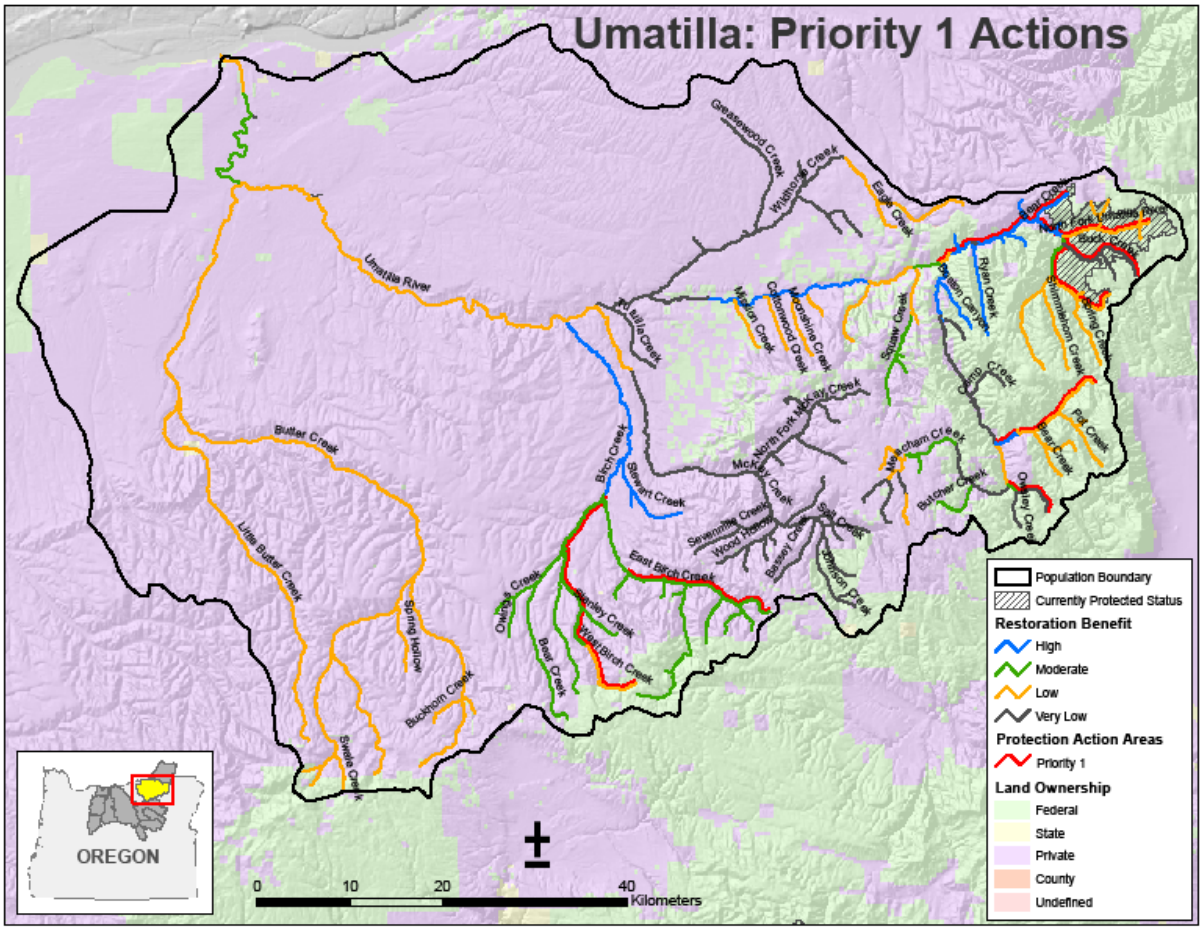

Figure 10-39. Map of the Umatilla River steelhead population showing geographic areas that are currently in protected status, reaches identified as high priority for proposed protection management actions, and relative restoration benefit from high priority (priority 1) proposed restoration actions for all reaches.

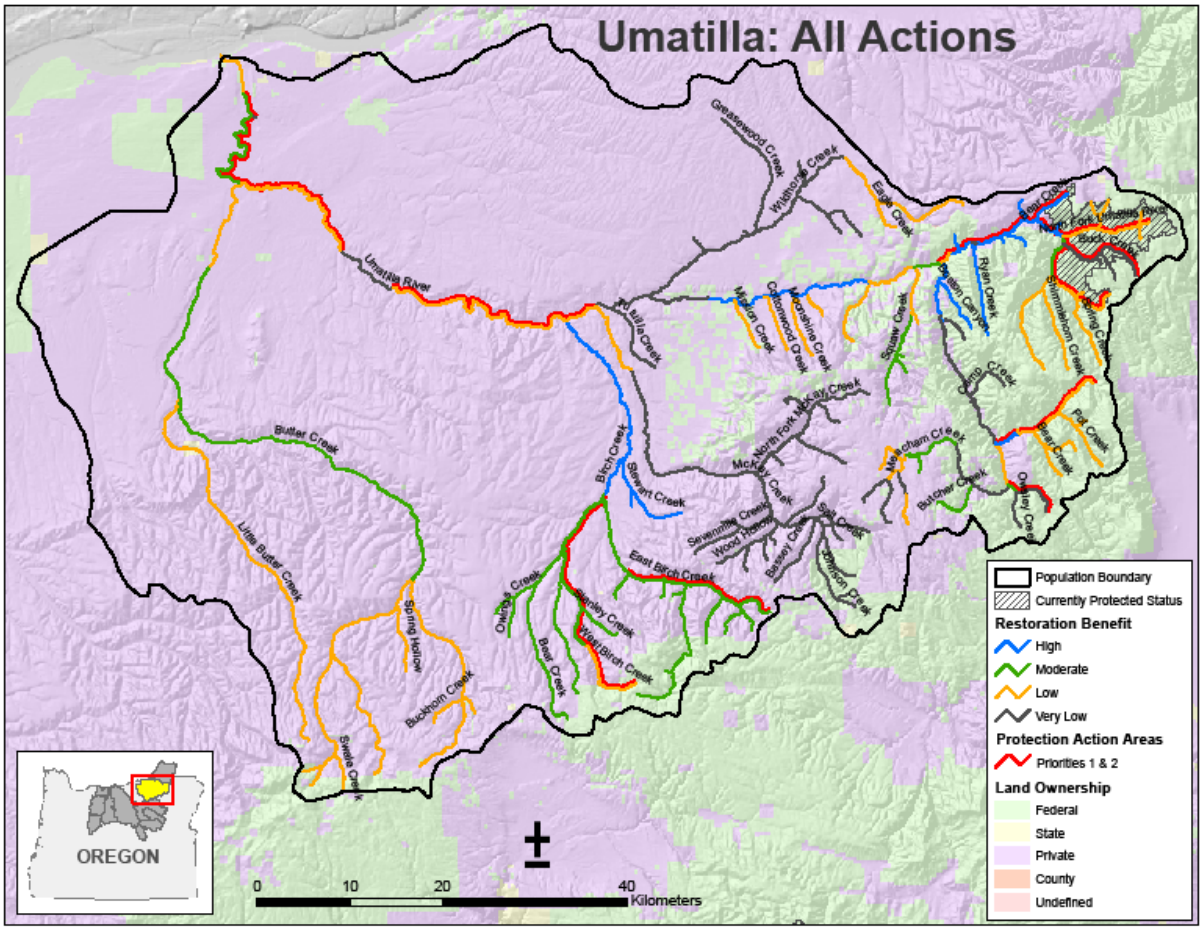

Figure 10-40. Map of the Umatilla River steelhead population showing geographic areas that are currently in protected status, reaches identified for proposed protection management actions (priority 1 and priority 2), and reaches with high, moderate, low and very low restoration benefit from all (priority 1 and priority 2) proposed restoration actions.

10.2.10 Walla Walla River Summer Steelhead

Level of Action Coverage

The number of actions applied in the analysis of the Walla Walla River population was substantially more than used to analyze any of the other Oregon Mid-C steelhead populations that were modeled. While the distribution of treatment for some of these actions was described in Section 9 as occurring within both Oregon and Washington, we modeled the actions as occurring only within Oregon. (Downstream effects of actions were still incorporated.) Table 10-33 summarizes tributary habitat action coverage and average action effectiveness values applied to the Walla Walla River summer steelhead population.

The level of treatment coverage by habitat actions applied to the Walla Walla River population is roughly in the middle of the range of coverages applied to other Oregon Mid-C steelhead populations. The ratios of cumulative miles potentially affected by actions to total stream miles available are in the range of 10-12 for Priority 1 and Priority 1 & 2 scenarios. However, the adjusted weighted average action effectiveness values show that actual treated areas would be far less than suggested by these ratios. The reader should note that the cumulative miles affected by the actions include stream miles outside the population's boundaries as defined by spawning distribution—encompassing miles within the migration corridor and downstream rearing areas down to the confluence of the subbasin with the mainstem Columbia River.

Table 10-33. Summary of tributary habitat action coverage and average action effectiveness values applied to the Walla Walla River summer steelhead population. Total stream miles are those modeled in EDT. Cumulative miles affected are the total miles targeted for actions without considering intensity of treatment by actions. Average potential and adjusted effectiveness values are weighted by stream miles targeted by each action. Average adjusted action effectiveness values incorporate all action scalars except the attribute scalar.

Population:	Walla Walla River	
Total stream miles in subbasin:	415	
	Priority 1	Priority 1 & 2
No. of actions:	53	53
Cum miles affected by actions:	4,434	4,789
Ratio cum miles affected to total miles:	10.7	11.5
Weighted ave potential action effectiveness 1/:	0.134	0.131
Weighted ave adjusted action effectiveness 1/:	0.047	0.043

1/ Weighted by stream miles affected per action

Projected Changes to Population Performance

Estimated percent changes in population performance of Walla Walla River summer steelhead due to tributary habitat actions are shown in tables 10-34 and 10-35, and figures 10-41 and 10-42. Results presented here reflect the result of actions applied only to waters within Oregon,

though effects to habitat characteristics continue downstream into Washington waters. Estimated increases in population performance resulting from tributary habitat actions are relatively moderate to large, depending on the performance measure (Figure 10-41).

Between approximately 40-60% of habitat potential (i.e., historical potential) for abundance and productivity is estimated to be achieved for the four scenarios considered (Figure 10-42). However, the amount of habitat potential expressed through life history diversity (i.e., distribution within the drainage) reaches only about 20%. This is apparently due to effects of barriers or poor quality conditions in reaches downstream of reaches in Oregon.

It should be noted that these measures of performance for this part of the analysis do not include any loss in performance that might be associated with genetic fitness loss due to strays.

Table 10-34. Estimated percent changes in population performance of Walla Walla River summer steelhead due to tributary habitat actions.

Performance measure	Scenario	Time period lag	
		25 yr	100 yr
Abundance	Priority 1	97%	119%
	Priority 1 & 2	99%	121%
Productivity	Priority 1	54%	70%
	Priority 1 & 2	54%	69%
Diversity index	Priority 1	82%	91%
	Priority 1 & 2	90%	112%

Table 10-35. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to Walla Walla River summer steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin. Performance for habitat potential is computed with baseline (i.e., post-development) out-of-subbasin conditions in place.

Performance measure	Scenario	Time period		
		Base/Curr	25 yr	100 yr
Abundance	Baseline	19%		
	Priority 1		38%	42%
	Priority 1 & 2		38%	42%
Productivity	Baseline	37%		
	Priority 1		57%	63%
	Priority 1 & 2		57%	63%
Diversity index	Baseline	12%		
	Priority 1		21%	22%
	Priority 1 & 2		22%	24%

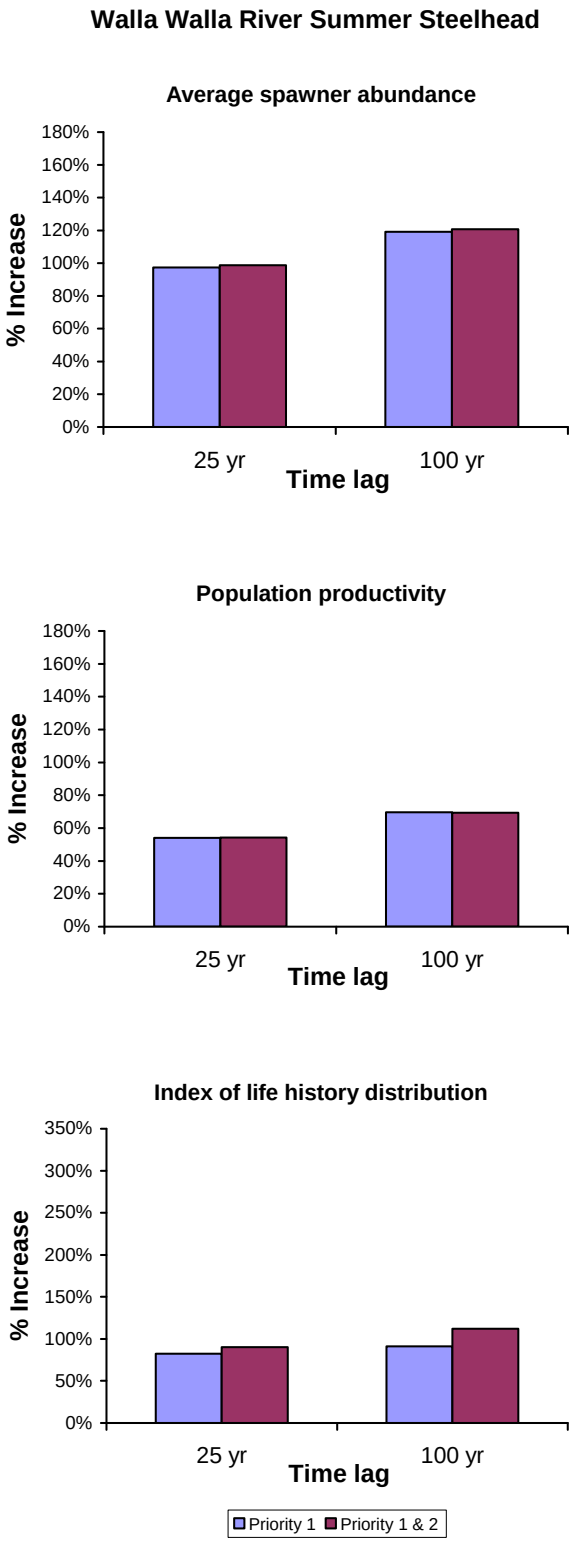

Figure 10-41. Estimated percent changes in population performance of Walla Walla River summer steelhead due to tributary habitat actions.

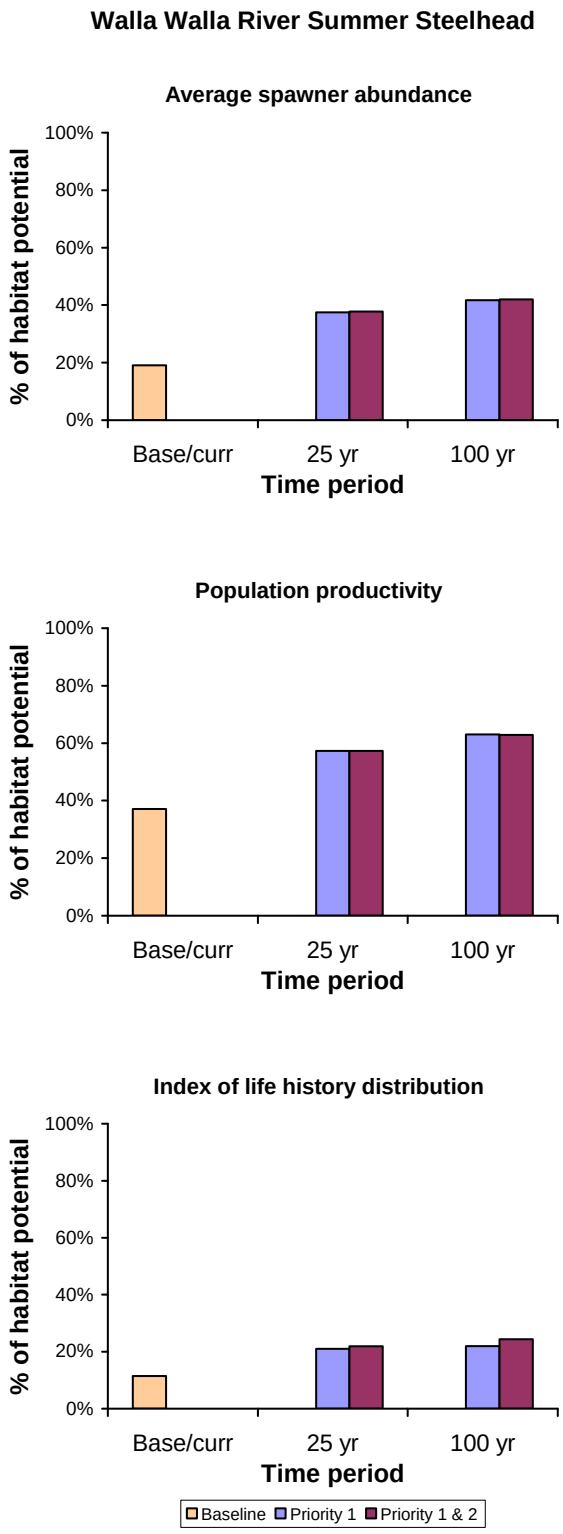

Figure 10-42. Estimated amounts of tributary habitat potential achieved by population performance measures resulting from tributary habitat actions applied to Walla Walla River summer steelhead. Habitat potential is assumed equal to performance associated with the pre-development condition in the subbasin.

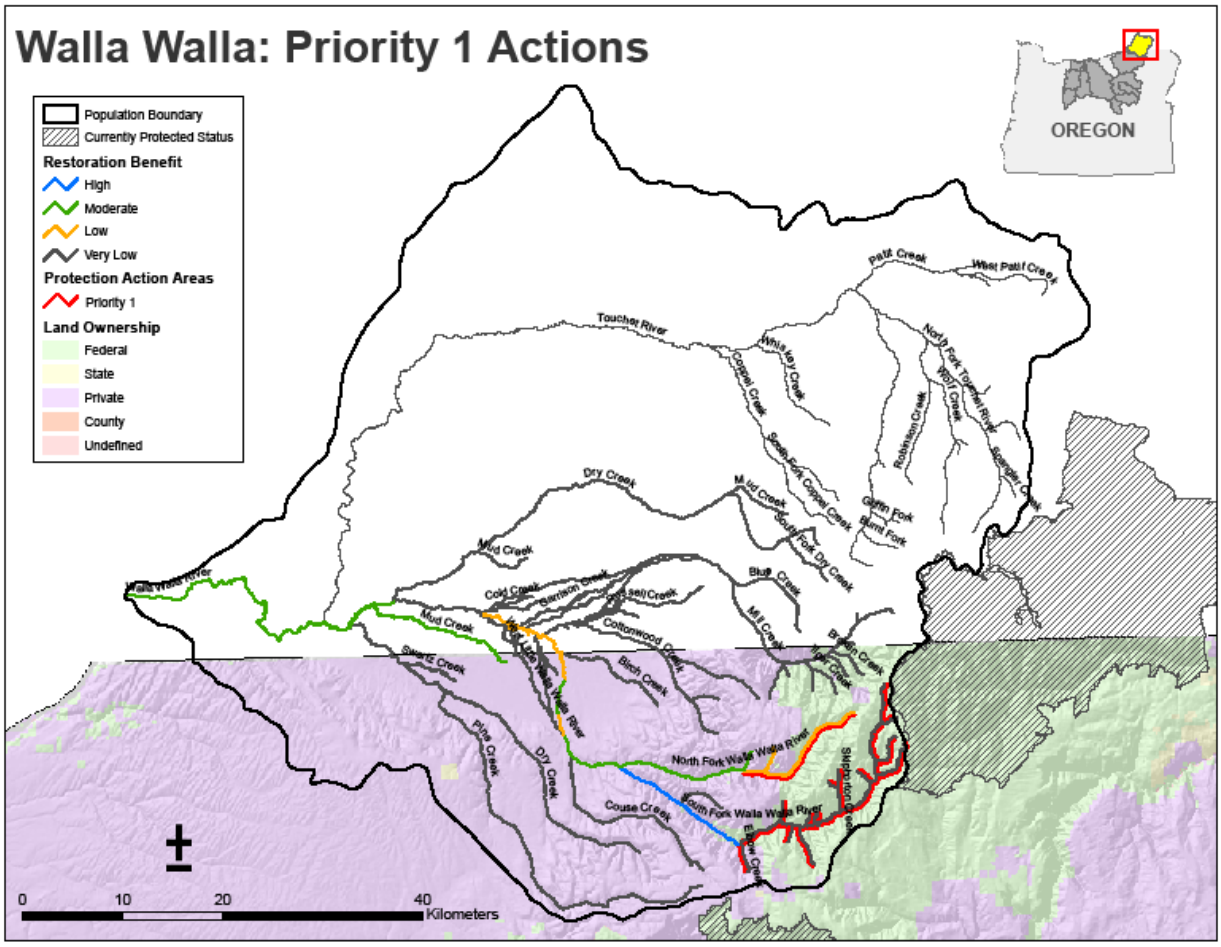

Figure 10-43. Map of the Walla Walla River steelhead population showing geographic areas that are currently in protected status, reaches identified as high priority for proposed protection management actions, and relative restoration benefit from high priority (priority 1) proposed restoration actions for all reaches.

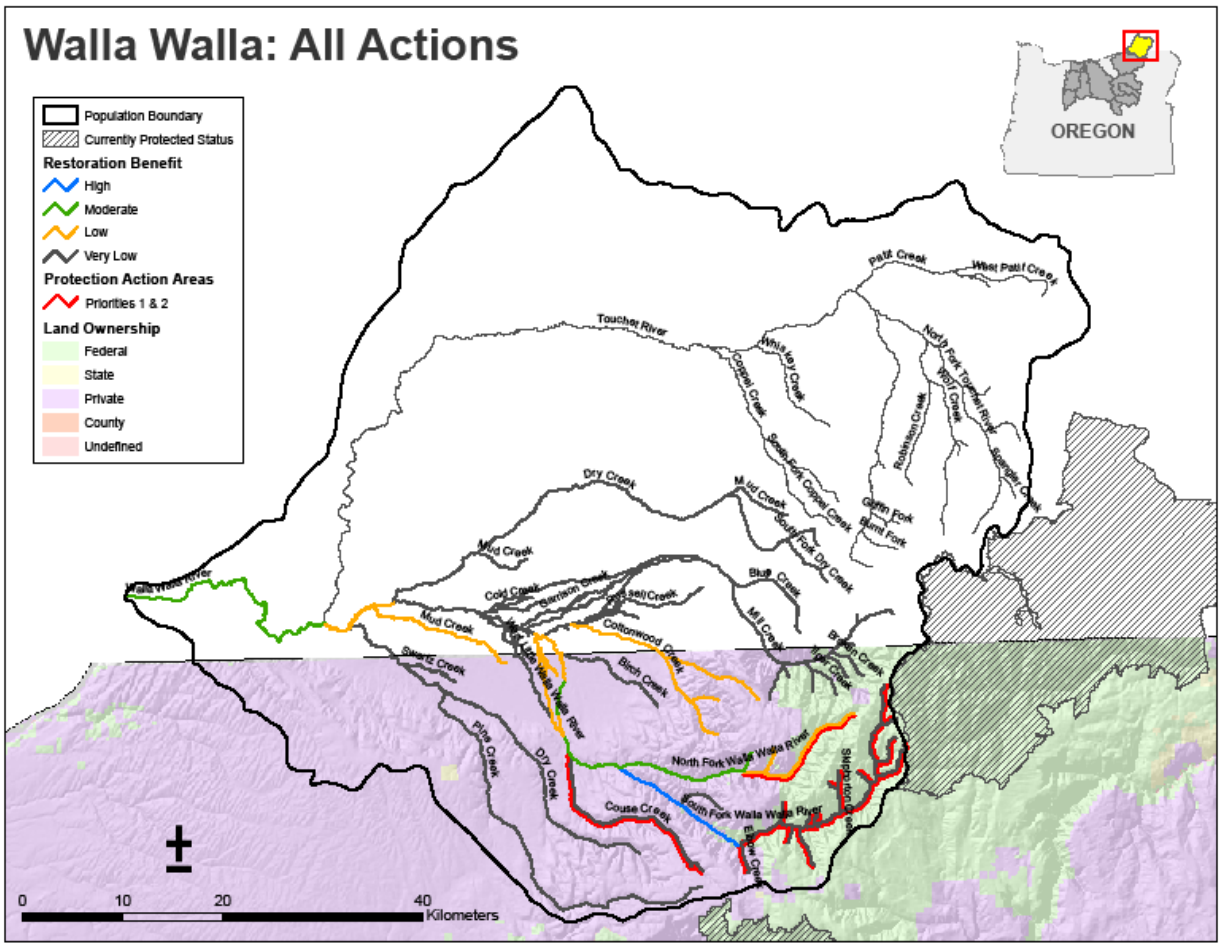

Figure 10-44. Map of the Walla Walla River steelhead population showing geographic areas that are currently in protected status, reaches identified for proposed protection management actions (priority 1 and priority 2), and reaches with high, moderate, low and very low restoration benefit from all (priority 1 and priority 2) proposed restoration actions.

10.3 All-H Integration Analysis

Results of All-H integration analysis are presented for each population below. Changes in performance measures associated with each action scenario are presented for intrinsic productivity and equilibrium spawner abundance, as these metrics were described earlier in this section. The results are comparable to population metrics presented in Section 6 for baseline performance, as derived empirically by the ICTRT, and to minimum productivity (at the threshold abundance level) and abundance viability thresholds at the 5% risk level (see Table 5-3 in Section 5). Thresholds represent one combination of abundance and productivity needed to achieve a 95% probability of persistence over 100 years. The threshold levels are specific to population size and are based on estimates of historical capacity.

Scenarios were run in a stepwise fashion, starting with baseline, then current condition, then adding in actions sequentially, each being added to the previous scenario. The effects of hatchery steelhead programs on genetic fitness—hence performance—of natural-origin fish were incorporated for each scenario using AHA.

To facilitate an understanding of how estimated performance levels compare to viability thresholds, we computed the ratio of scenario performance/viability threshold level for both abundance and productivity (referred to here as the threshold ratio). Values >1 indicate that performance is expected to achieve the viability threshold criterion for a 5% risk. The amount that the ratio exceeds 1 provides a relative measure of risk—with risk diminishing as the ratio increases. Ratio values <1 suggest a risk level >5%. Table 10-36 provides a list of abbreviations used in the tables and figures.

Table 10-36. Abbreviations used in tables reporting All-H integration results.

Area and abbreviation	Definition
Tributary	
B	Baseline condition
P1-25	Priority 1 actions at 25 yrs
P12-25	Priority 1 and 2 actions at 25 yrs
P1-100	Priority 1 actions at 100 yrs
P12-100	Priority 1 and 2 actions at 100 yrs
Mainstem and estuary	
B	Baseline condition
C	Current condition
Hyd	Hydro action
Pred	Predation plus hydro actions
Est	Estuarine, predation, hydro actions
Har	Harvest, Estuarine, predation, hydro actions
All	All actions (same as Har)
Ocean	
B/C	Baseline and current (assumed same)
-25%	75% of average marine survival
25%	125% of average marine survival

10.3.1 Fifteenmile Creek Winter Steelhead, Projected Changes to Population Performance

Population performance as measured by both productivity and spawner abundance is increased markedly for all scenario combinations analyzed. By far, the largest contribution to performance improvements is estimated to be due to tributary habitat actions. Relatively small increases are estimated to occur as a result of mainstem actions.

Viability thresholds are exceeded for all scenarios, including ones associated with a 25% decrease in marine survival. Most scenario combinations result in threshold ratios >2, suggesting a very low risk of extinction over 100 years.

Estimated changes in population performance (productivity and equilibrium abundance) of Fifteenmile Creek winter steelhead associated with combinations of tributary and out-of-subbasin actions are shown in Table 10-37 and Figure 10-45.

Table 10-37. Estimated population performance (productivity and equilibrium abundance) of Fifteenmile Creek winter steelhead associated with combinations of tributary and out-of-subbasin actions. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. The threshold ratio is the ratio of the performance measure/ viability threshold level at the 5% level.

Scenario combination			Performance		Threshold ratio	
Tributary	Main/est	Ocean	Prod	Abund	Prod	Abund
B	B	B/C	1.82	703	1.16	1.41
B	C	B/C	1.96	764	1.25	1.53
P1-25	C	B/C	2.91	1,322	1.85	2.64
P1-25	Hyd	B/C	2.92	1,325	1.86	2.65
P1-25	Pred	B/C	3.05	1,388	1.94	2.78
P1-25	Est	B/C	3.22	1,474	2.05	2.95
P1-25	Har	B/C	3.22	1,474	2.05	2.95
P12-25	C	B/C	3.02	1,342	1.92	2.68
P12-25	Hyd	B/C	3.02	1,345	1.92	2.69
P12-25	Pred	B/C	3.16	1,410	2.01	2.82
P12-25	Est	B/C	3.34	1,496	2.12	2.99
P12-25	Har	B/C	3.34	1,496	2.12	2.99
P1-100	C	B/C	3.63	1,479	2.31	2.96
P1-100	Hyd	B/C	3.64	1,482	2.32	2.96
P1-100	Pred	B/C	3.80	1,552	2.42	3.10
P1-100	Est	B/C	4.01	1,647	2.56	3.29
P1-100	Har	B/C	4.01	1,647	2.56	3.29
P12-100	C	B/C	3.79	1,502	2.41	3.00
P12-100	Hyd	B/C	3.80	1,506	2.42	3.01
P12-100	Pred	B/C	3.96	1,577	2.52	3.15
P12-100	Est	B/C	4.19	1,672	2.67	3.34
P12-100	Har	B/C	4.19	1,672	2.67	3.34
P12-25	All	-25%	2.50	1,095	1.59	2.19
P12-100	All	-25%	3.14	1,230	2.00	2.46
P12-25	All	+25%	4.17	1,898	2.66	3.80
P12-100	All	+25%	5.24	2,114	3.34	4.23

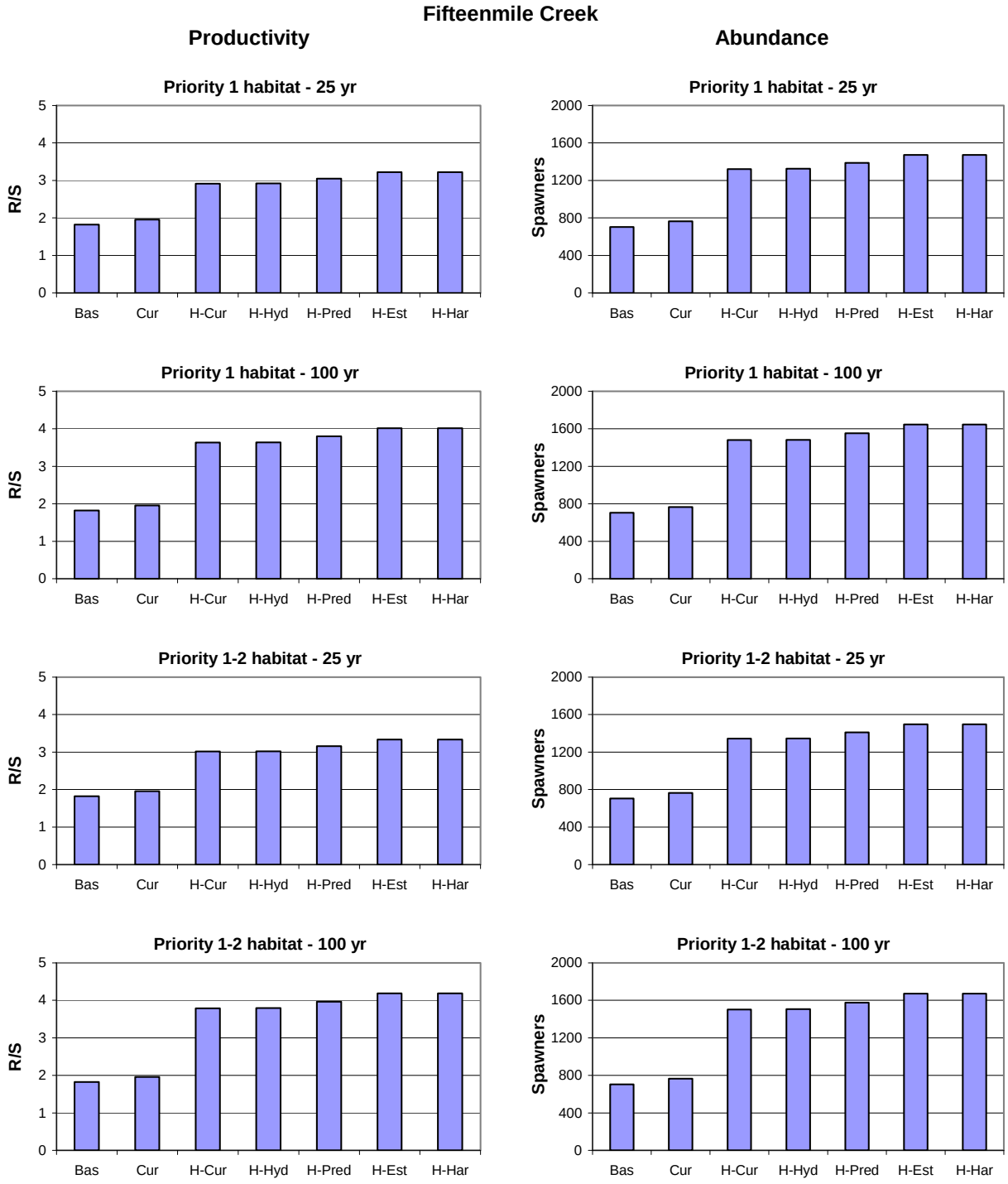

Figure 10-45. Estimated population performance (productivity and equilibrium abundance) of Fifteenmile Creek winter steelhead associated with combinations of tributary and out-of-subbasin actions. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. Baseline, current, and combinations of tributary habitat scenarios (shown as H) with out-of-subbasin factors (Hyd, Pred, Est, Har) are shown.

10.3.2 Deschutes River Eastside Summer Steelhead, Projected Changes to Population Performance

Population performance as measured by both productivity and spawner abundance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements is estimated to be due to tributary habitat actions, with greatest benefits accruing for the 100-year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of action measures. Very substantial benefits to both population productivity and natural-origin spawner abundance also occur as a result of reducing the number of stray hatchery fish that spawn with natural-origin fish.

Viability thresholds are exceeded for all scenarios, including ones associated with a 25% decrease in marine survival. All scenario combinations result in threshold ratios >2 for both productivity and abundance, suggesting a very low risk of extinction over 100 years. Reductions in stray hatchery fish produce threshold ratios >4 and >7 for all scenario combinations for productivity and abundance, respectively.

Table 10-38 and figures 10-46 and 10-47 show estimated changes in population performance of Deschutes River Eastside population associated with tributary and out-of-subbasin actions.

Table 10-38. Estimated population performance (productivity and equilibrium abundance) of Deschutes River Eastside summer steelhead associated with combinations of tributary and out-of-subbasin actions. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. Results are shown with and without action to reduce the number of hatchery strays by 95% of those expected to enter the relevant area for the scenario. The threshold ratio is the ratio of the performance measure/ viability threshold level at the 5% level.

Scenario combination			Performance				Threshold ratio			
			Prod		Abund		Prod		Abund	
Tributary	Main/est	Ocean	No stray action	Stray action	No stray action	Stray action	No stray action	Stray action	No stray action	Stray action
B	B	B/C	1.89		1,599		1.40		1.60	
B	C	B/C	2.10	3.71	2,340	4,634	1.55	2.75	2.34	4.63
P1-25	C	B/C	3.36	5.55	5,511	7,171	2.49	4.11	5.51	7.17
P1-25	Hyd	B/C	3.53	5.84	5,977	7,631	2.61	4.32	5.98	7.63
P1-25	Pred	B/C	3.69	6.10	6,398	8,047	2.73	4.52	6.40	8.05
P1-25	Est	B/C	3.89	6.45	6,958	8,600	2.88	4.78	6.96	8.60
P1-25	Har	B/C	3.89	6.45	6,958	8,600	2.88	4.78	6.96	8.60
P12-25	C	B/C	4.26	6.80	6,973	8,323	3.15	5.04	6.97	8.32
P12-25	Hyd	B/C	4.47	7.15	7,471	8,818	3.31	5.29	7.47	8.82
P12-25	Pred	B/C	4.67	7.47	7,921	9,265	3.46	5.53	7.92	9.27
P12-25	Est	B/C	4.93	7.89	8,520	9,859	3.65	5.85	8.52	9.86
P12-25	Har	B/C	4.93	7.89	8,520	9,859	3.65	5.85	8.52	9.86
P1-100	C	B/C	4.71	7.47	7,271	8,472	3.49	5.54	7.27	8.47
P1-100	Hyd	B/C	4.94	7.86	7,763	8,962	3.66	5.82	7.76	8.96
P1-100	Pred	B/C	5.16	8.21	8,208	9,405	3.82	6.08	8.21	9.41
P1-100	Est	B/C	5.44	8.68	8,799	9,994	4.03	6.43	8.80	9.99
P1-100	Har	B/C	5.44	8.68	8,799	9,994	4.03	6.43	8.80	9.99
P12-100	C	B/C	5.97	9.20	8,643	9,619	4.42	6.81	8.64	9.62
P12-100	Hyd	B/C	6.26	9.67	9,174	10,151	4.64	7.16	9.17	10.15
P12-100	Pred	B/C	6.53	10.10	9,656	10,632	4.84	7.48	9.66	10.63
P12-100	Est	B/C	6.89	10.68	10,295	11,272	5.10	7.91	10.30	11.27
P12-100	Har	B/C	6.89	10.68	10,295	11,272	5.10	7.91	10.30	11.27
P12-25	All	-25%	3.71	5.91	5,679	7,039	2.75	4.38	5.68	7.04
P12-100	All	-25%	5.22	8.00	7,265	8,239	3.87	5.93	7.26	8.24
P12-25	All	+25%	6.13	9.88	11,199	12,519	4.54	7.31	11.20	12.52
P12-100	All	+25%	8.54	13.35	13,167	14,140	6.33	9.89	13.17	14.14

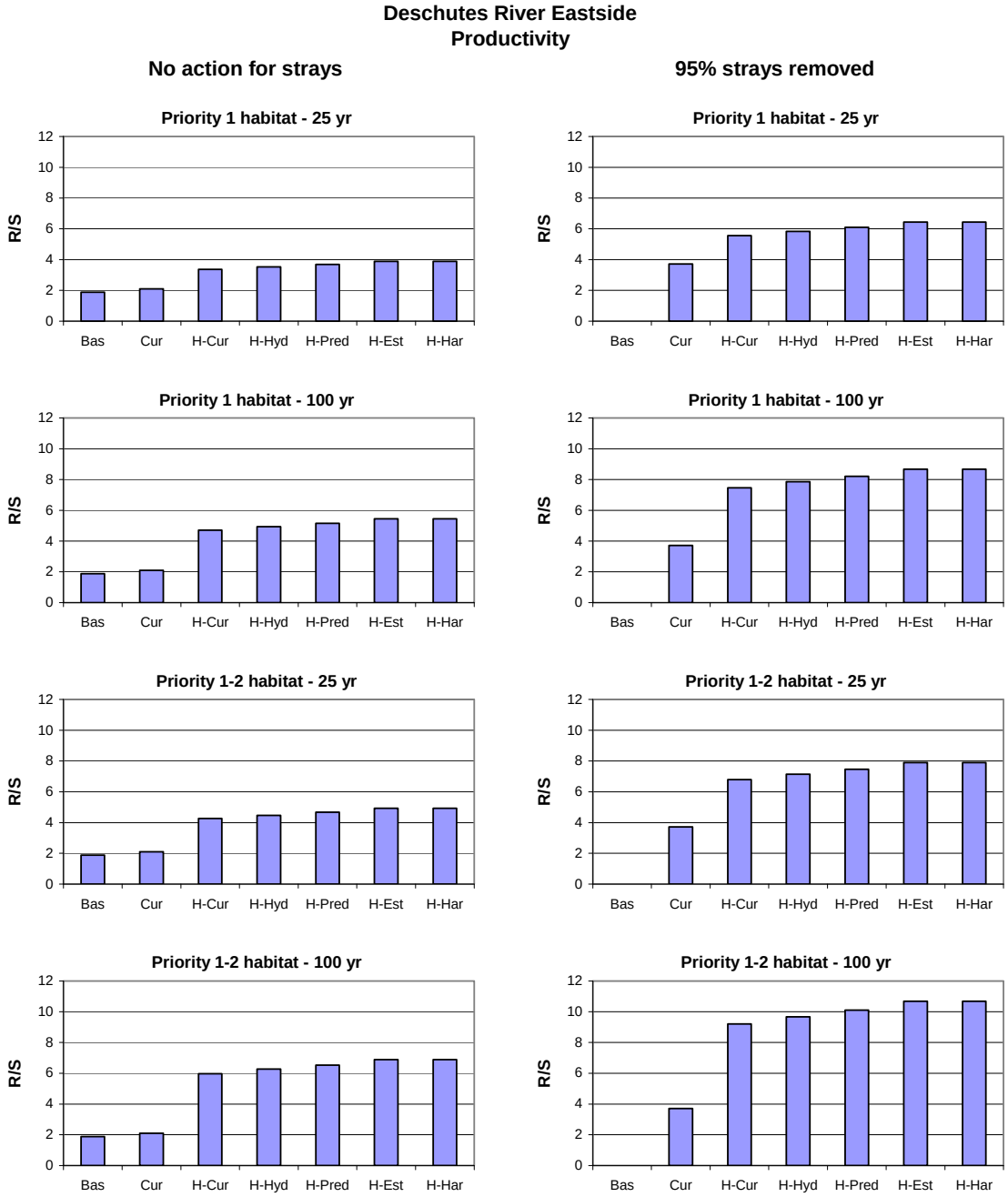

Figure 10-46. Estimated population productivity of Deschutes River Eastside summer steelhead associated with combinations of tributary and out-of-subbasin actions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. Results are shown with and without action to reduce the number of hatchery strays by 95% of those expected to enter the relevant area for the scenario. Baseline, current, and combinations of tributary habitat scenarios (shown as H) with out-of-subbasin factors (Hyd, Pred, Est, Har) are shown.

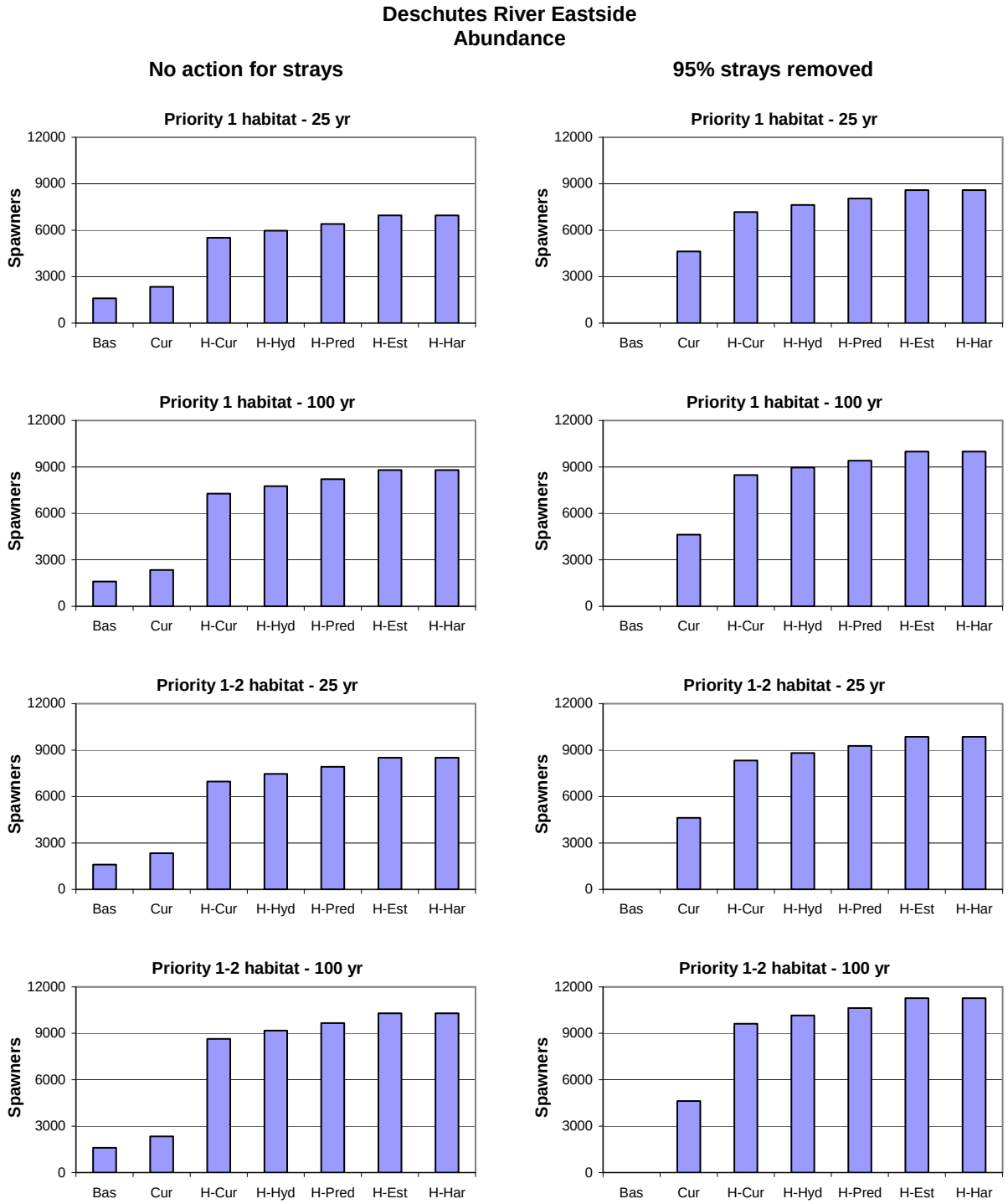

Figure 10-47. Estimated population equilibrium abundance of Deschutes River Eastside summer steelhead associated with combinations of tributary and out-of-subbasin actions. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. Results are shown with and without action to reduce the number of hatchery strays by 95% of those expected to enter the relevant area for the scenario. Baseline, current, and combinations of tributary habitat scenarios (shown as H) with out-of-subbasin factors (Hyd, Pred, Est, Har) are shown.

10.3.3 Deschutes River Westside Summer Steelhead, Projected Changes to Population Performance

The largest increases in population performance associated with the range of scenario combinations analyzed occur as a result of decreasing the number of stray hatchery fish and/or by providing passage at the Pelton-Round Butte complex (includes passage at Whychus Creek barriers). In the absence of the removal of strays or passage, benefits are much reduced. For those scenario combinations lacking removal of strays and passage, beneficial effects of tributary actions are greatest, though beneficial cumulative effects of adding in mainstem actions are clearly evident. The more modest benefits associated with tributary actions than found for the Deschutes Eastside population are due to the much better condition of tributary habitat in general compared to that on the east side of the subbasin (as reflected in how habitat conditions were characterized in EDT). We also hypothesize that performance of anadromous *O. mykiss* in west side tributaries is constrained in part by the significant presence of the resident form of *O. mykiss* in these streams.

The viability threshold for productivity is exceeded for all action scenarios, including ones associated with a 25% decrease in marine survival (threshold ratio >1 in all cases). It is noted however that the productivity threshold is tied to the minimum abundance threshold, which for this population, is not exceeded for any scenario combination considered. This suggests that the population would remain at significant risk of extinction despite the full range of actions considered. Only with all actions implemented and a 25% improvement in marine survival is the abundance threshold ratio of 1 approached (but still remaining <1). We hypothesize that this is, at least in part, due to a constraining influence of the presence of resident *O. mykiss* on abundance.

Table 10-39 and figures 10-48, 10-49 and 10-50 show changes in population performance of the Deschutes River Westside population associated with tributary and out-of-subbasin actions.

Table 10-39. Estimated population performance (productivity and equilibrium abundance) of Deschutes River Westside summer steelhead associated with combinations of tributary and out-of-subbasin actions. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. Results are shown with and without passage at Pelton-Round Butte Complex and with and without action to reduce the number of hatchery strays by 95% of those expected to enter the relevant area for the scenario. The threshold ratio is the ratio of the performance measure/ viability threshold level at the 5% level.

Scenario combination			Performance					
			Prod			Abund		
Tributary	Main/est	Ocean	No passage - no stray action	No passage - with stray action	Passage - with stray action	No passage - no stray action	No passage - with stray action	Passage - with stray action
B	B	B/C	1.05			456		
B	C	B/C	1.17	1.84		514	557	
P1-25	C	B/C	1.44	2.23	2.18	550	585	838
P1-25	Hyd	B/C	1.51	2.35	2.29	581	615	882
P1-25	Pred	B/C	1.57	2.45	2.39	608	643	921
P1-25	Est	B/C	1.66	2.59	2.52	645	679	973
P1-25	Har	B/C	1.66	2.59	2.52	645	679	973
P12-25	C	B/C	1.59	2.44	2.39	578	610	880
P12-25	Hyd	B/C	1.67	2.57	2.52	610	641	925
P12-25	Pred	B/C	1.74	2.68	2.63	638	669	966
P12-25	Est	B/C	1.84	2.84	2.78	675	707	1,020
P12-25	Har	B/C	1.84	2.84	2.78	675	707	1,020
P1-100	C	B/C	1.63	2.50	2.42	587	618	887
P1-100	Hyd	B/C	1.71	2.63	2.54	618	649	932
P1-100	Pred	B/C	1.78	2.74	2.66	647	678	974
P1-100	Est	B/C	1.88	2.90	2.81	684	715	1,028
P1-100	Har	B/C	1.88	2.90	2.81	684	715	1,028
P12-100	C	B/C	1.82	2.78	2.74	630	660	931
P12-100	Hyd	B/C	1.92	2.92	2.88	665	694	978
P12-100	Pred	B/C	2.00	3.05	3.01	696	725	1,020
P12-100	Est	B/C	2.11	3.23	3.18	738	767	1,077
P12-100	Har	B/C	2.11	3.23	3.18	738	767	1,077
P12-25	All	-25%	1.38	2.13	2.08	497	530	763
P12-100	All	-25%	1.59	2.42	2.39	542	571	810
P12-25	All	+25%	2.29	3.55	3.47	844	875	1,263
P12-100	All	+25%	2.64	4.03	3.98	927	955	1,329

Table 10-39. Continued.

Scenario combination			Threshold ratio					
			Prod			Abund		
Tributary	Main/est	Ocean	No passage - no stray action	No passage - with stray action	Passage - with stray action	No passage - no stray action	No passage - with stray action	Passage - with stray action
B	B	B/C	0.78			0.46		
B	C	B/C	0.86	1.36		0.51	0.56	
P1-25	C	B/C	1.06	1.66	1.73	0.55	0.59	0.56
P1-25	Hyd	B/C	1.12	1.74	1.81	0.58	0.62	0.59
P1-25	Pred	B/C	1.17	1.82	1.89	0.61	0.64	0.61
P1-25	Est	B/C	1.23	1.92	2.00	0.64	0.68	0.65
P1-25	Har	B/C	1.23	1.92	2.00	0.64	0.68	0.65
P12-25	C	B/C	1.18	1.81	1.90	0.58	0.61	0.59
P12-25	Hyd	B/C	1.24	1.90	2.00	0.61	0.64	0.62
P12-25	Pred	B/C	1.29	1.99	2.09	0.64	0.67	0.64
P12-25	Est	B/C	1.36	2.10	2.20	0.68	0.71	0.68
P12-25	Har	B/C	1.36	2.10	2.20	0.68	0.71	0.68
P1-100	C	B/C	1.21	1.85	1.92	0.59	0.62	0.59
P1-100	Hyd	B/C	1.27	1.94	2.02	0.62	0.65	0.62
P1-100	Pred	B/C	1.32	2.03	2.11	0.65	0.68	0.65
P1-100	Est	B/C	1.40	2.15	2.23	0.68	0.72	0.69
P1-100	Har	B/C	1.40	2.15	2.23	0.68	0.72	0.69
P12-100	C	B/C	1.35	2.06	2.18	0.63	0.66	0.62
P12-100	Hyd	B/C	1.42	2.16	2.29	0.66	0.69	0.65
P12-100	Pred	B/C	1.48	2.26	2.39	0.70	0.73	0.68
P12-100	Est	B/C	1.57	2.39	2.53	0.74	0.77	0.72
P12-100	Har	B/C	1.57	2.39	2.53	0.74	0.77	0.72
P12-25	All	-25%	1.02	1.58	1.65	0.50	0.53	0.51
P12-100	All	-25%	1.18	1.79	1.89	0.54	0.57	0.54
P12-25	All	+25%	1.70	2.63	2.76	0.84	0.88	0.84
P12-100	All	+25%	1.95	2.99	3.16	0.93	0.96	0.89

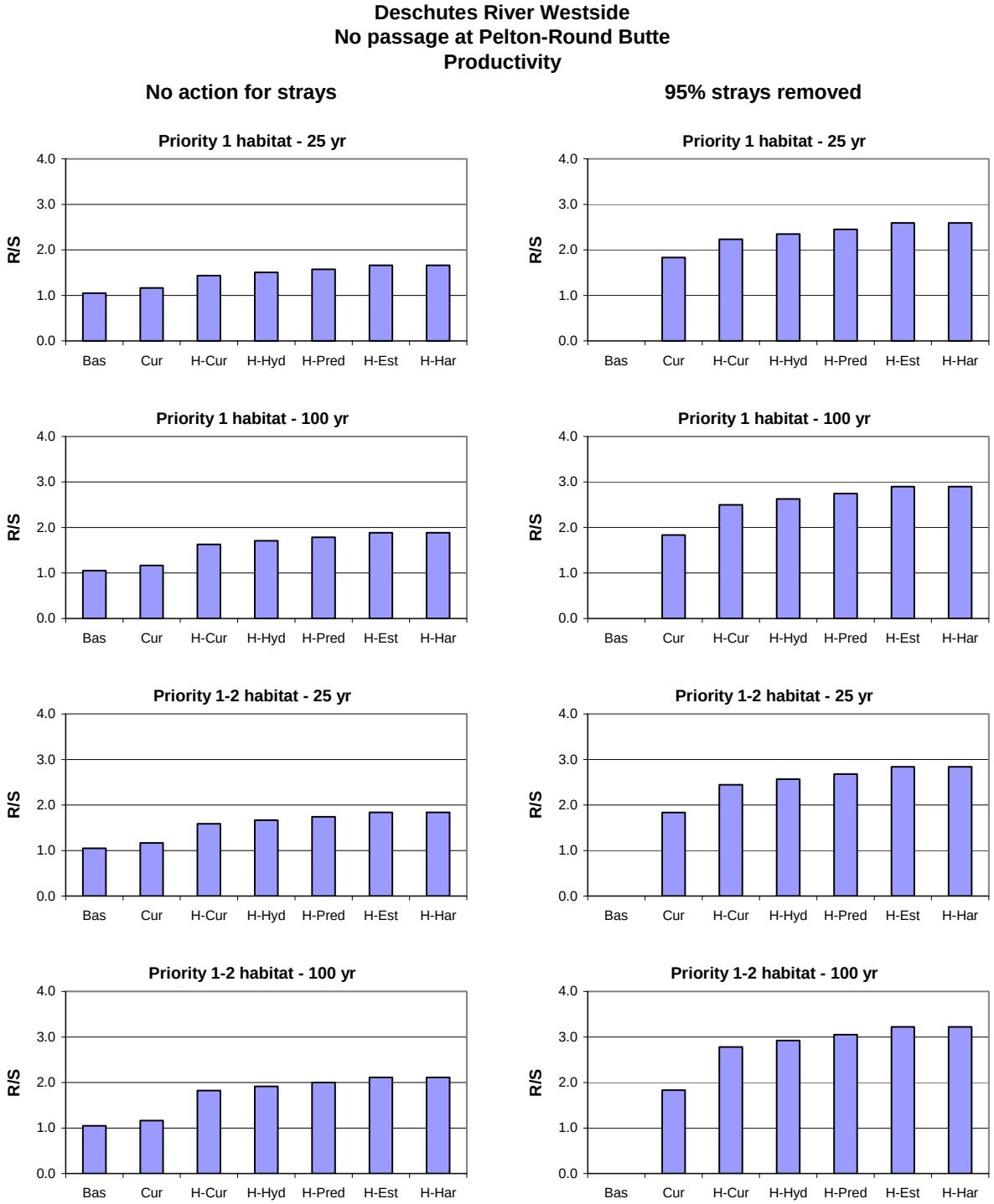

Figure 10-48. Estimated population productivity of Deschutes River Westside summer steelhead associated with combinations of tributary and out-of-subbasin actions and no passage at Pelton-Round Butte Complex. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. Results are shown with and without action to reduce the number of hatchery strays by 95% of those expected to enter the relevant area for the scenario. Baseline, current, and combinations of tributary habitat scenarios (shown as H) with out-of-subbasin factors (Hyd, Pred, Est, Har) are shown.

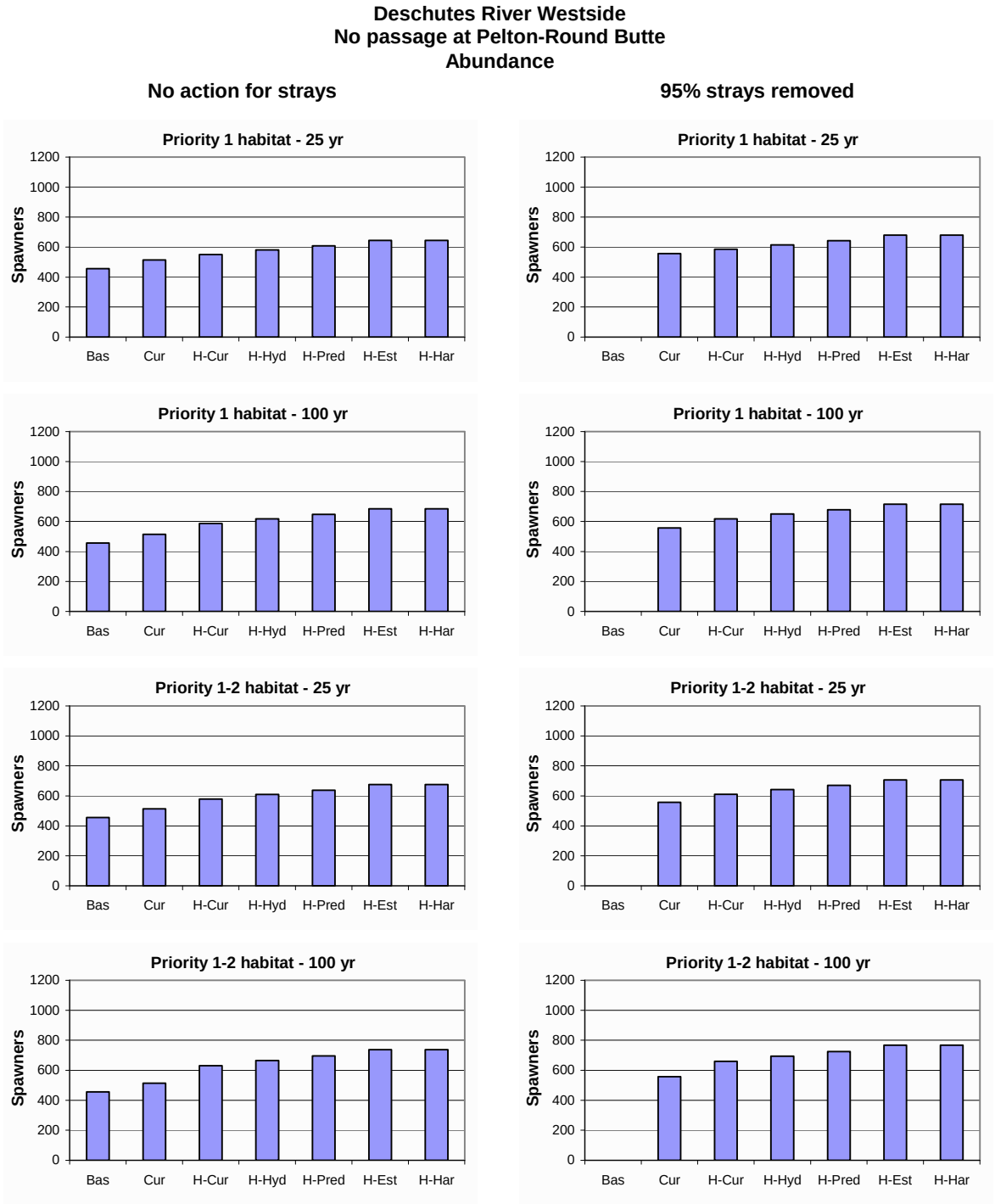

Figure 10-49. Estimated population equilibrium abundance of Deschutes River Westside summer steelhead associated with combinations of tributary and out-of-subbasin actions and no passage at Pelton-Round Butte Complex. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. Results are shown with and without action to reduce the number of hatchery strays by 95% of those expected to enter the relevant area for the scenario. Baseline, current, and combinations of tributary habitat scenarios (shown as H) with out-of-subbasin factors (Hyd, Pred, Est, Har) are shown.

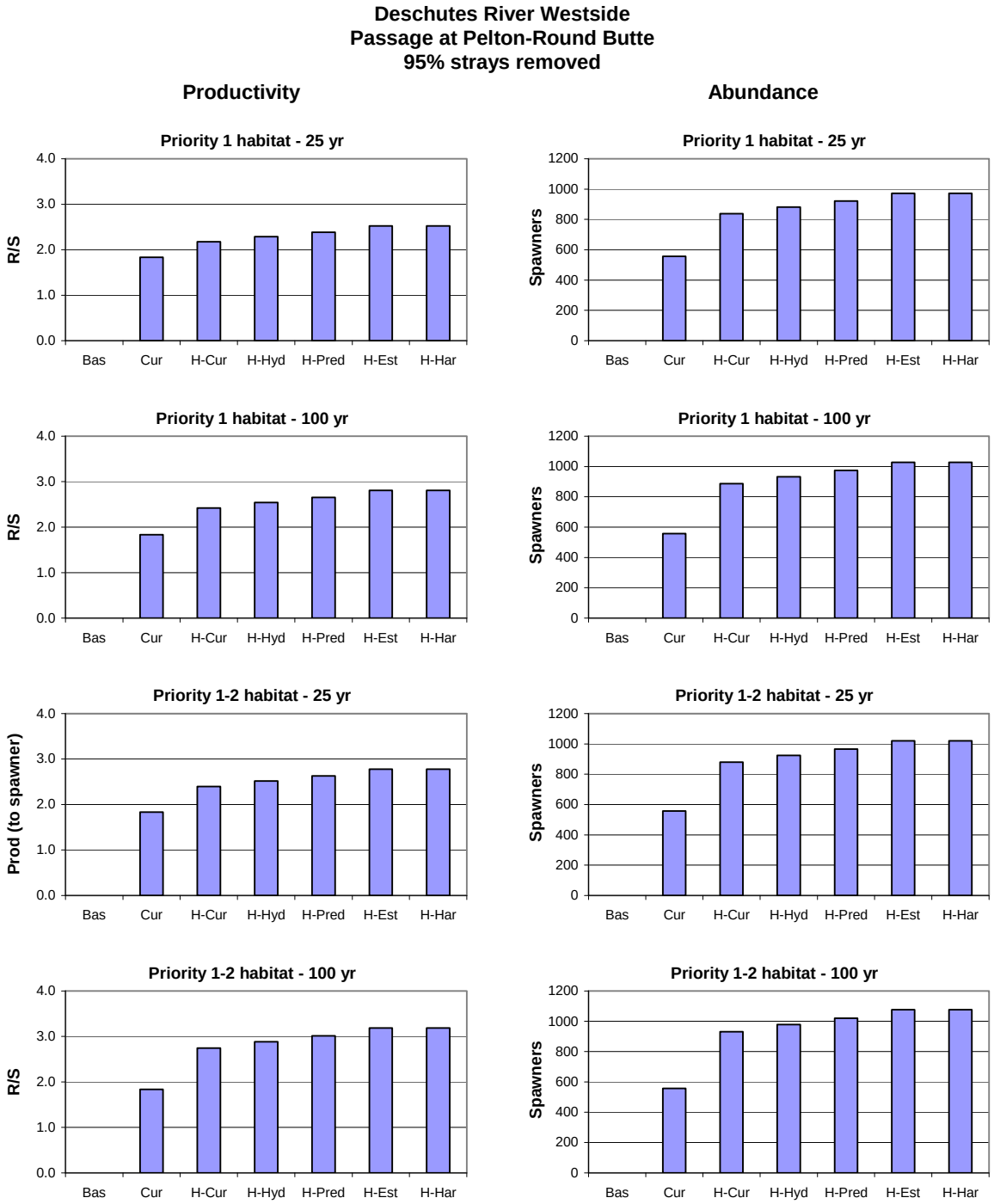

Figure 10-50. Estimated population performance measures (productivity and equilibrium abundance) of Deschutes River Westside summer steelhead associated with combinations of tributary and out-of-subbasin actions and with passage at Pelton-Round Butte Complex. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. Results are shown with action to reduce the number of hatchery strays by 95% of those expected to enter the relevant area for the scenario. Baseline, current, and combinations of tributary habitat scenarios (shown as H) with out-of-subbasin factors (Hyd, Pred, Est, Har) are shown.

10.3.4 Lower Mainstem John Day River Summer Steelhead, Projected Changes to Population Performance

Population performance as measured by both productivity and spawner abundance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements is estimated to be due to tributary habitat actions, with greatest benefits accruing for the 100-year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions.

Viability thresholds are exceeded for all scenarios, including ones associated with a 25% decrease in marine survival. All scenario combinations result in threshold ratios >4 (approximately) for productivity and >2 for abundance, suggesting a very low risk of extinction over 100 years.

Table 10-40 and Figure 10-51 show projected changes in estimated population performance of Lower Mainstem John Day River summer steelhead associated with combinations of tributary and out-of-subbasin actions.

Table 10-40. Estimated population performance (productivity and equilibrium abundance) of Lower Mainstem John Day River summer steelhead associated with combinations of tributary and out-of-subbasin actions. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. The threshold ratio is the ratio of the performance measure/ viability threshold level at the 5% level.

Scenario combination			Performance		Threshold ratio	
Tributary	Main/est	Ocean	Prod	Abund	Prod	Abund
B	B	B/C	2.99	1,800	2.51	0.80
B	C	B/C	3.44	2,423	2.89	1.08
P1-25	C	B/C	4.75	4,743	3.99	2.11
P1-25	Hyd	B/C	5.18	5,393	4.35	2.40
P1-25	Pred	B/C	5.39	5,706	4.53	2.54
P1-25	Est	B/C	5.67	6,122	4.77	2.72
P1-25	Har	B/C	5.67	6,122	4.77	2.72
P12-25	C	B/C	4.99	5,751	4.19	2.56
P12-25	Hyd	B/C	5.43	6,537	4.56	2.91
P12-25	Pred	B/C	5.65	6,918	4.74	3.07
P12-25	Est	B/C	5.94	7,427	4.99	3.30
P12-25	Har	B/C	5.94	7,427	4.99	3.30
P1-100	C	B/C	6.20	6,547	5.21	2.91
P1-100	Hyd	B/C	6.74	7,324	5.67	3.26
P1-100	Pred	B/C	7.01	7,699	5.89	3.42
P1-100	Est	B/C	7.37	8,197	6.19	3.64
P1-100	Har	B/C	7.37	8,197	6.19	3.64
P12-100	C	B/C	7.31	8,627	6.15	3.83
P12-100	Hyd	B/C	7.94	9,628	6.67	4.28
P12-100	Pred	B/C	8.25	10,112	6.93	4.49
P12-100	Est	B/C	8.67	10,758	7.29	4.78
P12-100	Har	B/C	8.67	10,758	7.29	4.78
P12-25	All	-25%	4.61	5,047	3.87	2.24
P12-100	All	-25%	6.77	7,728	5.69	3.43
P12-25	All	+25%	7.33	9,722	6.16	4.32
P12-100	All	+25%	10.66	13,667	8.96	6.07

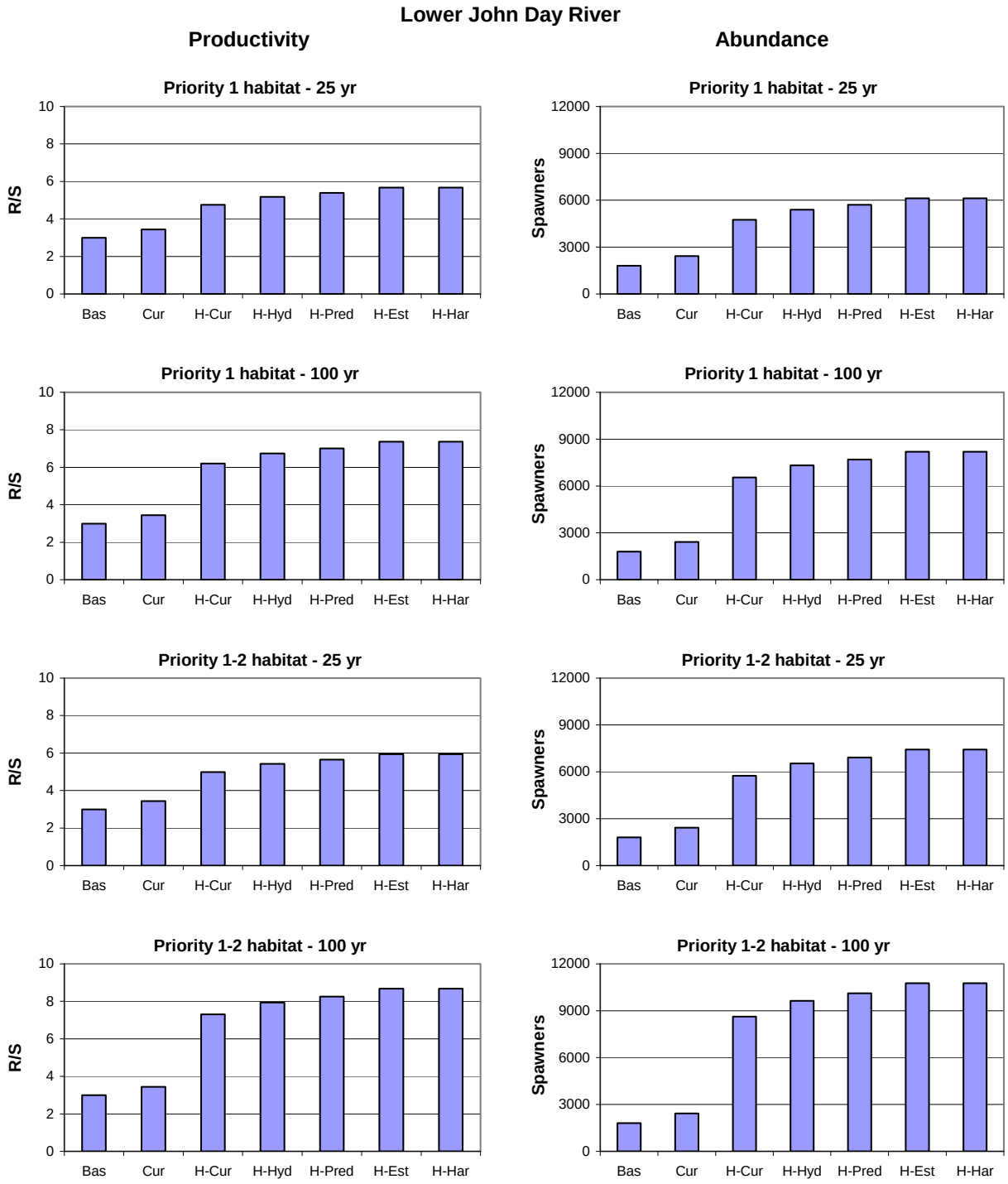

Figure 10-51. Estimated population performance measures (productivity and equilibrium abundance) of Lower Mainstem John Day River summer steelhead associated with combinations of tributary and out-of-subbasin actions. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. Baseline, current, and combinations of tributary habitat scenarios (shown as H) with out-of-subbasin factors (Hyd, Pred, Est, Har) are shown.

10.3.5 North Fork John Day River Summer Steelhead, Projected Changes to Population Performance

Population performance as measured by both productivity and spawner abundance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements is estimated to be due to tributary habitat actions, with greatest benefits accruing for the 100-year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions.

Viability thresholds are exceeded for all scenarios, including ones associated with a 25% decrease in marine survival. Most scenario combinations result in threshold ratios >3 for productivity and >2 for abundance, suggesting a very low risk of extinction over 100 years.

Table 10-41 and Figure 10-52 show projected changes in population performance of North Fork John Day River summer steelhead associated with tributary and out-of-subbasin actions.

Table 10-41. Estimated population performance (productivity and equilibrium abundance) of North Fork John Day River summer steelhead associated with combinations of tributary and out-of-subbasin actions. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. The threshold ratio is the ratio of the performance measure/ viability threshold level at the 5% level.

Scenario combination			Performance		Threshold ratio	
Tributary	Main/est	Ocean	Prod	Abund	Prod	Abund
B	B	B/C	2.41	1,740	1.91	1.16
B	C	B/C	2.77	2,101	2.20	1.40
P1-25	C	B/C	3.34	2,678	2.65	1.79
P1-25	Hyd	B/C	3.66	2,999	2.91	2.00
P1-25	Pred	B/C	3.82	3,153	3.03	2.10
P1-25	Est	B/C	4.04	3,358	3.20	2.24
P1-25	Har	B/C	4.04	3,358	3.20	2.24
P12-25	C	B/C	3.44	2,762	2.73	1.84
P12-25	Hyd	B/C	3.77	3,090	3.00	2.06
P12-25	Pred	B/C	3.94	3,248	3.13	2.17
P12-25	Est	B/C	4.16	3,458	3.30	2.31
P12-25	Har	B/C	4.16	3,458	3.30	2.31
P1-100	C	B/C	3.84	3,078	3.04	2.05
P1-100	Hyd	B/C	4.21	3,432	3.34	2.29
P1-100	Pred	B/C	4.39	3,603	3.48	2.40
P1-100	Est	B/C	4.63	3,830	3.68	2.55
P1-100	Har	B/C	4.63	3,830	3.68	2.55
P12-100	C	B/C	4.03	3,209	3.20	2.14
P12-100	Hyd	B/C	4.42	3,572	3.51	2.38
P12-100	Pred	B/C	4.61	3,747	3.66	2.50
P12-100	Est	B/C	4.87	3,980	3.86	2.65
P12-100	Har	B/C	4.87	3,980	3.86	2.65
P12-25	All	-25%	3.14	2,465	2.49	1.64
P12-100	All	-25%	3.69	2,880	2.93	1.92
P12-25	All	+25%	5.18	4,404	4.11	2.94
P12-100	All	+25%	6.06	5,028	4.81	3.35

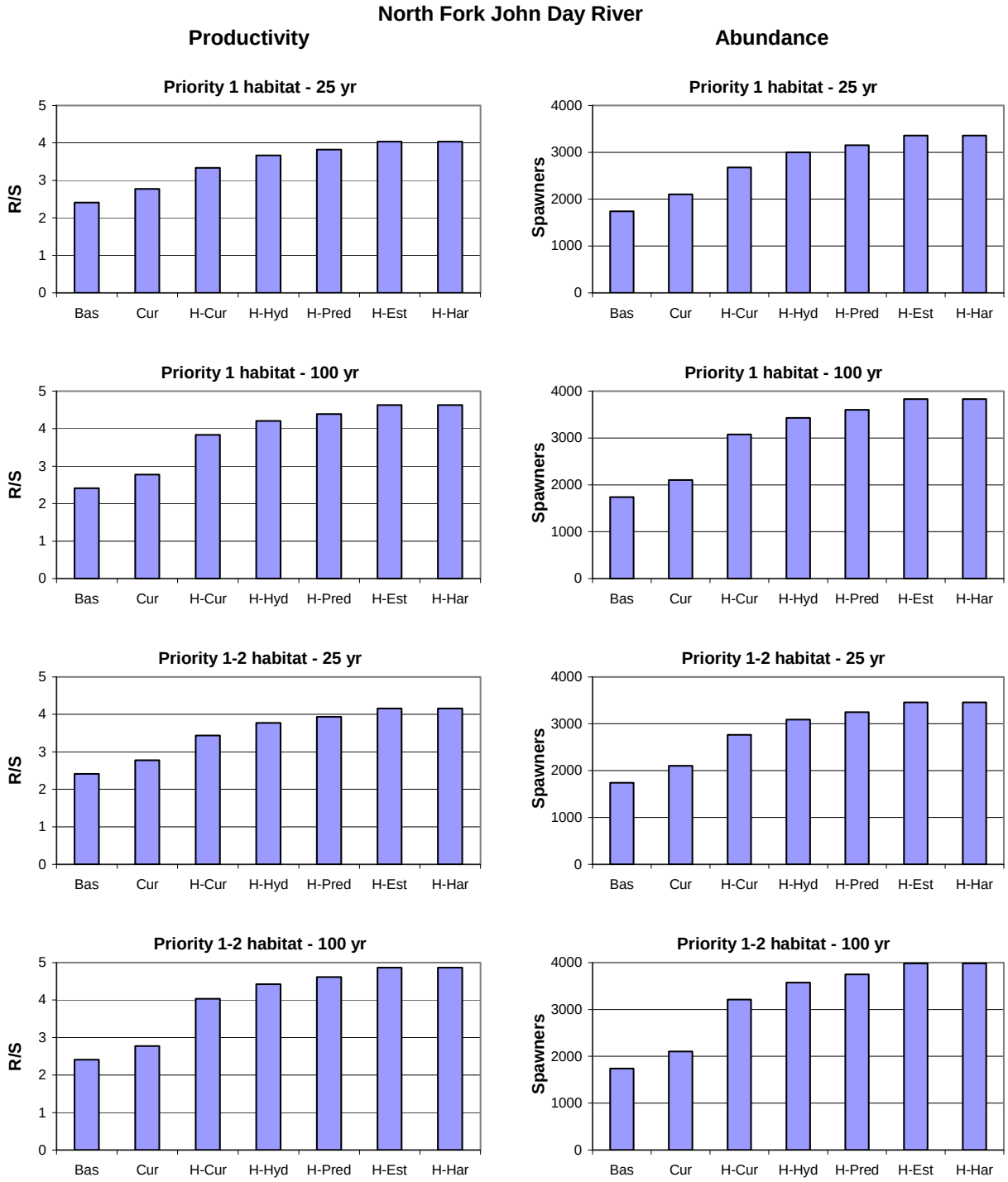

Figure 10-52. Estimated population performance measures (productivity and equilibrium abundance) of North Fork John Day River summer steelhead associated with combinations of tributary and out-of-subbasin actions. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. Baseline, current, and combinations of tributary habitat scenarios (shown as H) with out-of-subbasin factors (Hyd, Pred, Est, Har) are shown.

10.3.6 Middle Fork John Day River Summer Steelhead, Projected Changes to Population Performance

Population performance as measured by both productivity and spawner abundance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements is estimated to be due to tributary habitat actions, with greatest benefits accruing for the 100-year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions.

Viability thresholds are exceeded for all scenarios, including ones associated with a 25% decrease in marine survival. Most scenario combinations result in threshold ratios >3 for productivity. Threshold ratios for abundance across the range of scenario combinations are lower, generally between values of 1-2.

Table 10-42 and Figure 10-53 show projected changes to population performance of Middle Fork John Day River summer steelhead associated with tributary and out-of-subbasin actions.

Table 10-42. Estimated population performance (productivity and equilibrium abundance) of Middle Fork John Day River summer steelhead associated with combinations of tributary and out-of-subbasin actions. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. The threshold ratio is the ratio of the performance measure/ viability threshold level at the 5% level.

Scenario combination			Performance		Threshold ratio	
Tributary	Main/est	Ocean	Prod	Abund	Prod	Abund
B	B	B/C	2.45	756	1.81	0.76
B	C	B/C	2.82	921	2.09	0.92
P1-25	C	B/C	4.01	1,313	2.97	1.31
P1-25	Hyd	B/C	4.40	1,467	3.26	1.47
P1-25	Pred	B/C	4.59	1,541	3.40	1.54
P1-25	Est	B/C	4.84	1,640	3.59	1.64
P1-25	Har	B/C	4.84	1,640	3.59	1.64
P12-25	C	B/C	4.24	1,385	3.14	1.38
P12-25	Hyd	B/C	4.64	1,545	3.44	1.54
P12-25	Pred	B/C	4.84	1,622	3.59	1.62
P12-25	Est	B/C	5.11	1,724	3.79	1.72
P12-25	Har	B/C	5.11	1,724	3.79	1.72
P1-100	C	B/C	5.09	1,579	3.77	1.58
P1-100	Hyd	B/C	5.57	1,753	4.13	1.75
P1-100	Pred	B/C	5.81	1,837	4.30	1.84
P1-100	Est	B/C	6.13	1,948	4.54	1.95
P1-100	Har	B/C	6.13	1,948	4.54	1.95
P12-100	C	B/C	5.46	1,694	4.04	1.69
P12-100	Hyd	B/C	5.97	1,878	4.43	1.88
P12-100	Pred	B/C	6.23	1,966	4.61	1.97
P12-100	Est	B/C	6.57	2,084	4.86	2.08
P12-100	Har	B/C	6.57	2,084	4.86	2.08
P12-25	All	-25%	3.88	1,240	2.87	1.24
P12-100	All	-25%	5.00	1,528	3.70	1.53
P12-25	All	+25%	6.35	2,186	4.70	2.19
P12-100	All	+25%	8.15	2,616	6.03	2.62

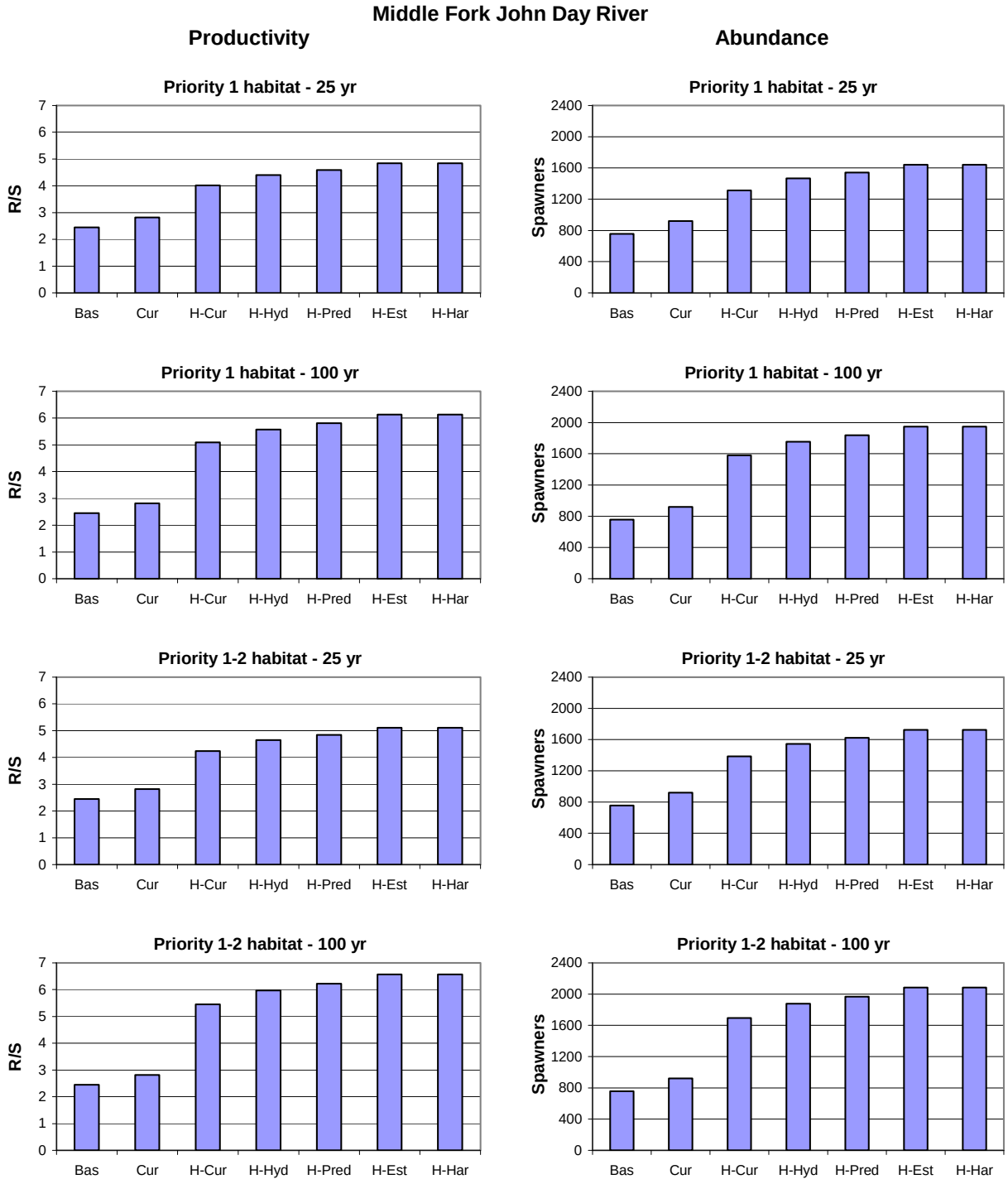

Figure 10-53. Estimated population performance measures (productivity and equilibrium abundance) of Middle Fork John Day River summer steelhead associated with combinations of tributary and out-of-subbasin actions. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. Baseline, current, and combinations of tributary habitat scenarios (shown as H) with out-of-subbasin factors (Hyd, Pred, Est, Har) are shown.

10.3.7 South Fork John Day River Summer Steelhead, Projected Changes to Population Performance

Population performance as measured by both productivity and spawner abundance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements is estimated to be due to tributary habitat actions, with greatest benefits accruing for the 100 year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions.

The viability threshold for productivity is exceeded for all action scenarios, including ones associated with a 25% decrease in marine survival (threshold ratio >1 in all cases). It is noted however that the productivity threshold is tied to the minimum abundance threshold, which for this population, is not exceeded for approximately half of the scenario combinations considered. Only at 100 years, after some tributary habitat actions have fully matured, in combination with addition of mainstem actions, does the threshold ratio for abundance >1. The abundance ratio with all actions implemented, even after 100 years of maturation, drops to <1 when marine survival is reduced to 75% of the current average.

Table 10-43 and Figure 10-54 show projected changes in population performance of South Fork John Day River summer steelhead associated with tributary and out-of-subbasin actions.

Table 10-43. Estimated population performance (productivity and equilibrium abundance) of South Fork John Day River summer steelhead associated with combinations of tributary and out-of-subbasin actions. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for ICTRT baseline conditions. The threshold ratio is the ratio of the performance measure/ viability threshold level at the 5% level.

Scenario combination			Performance		Threshold ratio	
Tributary	Main/est	Ocean	Prod	Abund	Prod	Abund
B	B	B/C	2.06	259	1.31	0.52
B	C	B/C	2.37	315	1.51	0.63
P1-25	C	B/C	2.86	391	1.82	0.78
P1-25	Hyd	B/C	3.14	439	2.00	0.88
P1-25	Pred	B/C	3.28	462	2.09	0.92
P1-25	Est	B/C	3.46	492	2.21	0.98
P1-25	Har	B/C	3.46	492	2.21	0.98
P12-25	C	B/C	3.03	414	1.93	0.83
P12-25	Hyd	B/C	3.32	464	2.11	0.93
P12-25	Pred	B/C	3.46	488	2.21	0.98
P12-25	Est	B/C	3.66	520	2.33	1.04
P12-25	Har	B/C	3.66	520	2.33	1.04
P1-100	C	B/C	3.35	454	2.14	0.91
P1-100	Hyd	B/C	3.68	506	2.34	1.01
P1-100	Pred	B/C	3.84	532	2.44	1.06
P1-100	Est	B/C	4.05	566	2.58	1.13
P1-100	Har	B/C	4.05	566	2.58	1.13
P12-100	C	B/C	3.72	491	2.37	0.98
P12-100	Hyd	B/C	4.07	546	2.59	1.09
P12-100	Pred	B/C	4.25	573	2.70	1.15
P12-100	Est	B/C	4.48	609	2.85	1.22
P12-100	Har	B/C	4.48	609	2.85	1.22
P12-25	All	-25%	2.76	369	1.76	0.74
P12-100	All	-25%	3.40	440	2.16	0.88
P12-25	All	+25%	4.55	665	2.90	1.33
P12-100	All	+25%	5.57	769	3.55	1.54

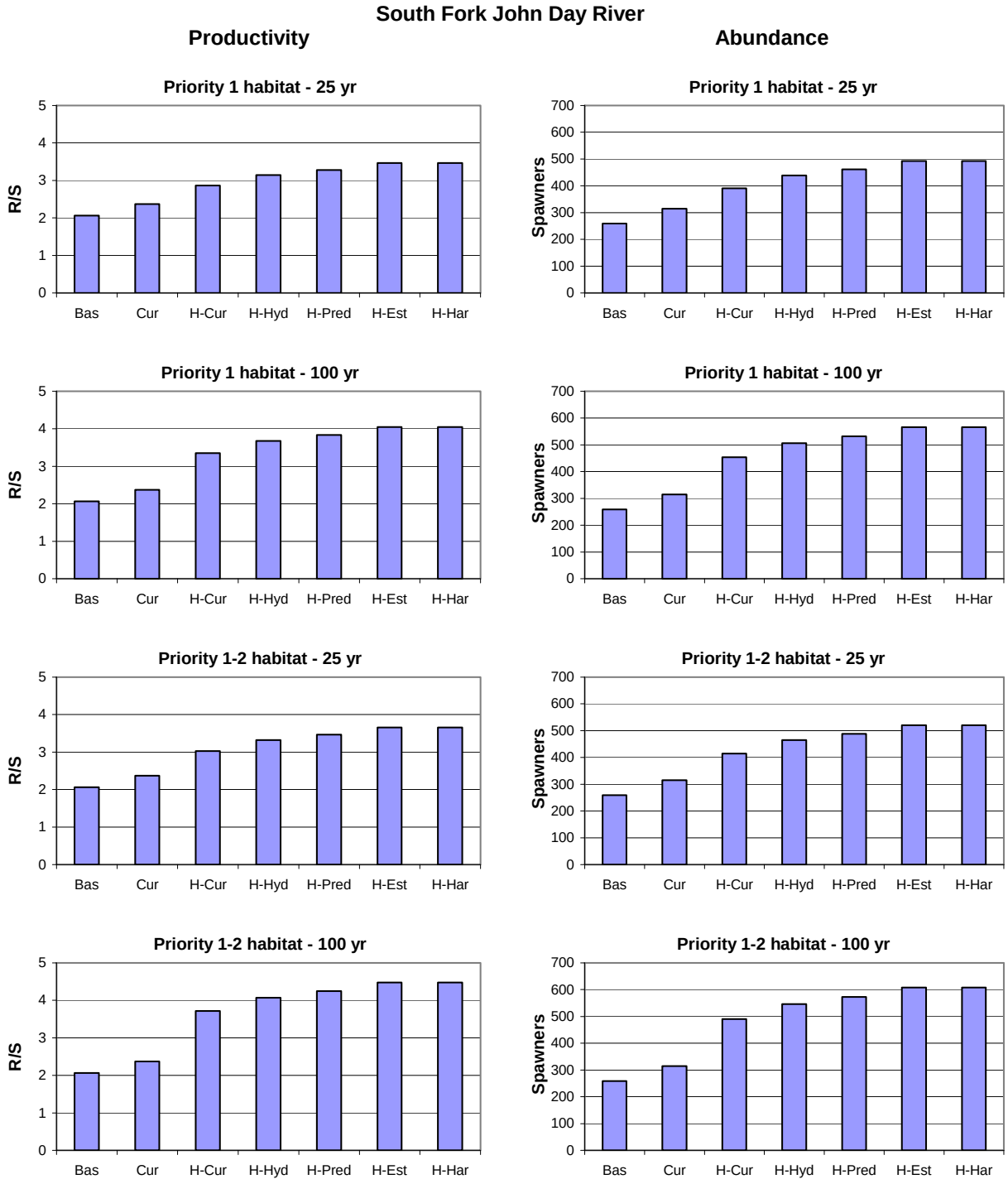

Figure 10-54. Estimated population performance measures (productivity and equilibrium abundance) of South Fork John Day River summer steelhead associated with combinations of tributary and out-of-subbasin actions. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. Baseline, current, and combinations of tributary habitat scenarios (shown as H) with out-of-subbasin factors (Hyd, Pred, Est, Har) are shown.

10.3.8 Upper Mainstem John Day River Summer Steelhead, Projected Changes to Population Performance

Population performance as measured by both productivity and spawner abundance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements is estimated to be due to tributary habitat actions, with greatest benefits accruing for the 100 year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions.

Viability thresholds are exceeded for all scenarios, including ones associated with a 25% decrease in marine survival. All scenario combinations result in threshold ratios between 2 and 5 for productivity. Most scenario combinations result in abundance threshold ratios between 1 and 2. These abundance threshold ratios are, however, markedly higher than the current ratio value.

Table 10-44 and Figure 10-55 show projected changes in population performance of Upper Mainstem John Day River summer steelhead associated with tributary and out-of-subbasin actions.

Table 10-44. Estimated population performance (productivity and equilibrium abundance) of Upper Mainstem John Day River summer steelhead associated with combinations of tributary and out-of-subbasin actions. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. The threshold ratio is the ratio of the performance measure/ viability threshold level at the 5% level.

Scenario combination			Performance		Threshold ratio	
Tributary	Main/est	Ocean	Prod	Abund	Prod	Abund
B	B	B/C	2.14	524	1.59	0.52
B	C	B/C	2.46	650	1.82	0.65
P1-25	C	B/C	3.24	955	2.40	0.96
P1-25	Hyd	B/C	3.55	1,076	2.63	1.08
P1-25	Pred	B/C	3.70	1,134	2.74	1.13
P1-25	Est	B/C	3.91	1,212	2.89	1.21
P1-25	Har	B/C	3.91	1,212	2.89	1.21
P12-25	C	B/C	4.14	1,262	3.06	1.26
P12-25	Hyd	B/C	4.52	1,409	3.35	1.41
P12-25	Pred	B/C	4.71	1,480	3.49	1.48
P12-25	Est	B/C	4.97	1,575	3.68	1.58
P12-25	Har	B/C	4.97	1,575	3.68	1.58
P1-100	C	B/C	3.95	1,160	2.92	1.16
P1-100	Hyd	B/C	4.32	1,298	3.20	1.30
P1-100	Pred	B/C	4.50	1,364	3.33	1.36
P1-100	Est	B/C	4.75	1,452	3.51	1.45
P1-100	Har	B/C	4.75	1,452	3.51	1.45
P12-100	C	B/C	5.35	1,566	3.97	1.57
P12-100	Hyd	B/C	5.85	1,738	4.33	1.74
P12-100	Pred	B/C	6.09	1,821	4.51	1.82
P12-100	Est	B/C	6.42	1,931	4.76	1.93
P12-100	Har	B/C	6.42	1,931	4.76	1.93
P12-25	All	-25%	3.79	1,129	2.81	1.13
P12-100	All	-25%	4.91	1,411	3.64	1.41
P12-25	All	+25%	6.16	2,004	4.56	2.00
P12-100	All	+25%	7.95	2,431	5.89	2.43

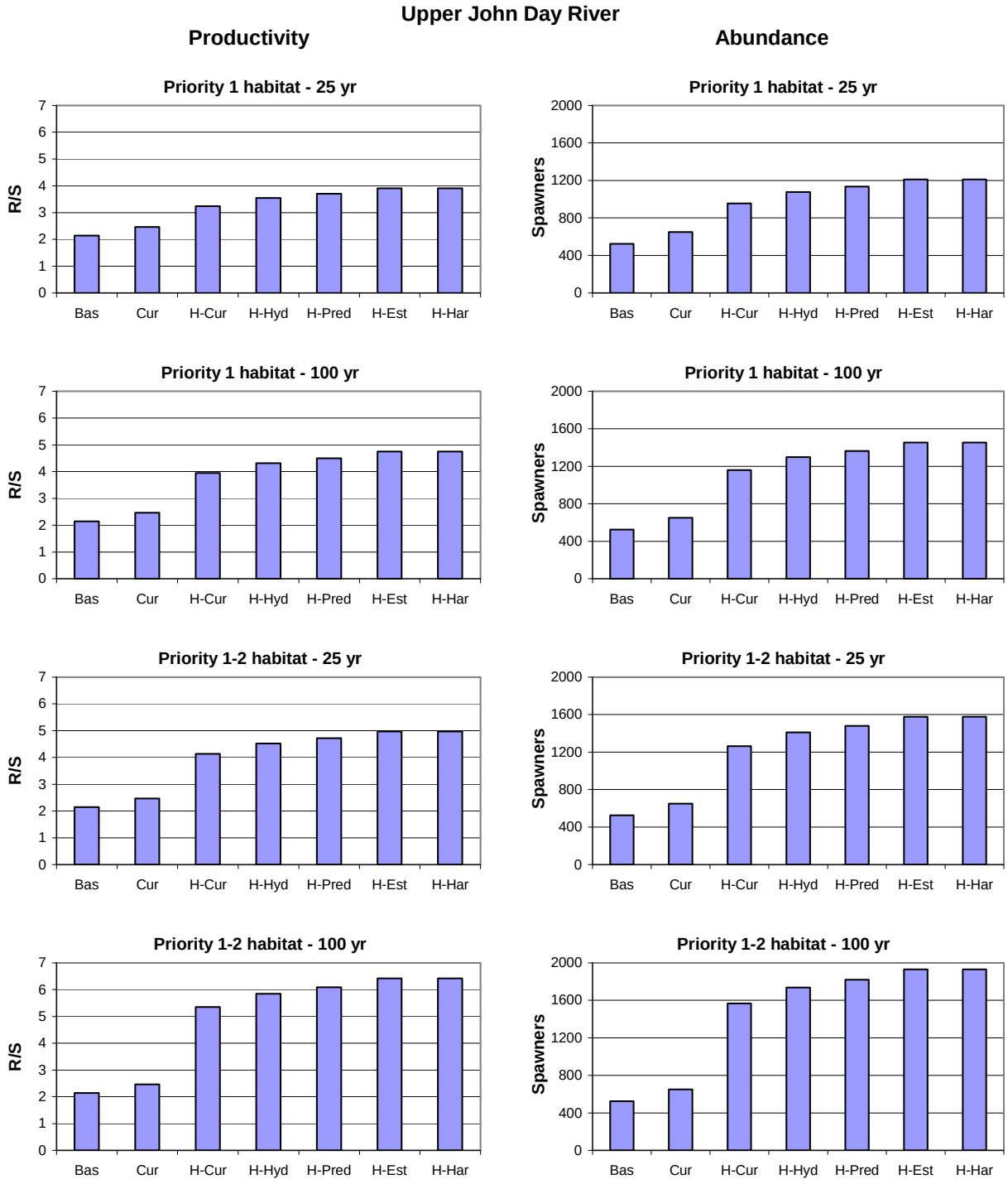

Figure 10-55. Estimated population performance measures (productivity and equilibrium abundance) of Upper Mainstem John Day River summer steelhead associated with combinations of tributary and out-of-subbasin actions. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. Baseline, current, and combinations of tributary habitat scenarios (shown as H) with out-of-subbasin factors (Hyd, Pred, Est, Har) are shown.

10.3.9 Umatilla River Summer Steelhead, Projected Changes to Population Performance

Population performance as measured by both productivity and spawner abundance is increased markedly for all scenario combinations analyzed. The largest contribution to performance improvements is estimated to be due to tributary habitat actions, with greatest benefits accruing for the 100 year scenarios. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions.

Viability thresholds are exceeded for all scenarios, including ones associated with a 25% decrease in marine survival. All scenario combinations result in threshold ratios between 2-5 for both productivity and abundance, suggesting a very low risk of extinction over 100 years.

Table 10-45 and Figure 10-56 show projected changes in population performance of Umatilla River summer steelhead associated with combinations of tributary and out-of-subbasin actions.

Table 10-45. Estimated population performance (productivity and equilibrium abundance) of Umatilla River summer steelhead associated with combinations of tributary and out-of-subbasin actions. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. The threshold ratio is the ratio of the performance measure/ viability threshold level at the 5% level.

Scenario combination			Performance		Threshold ratio	
Tributary	Main/est	Ocean	Prod	Abund	Prod	Abund
B	B	B/C	1.50	1,472	1.19	0.98
B	C	B/C	1.73	1,820	1.37	1.21
P1-25	C	B/C	3.30	3,373	2.62	2.25
P1-25	Hyd	B/C	3.63	3,748	2.88	2.50
P1-25	Pred	B/C	3.79	3,929	3.01	2.62
P1-25	Est	B/C	4.01	4,168	3.18	2.78
P1-25	Har	B/C	4.01	4,168	3.18	2.78
P12-25	C	B/C	3.18	3,685	2.52	2.46
P12-25	Hyd	B/C	3.50	4,092	2.77	2.73
P12-25	Pred	B/C	3.65	4,287	2.90	2.86
P12-25	Est	B/C	3.86	4,545	3.06	3.03
P12-25	Har	B/C	3.86	4,545	3.06	3.03
P1-100	C	B/C	4.26	3,954	3.38	2.64
P1-100	Hyd	B/C	4.68	4,366	3.71	2.91
P1-100	Pred	B/C	4.89	4,564	3.88	3.04
P1-100	Est	B/C	5.16	4,827	4.10	3.22
P1-100	Har	B/C	5.16	4,827	4.10	3.22
P12-100	C	B/C	4.03	4,355	3.20	2.90
P12-100	Hyd	B/C	4.42	4,808	3.51	3.21
P12-100	Pred	B/C	4.62	5,026	3.66	3.35
P12-100	Est	B/C	4.88	5,314	3.87	3.54
P12-100	Har	B/C	4.88	5,314	3.87	3.54
P12-25	All	-25%	2.90	3,313	2.30	2.21
P12-100	All	-25%	3.67	3,940	2.91	2.63
P12-25	All	+25%	4.82	5,693	3.83	3.80
P12-100	All	+25%	6.09	6,592	4.83	4.39

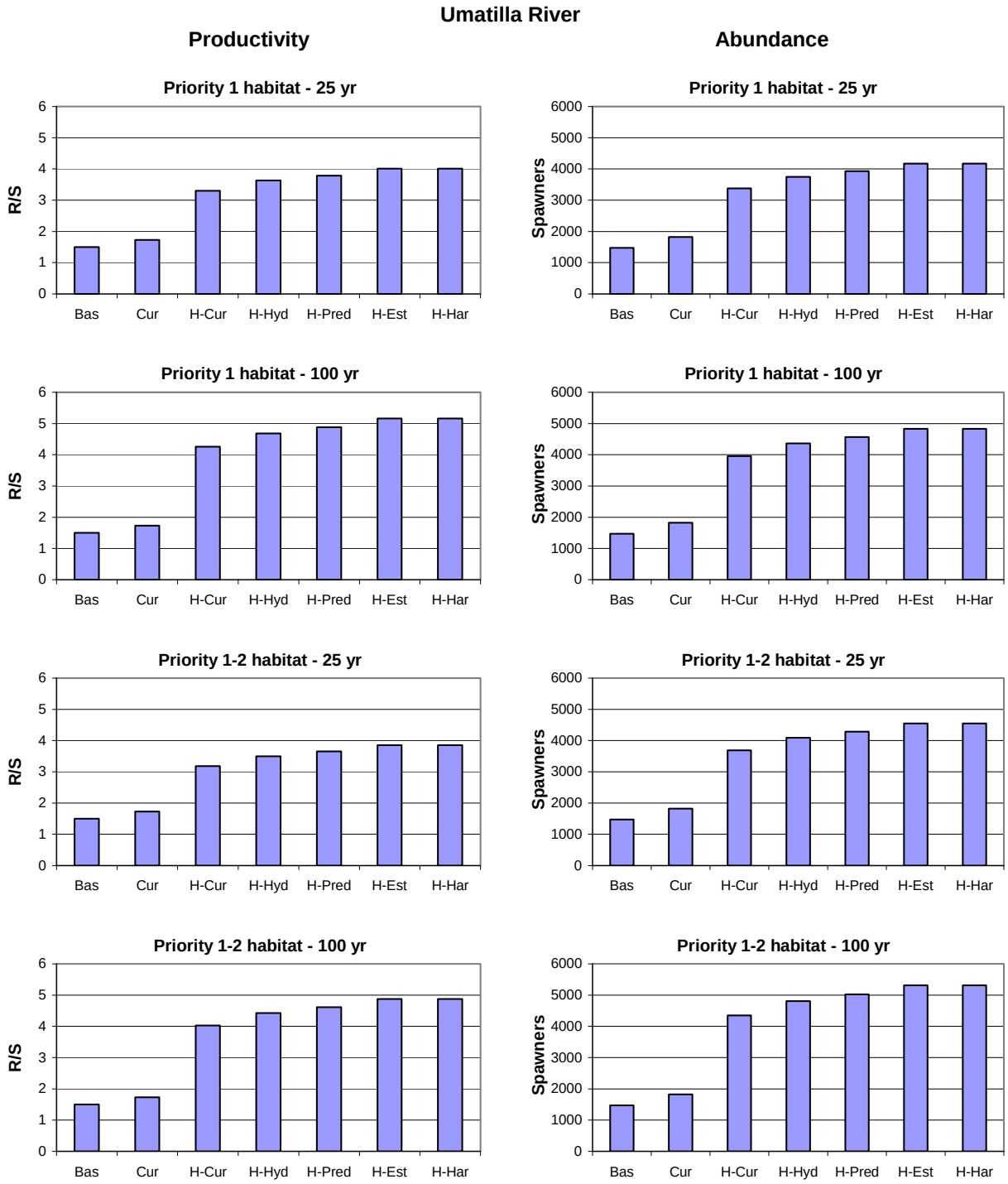

Figure 10-56. Estimated population performance measures (productivity and equilibrium abundance) of Umatilla River summer steelhead associated with combinations of tributary and out-of-subbasin actions. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. Baseline, current, and combinations of tributary habitat scenarios (shown as H) with out-of-subbasin factors (Hyd, Pred, Est, Har) are shown.

10.3.10 Walla Walla River Summer Steelhead, Projected Changes to Population Performance

We ran two sets of model runs for the Walla Walla River population. The first set included tributary habitat actions described in this plan, most of which were within the geographic boundaries of the state of Oregon. The second set of model runs included the tributary habitat actions identified in this plan, and in addition included the tributary habitat action scenarios modeled in the subbasin planning process within the boundaries of the state of Washington. For both sets of model runs, we used the out-of-subbasin survival improvements previously described in this section.

Action Effectiveness for Action Analysis Used in the Subbasin Plan
The approach used to model action effectiveness within the Washington Walla Walla subbasin planning process (carried forward into the Washington Walla Walla steelhead recovery plan) was less rigorous and less specific to actual proposed actions than the Oregon planning process.

Formulation of action strategies and effectiveness modeling in the subbasin planning process was done in three steps or components: working hypotheses, biological objectives, and strategies. Working hypotheses were the conclusions derived through the EDT diagnostic analysis about limiting factors. The second step was to establish restoration objectives for each of the limiting factors targeted for the analysis. These objectives were set for individual areas of the subbasin based on what the subbasin planning team assumed about what might be realistically attainable. For example, the percentage of pool habitat within a section of the mainstem river had been characterized to be 10% of the wetted surface area. The historical condition was hypothesized to be 20% of the wetted surface area. The biological objective for restoration in this case was set to be 20%. In other reaches, or for other habitat attributes, the objective was set to be intermediate between current condition and historical condition as it was hypothesized to exist. These biological objectives then prescribed a level of action effectiveness needed to achieve each objective, where the action represented whatever kinds of strategies might be employed to achieve the attribute specific objectives. Therefore, action effectiveness was not actually defined by the team, but became a by-product of first setting the objectives for targeted habitat attributes. Based on the targeted biological objectives that had been set, the subbasin planners then defined suites of strategies (or action types) that might be employed to achieve the objectives.

In contrast to ODFW's approach, the Walla Walla subbasin planning approach in 2004 only considered action effects at a 10-15 year time horizon. The action set for areas within Washington was comprised of the full suite of actions—including barrier removal (i.e., provisions for passage were made)—that were assembled for the subbasin plan. Because the Washington Walla Walla recovery plan only identified actions for a 10-15 year time horizon, we only modeled the response to actions for the 25 year timeframe and not for the 100 year timeframe.

Population performance as measured by both productivity and spawner abundance is increased markedly for all scenario combinations identified in this recovery plan, as well as, the aggregate actions of this plan and the Washington recovery plan. Relatively small differences exist between scenario results at 25 and 100 years. The largest contribution to performance

improvements is estimated to be due to tributary habitat actions. Benefits associated with mainstem actions are seen to be cumulative with the sequential addition of actions.

Viability thresholds are exceeded for all scenarios, including ones associated with a 25% decrease in marine survival. All scenario combinations result in threshold ratios between 1-3 for both productivity and abundance, suggesting a low risk of extinction over 100 years.

Table 10-46 and Figure 10-57 show projected changes in population performance of Walla Walla River summer steelhead populations associated with tributary and out-of-subbasin actions. Table 10-47 and Figure 10-58 show actions identified in this recovery plan. Projected changes in population performance of the Walla Walla River summer steelhead population associated with the tributary actions identified in this recovery plan and the Washington Walla Walla River steelhead recovery plan and out-of-subbasin actions.

Table 10-46. Estimated population performance (productivity and equilibrium abundance) of Walla Walla River summer steelhead associated with combinations of tributary and out-of-subbasin actions. See Table 10-36 for abbreviation definitions. The results represent tributary actions that are described in this recovery plan and do not represent actions described in the Washington Walla Walla recovery plan area. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. The threshold ratio is the ratio of the performance measure/ viability threshold level at the 5% level.

Scenario combination			Performance		Threshold ratio	
Tributary	Main/est	Ocean	Prod	Abund	Prod	Abund
B	B	B/C	1.34	650	0.99	0.65
B	C	B/C	1.60	864	1.18	0.86
P1-25	C	B/C	2.51	1,564	1.86	1.56
P1-25	Hyd	B/C	2.81	1,766	2.08	1.77
P1-25	Pred	B/C	2.94	1,844	2.18	1.84
P1-25	Est	B/C	3.10	1,946	2.30	1.95
P1-25	Har	B/C	3.10	1,946	2.30	1.95
P12-25	C	B/C	2.51	1,576	1.86	1.58
P12-25	Hyd	B/C	2.81	1,779	2.08	1.78
P12-25	Pred	B/C	2.94	1,859	2.18	1.86
P12-25	Est	B/C	3.11	1,961	2.30	1.96
P12-25	Har	B/C	3.11	1,961	2.30	1.96
P1-100	C	B/C	2.77	1,712	2.05	1.71
P1-100	Hyd	B/C	3.11	1,922	2.30	1.92
P1-100	Pred	B/C	3.24	2,004	2.40	2.00
P1-100	Est	B/C	3.43	2,110	2.54	2.11
P1-100	Har	B/C	3.43	2,110	2.54	2.11
P12-100	C	B/C	2.76	1,730	2.04	1.73
P12-100	Hyd	B/C	3.09	1,944	2.29	1.94
P12-100	Pred	B/C	3.23	2,027	2.39	2.03
P12-100	Est	B/C	3.41	2,136	2.53	2.14
P12-100	Har	B/C	3.41	2,136	2.53	2.14
P12-25	All	-25%	2.33	1,451	1.73	1.45
P12-100	All	-25%	2.56	1,599	1.90	1.60
P12-25	All	+25%	3.88	2,393	2.88	2.39
P12-100	All	+25%	4.27	2,590	3.16	2.59

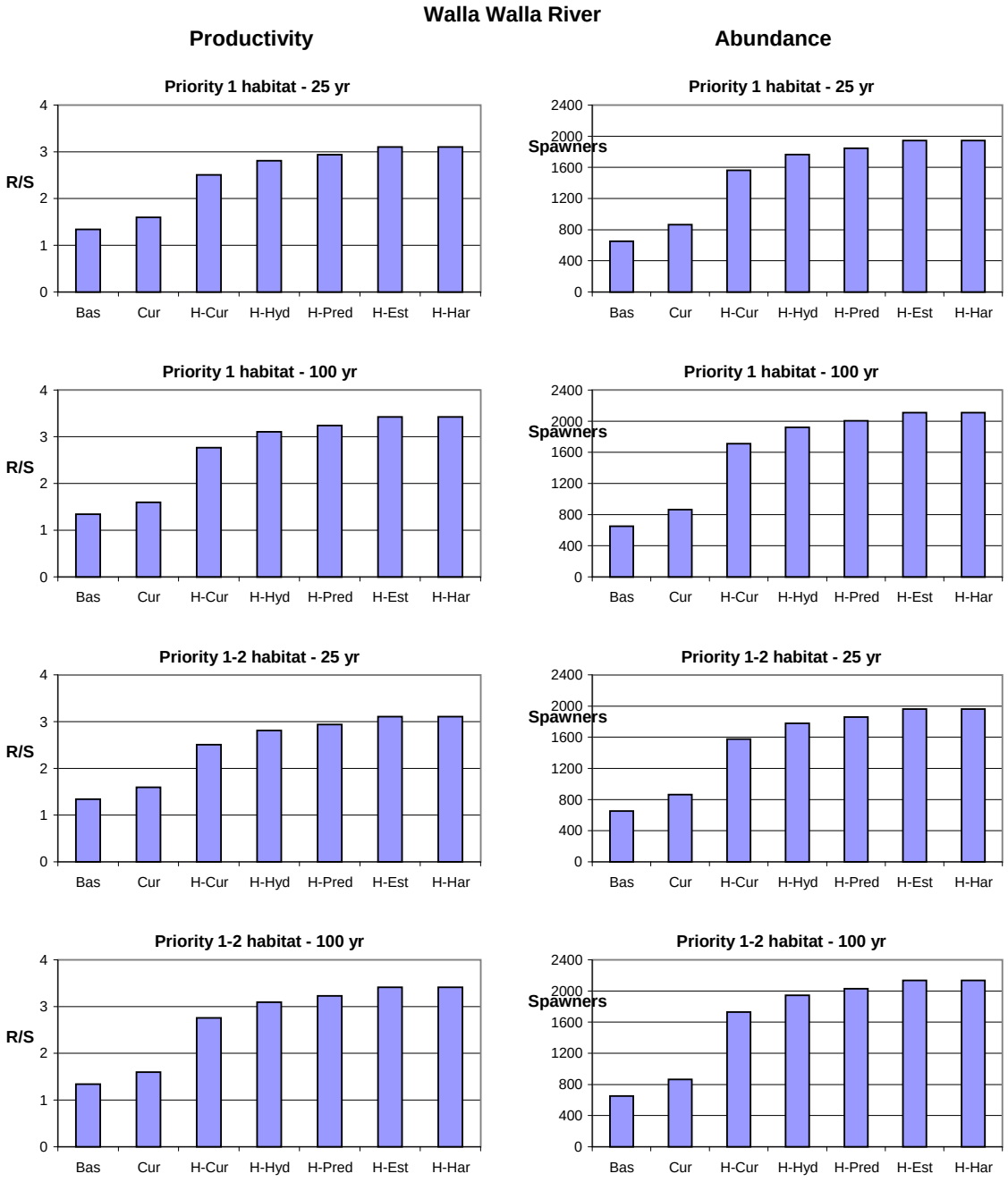

Figure 10-57. Estimated population performance measures (productivity and equilibrium abundance) of Walla Walla River summer steelhead associated with combinations of tributary actions identified in the Oregon recovery plan and out-of-subbasin actions. See Table 10-36 for abbreviation definitions. Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. Baseline, current, and combinations of tributary habitat scenarios (shown as H) with out-of-subbasin factors (Hyd, Pred, Est, Har) are shown.

Table 10-47. Estimated population performance (productivity and equilibrium abundance) of Walla Walla River summer steelhead associated with combinations of tributary and out-of-subbasin actions. Results are shown for actions performed on just Oregon lands (P12Ore) and with actions combined on Oregon and Washington lands (P12OreWa). Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. The threshold ratio is the ratio of the performance measure/ viability threshold level at the 5% level.

Scenario combination			Performance		Threshold ratio	
Tributary	Main/est	Ocean	Prod	Abund	Prod	Abund
B	B	B/C	1.34	650	0.99	0.65
B	C	B/C	1.60	864	1.18	0.86
P12Ore	C	B/C	2.51	1,576	1.86	1.58
P12OreWa	C	B/C	2.78	2,214	2.06	2.21
P12Ore	Hyd	B/C	2.81	1,779	2.08	1.78
P12OreWa	Hyd	B/C	3.12	2,515	2.31	2.52
P12Ore	Pred	B/C	2.94	1,858	2.18	1.86
P12OreWa	Pred	B/C	3.25	2,634	2.41	2.63
P12Ore	Est	B/C	3.11	1,961	2.30	1.96
P12OreWa	Est	B/C	3.44	2,790	2.55	2.79
P12Ore	Har	B/C	3.11	1,961	2.30	1.96
P12OreWa	Har	B/C	3.44	2,790	2.55	2.79
P12Ore	All	-25%	2.33	1,450	1.73	1.45
P12OreWa	All	-25%	2.58	2,033	1.91	2.03
P12Ore	All	+25%	3.88	2,392	2.88	2.39
P12OreWa	All	+25%	4.30	3,465	3.18	3.46

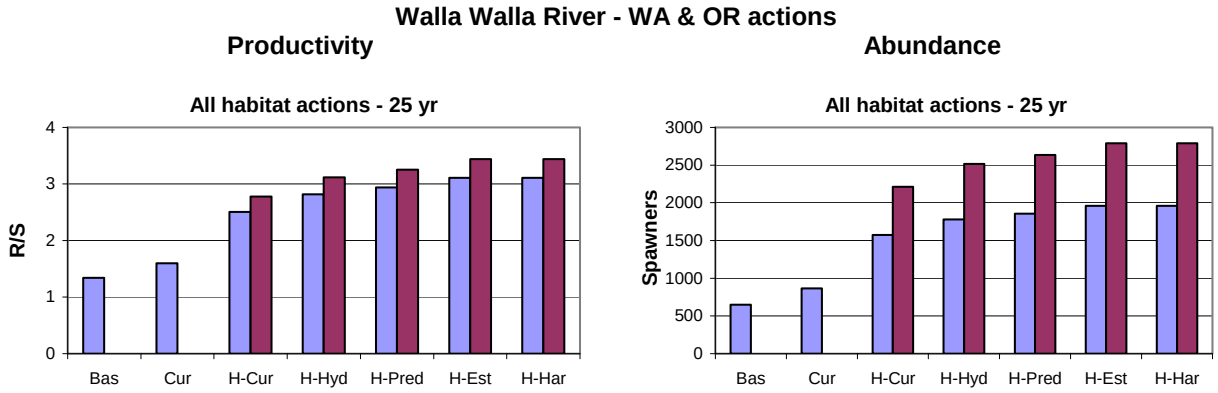

Figure 10-58. Estimated population performance measures (productivity and equilibrium abundance) of Walla Walla River summer steelhead associated with combinations of tributary and out-of-subbasin actions. Results are shown for actions performed on just Oregon lands (blue) and with actions combined on Oregon and Washington lands (red). Population performance measures are directly comparable to those derived empirically for baseline conditions by the ICTRT. Baseline, current, and combinations of tributary habitat scenarios (shown as H) with out-of-subbasin factors (Hyd, Pred, Est, Har) are shown.

10.4 All-H Management Action Effectiveness Analyses for Spatial Structure/Diversity

Fifteenmile Creek Population
There are no spatial structure or diversity gaps for the Fifteenmile Creek population. However, priority tributary habitat actions focus on restoring the natural hydrograph and reducing stream temperatures which are considered limiting factors. Improving these environmental conditions will allow for expansion of spawning distribution and expression of greater juvenile life history diversity, thus improving spatial structure and diversity status.

Deschutes River Eastside Population
Diversity is significantly impaired with gaps for phenotypic variation and spawner composition metrics. Reduced variability in both adult and juvenile migration patterns have likely occurred due to flow and temperature changes in Bakeoven, Buck Hollow, and Trout creeks, all of which are important production areas. Tributary habitat management actions target restoring the natural hydrograph and reducing stream temperatures. Restoring more normative flow patterns and reducing temperature will provide opportunity for more natural expression adult and juvenile migration patterns thus reducing risk ratings and improving viability.

Abundance of out-of-DPS stray hatchery spawners is a significant diversity impairment creating a high risk rating for the spawner composition metric. Management actions to reduce the abundance of stray hatchery spawners in this population include expansion of trapping and removal of hatchery fish in Trout Creek and initiation of trap and removal of stray hatchery fish in Bakeoven and Buck Hollow creeks. These actions are expected to significantly reduce the

proportion of spawners that are hatchery-origin fish in the population resulting in a lower risk rating for the spawner composition metric in the future.

Deschutes River Westside Population
The Deschutes River Westside population has gaps in both spatial structure and diversity. Spatial structure is significantly impaired because a substantial proportion of the spawning habitat is blocked by the Pelton-Round Butte Complex. This blockage results in spatial structure gaps for multiple metrics including spatial extent/range of spawning and increase in gaps between spawning aggregates. Management actions are underway to provide passage upstream and downstream at the dam complex and to reintroduce steelhead using Westside Deschutes stock to re-establish sustained natural production throughout the historic distribution. These actions, if successful, will result in reducing the risk ratings and improving viability.

Abundance of out-of-DPS stray hatchery spawners and genetic variation are significant diversity impairments. The high proportions of hatchery spawners results in a high risk rating for the spawner composition metric and genetic samples show moderate to low differentiation from outside-basin hatchery samples. Management actions to reduce abundance of out-of-basin hatchery spawners include continuation of trap and removal of strays at Warm Springs hatchery and initiation of trap and removal at Shitike Creek. These actions are expected to significantly reduce abundance of hatchery spawners and improve the diversity metric ratings in the future.

Lower Mainstem John Day River Population
Life history diversity, genetic variation and spawner composition are all metrics that have gaps for this population. Juvenile life history diversity has been reduced as a result of flow and temperature changes. Abundance of out-of-DPS spawners has resulted in a high risk rating for spawner composition. There are many tributary habitat actions that target restoring natural processes and improving both flow and temperature for the long term. These actions are expected to provide opportunity for expression of broader life history diversity. There are no specific actions proposed within this population to reduce abundance of out-of-DPS hatchery strays. However, we expect that if transportation of Snake River hatchery smolts is reduced in the future, and if some alternative broodstock are used for Snake River hatchery programs in the future, that the number of hatchery strays in this population will be reduced.

North Fork John Day River Population
The spatial structure/diversity gap for the North Fork population is spawner composition. Although there is a high degree of uncertainty associated with the proportion of hatchery spawners in this population this metric was rated high risk. No within-population actions are proposed to reduce out-of-basin hatchery stray abundance; however, reduced transportation of Snake River hatchery smolts and broodstock reform in Snake River hatchery programs may reduce abundance of strays in the future.

Middle Fork John Day River Population
All spatial structure/diversity metrics were rated low except spawner composition which was high risk due to abundance of out-of-DPS strays. No within-population management actions are proposed to reduce stray abundance. See the Lower Mainstem description of potential Snake River transportation and hatchery actions that may reduce strays.

South Fork John Day River Population
All spatial structure/diversity metrics were rated low except spawner composition which was high risk due to the proportion of out-of-DPS stray hatchery spawners. No within-population management actions are proposed to reduce the abundance of stray hatchery fish. See the Lower Mainstem description of potential Snake River transportation and hatchery actions that may reduce strays.

Upper Mainstem John Day River Population
Life history diversity and spawner composition are metrics that have gaps for this population. Juvenile movement patterns and reduced summer rearing distribution have likely resulted from altered tributary and mainstem habitats. There are many tributary habitat actions that target restoring natural processes with focus on reducing temperature, improving riparian condition, and increasing flow. These actions are expected to improve habitat conditions and result in opportunity for greater life history expression. The spawner composition metric was rated high risk due to abundance of out-of-DPS hatchery strays. No within-population management actions are proposed to reduce stray abundance. See the Lower Mainstem description of potential Snake River transportation and hatchery actions that may reduce strays.

Umatilla River Population
The Umatilla River population, along with the Walla Walla River population, has the greatest extent of spatial structure/diversity impairment of all Oregon's Mid-C populations. Both spatial structure and diversity have multiple metrics with substantial gaps. The current spawner distribution is significantly reduced from historical due to loss of spawning in Butter Creek and McKay Creek watersheds. Tributary habitat management actions in the Butter Creek watershed target improvement of passage, temperature and flow conditions which are the key limiting factors. These efforts, in the long term, will restore conditions and provide the potential for production in the future.

Four diversity metrics have gaps including life history, phenotypic variation, spawner composition and selective change in natural processes. Tributary management actions that target restoration of natural processes including reducing temperatures, improving the hydrograph, and improving riparian conditions will allow for broader expression of life history diversity including more normative adult and juvenile migration characteristics. These actions are expected to significantly reduce the diversity gaps. There are no Columbia River mainstem hydrosystem management actions proposed that will reduce the selectivity impacts of the hydrosystem.

Walla Walla River Population
The Walla Walla River population is one of Oregon's Mid-C populations with the greatest spatial structure/diversity impairments. Both spatial structure and diversity have multiple metrics with significant gaps. The current spawner distribution is reduced from the historic distribution due to loss of spawning in the Pine Creek watershed. Tributary management actions target restoration of natural processes and conditions, and actions within Pine Creek that focus on improving flow and water quality are considered high priority. Although, we expect that it will take a long time to restore Pine Creek to a condition that will allow sustained natural production. Restoration of sustained natural production in Pine Creek will significantly improve spatial structure with the population.

Four diversity metrics have gaps including life history, phenotypic variation, spawner composition and selective change in natural processes. Tributary habitat management actions target restoration of natural processes and include specific focus on the limiting factors causing diversity impairments. Actions focus on improving temperature, restoring natural hydrograph, and improving passage. These actions, although they will take a long time, will improve conditions and allow for more natural expression of life history diversity and phenotypic traits, such as adult and juvenile migration characteristics. There are no Columbia River mainstem hydrosystem management actions proposed that will reduce the selectivity impacts of the hydrosystem.

Section 11 Time and Cost Estimates

The ESA section 4(f)(1) requires that recovery plans include "estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal" (16 U.S.C. 1531-1544, as amended). This section and Appendix I are intended to meet this ESA requirement, and will be used by NMFS to estimate the total recovery costs for the Mid-Columbia steelhead DPS in its draft Mid-Columbia Steelhead DPS Plan.

11.1 Cost Estimates

The Oregon Department of Fish and Wildlife, together with its Recovery Planning Team, Management Action Teams, and the Oregon Mid-Columbia River Sounding Board have developed an extensive list of projects needed to recover the Oregon populations in the Mid-Columbia steelhead DPS. These projects are intended to address the recovery of ESA-listed Mid-Columbia River steelhead. This project list was developed using the most up-to-date assessment of Mid-Columbia steelhead recovery needs, without consideration of cost or potential funding. This section summarizes cost estimate findings and Appendix I provides cost estimates for recovery projects where available information was sufficient to do so. These draft cost estimates were prepared by a NMFS economist at the Northwest Fisheries Science Center in Seattle using a regional recovery cost database, together with input and review from ODFW, regional experts, and the Mid-Columbia Sounding Board in 2007.

Cost estimates for proposed recovery projects were developed using the unit cost method described in Appendix I. This involved: (1) grouping proposed recovery actions in Section 9 by project type; (2) determining the scale for each action; (3) developing unit costs for each project type and then calculating the total cost estimate for each project; and (4) the resulting total cost estimate by project was multiplied by 1.6 to reflect the additional costs of project planning, coordination, engineering, permits and other administrative needs. The multiplier was estimated after consulting with ODFW and other parties experienced in habitat restoration project implementation.

Table 11-1, Recovery Costs Summary Table, summarizes the total estimated cost for each strategy by population. The estimates are based on cost estimates in Appendix I, Table I-1 (*All Actions by Population, Strategy and Category*) that summarizes estimated total costs that can currently be identified for recovery actions in each Oregon population and strategy. No cost estimates are provided for (1) baseline actions (programs that are already in existence and would occur regardless of this recovery plan, or voluntary actions) that are listed as Not Applicable (N/A); and (2) for actions that need costs to be developed, need unit costs, and/or need project scale estimates, which are listed as To Be Determined (TBD). ODFW will work with regional experts to identify costs, scale or unit costs for actions that need more information during the public comment period. Appendix I will be updated with this new information for the final recovery plan.

The total estimated costs shown in Table 11-1 are by strategy and are either the Priority 1 and 2 estimated total stream mile costs or the estimated project costs in Appendix I, Table I-1. There are several cautions that must be highlighted regarding these summary costs, because many of these estimates may be incomplete until actions are better defined. For example, costs for potentially expensive projects such as land and water acquisition, water leasing, and RM&E have not yet been estimated for many populations. For other projects, unit cost estimates or determination of project scale may also still need to be calculated. Therefore, Table 11-1 presents preliminary summary costs, which will increase when unit cost estimates, scale of projects, and costs for actions are determined, for recovery of these populations.

The estimated total recovery costs in Table 11-1 range widely from relatively less expensive fish passage projects to more expensive projects such as restoring stream channel structure and complexity. The Lower John Day ($116,192,806) and Deschutes River Westside ($114,110,501) populations have the most expensive estimated total project costs, while the South Fork John Day ($8,656,103) and Fifteenmile ($28,358,906) populations have the smallest total costs. These total cost differences may be due to many factors such as size of the population's watershed, extent to which current conditions need to be improved, scale of projects, number of projects identified, and the availability of recovery action cost information by population at this time. The overall total cost estimate for all proposed actions where costs are available for all populations is $512,843,328.

Table 11-1. Recovery Costs Summary Table.

Population and Strategy	Total Estimated Cost
Fifteenmile Creek Population	
1. Protect and conserve natural ecological processes.	$176,000
2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.	$480,000
3. Maintain and restore floodplain connectivity and function.	$7,760,314
4. Restore degraded and maintain properly functioning channel structure and complexity.	$17,090,583
5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions	$2,852,009
6. Restore natural hydrograph to provide sufficient flow during critical periods.	
7. Improve degraded water quality and maintain unimpaired water quality.	
8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.	
Fifteenmile Total	**$28,358,906**
Totals do not include actions with potentially significant costs to be determined later, including habitat acquisition, water right purchases, Orchard Ridge and Wolf Run diversion piping, and upland vegetation management.	
Deschutes River Eastside Population	
1. Protect and conserve natural ecological processes.	$176,000
2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.	$160,000
3. Maintain and restore floodplain connectivity and function.	$17,795,520
4. Restore degraded and maintain properly functioning channel structure and complexity.	$18,539,341
5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.	$7,046,854
6. Restore natural hydrograph to provide sufficient flow during critical periods.	$197,702
7. Improve degraded water quality and maintain unimpaired water quality.	

Population and Strategy	Total Estimated Cost
8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.	
Deschutes River Eastside Total	**$43,915,417**
Totals do not include actions with potentially significant costs to be determined later, including habitat acquisition, water right purchases, and upland vegetation management.	
Deschutes River Westside Population	
1. Protect and conserve natural ecological processes.	$176,000
2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.	
3. Maintain and restore floodplain connectivity and function.	$50,499,360
4. Restore degraded and maintain properly functioning channel structure and complexity.	$52,808,352
5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.	$10,626,789
6. Restore natural hydrograph to provide sufficient flow during critical periods.	
7. Improve degraded water quality and maintain unimpaired water quality.	
8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.	
Deschutes River Westside Total	**$114,110,501**
Totals do not include actions with potentially significant costs to be determined later, including habitat acquisition, water right purchases, and forest road upgrading/removal.	
Lower Mainstem John Day River Population	
1. Protect and conserve natural ecological processes.	$176,000
2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers.	$7,600,000
3. Maintain and restore floodplain connectivity and function and maintain unimpaired conditions.	$42,164,092
4. Restore degraded and maintain properly functioning channel structure and complexity.	$44,623,665
5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.	$17,121,854
6. Restore natural hydrograph to provide sufficient flow during critical periods.	
7. Improve degraded water quality and maintain unimpaired water quality.	$4,507,195
8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.	
Lower Mainstem John Day Total	**$116,192,806**
Totals do not include actions with potentially significant costs to be determined later, including habitat acquisition, water right purchases, push up dam removals, grazing management, and forest road upgrading/removal.	
North Fork John Day River Population	
1. Protect and conserve natural ecological processes.	$176,000
2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.	$16,120,000
3. Maintain and restore floodplain connectivity and function.	$6,728,300
4. Restore degraded and maintain properly functioning channel structure and complexity.	$6,288,402
5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.	$3,116,517
6. Restore natural hydrograph to provide sufficient flow during critical periods.	
7. Improve degraded water quality and maintain unimpaired water quality.	$1,704,357
8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.	$707,200

Population and Strategy	Total Estimated Cost
North Fork John Day Total	**$34,840,776**
Totals do not include actions with potentially significant costs to be determined later, including habitat acquisition, water right purchases, push up dam removal, and mine discharge management.	
Middle Fork John Day River Population	
1. Protect and conserve natural ecological processes.	$176,000
2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.	$18,880,000
3. Maintain and restore floodplain connectivity and function.	$12,034,700
4. Restore degraded and maintain properly functioning channel structure and complexity.	$11,847,511
5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.	$5,262,030
6. Restore natural hydrograph to provide sufficient flow during critical periods.	
7. Improve degraded water quality and maintain unimpaired water quality.	$1,489,614
8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.	$1,060,800
Middle Fork John Day Total	**$50,750,655**
Totals do not include actions with potentially significant costs to be determined later, including habitat acquisition, water right purchases, and push up dam removal.	
South Fork John Day River Population	
1. Protect and conserve natural ecological processes.	$176,000
2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.	$5,680,000
3. Maintain and restore floodplain connectivity and function.	$551,660
4. Restore degraded and maintain properly functioning channel structure and complexity.	$481,353
5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions	$1,234,920
6. Restore natural hydrograph to provide sufficient flow during critical periods.	
7. Improve degraded water quality and maintain unimpaired water quality.	$532,170
8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.	
South Fork John Day Total	$8,656,103
Totals do not include actions with potentially significant costs to be determined later, including habitat acquisition, water right purchases, push up dam removal, and forest road upgrading/removal.	
Upper Mainstem John Day River Population	
1. Protect and conserve natural ecological processes.	$176,000
2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.	$12,240,000
3. Maintain and restore floodplain connectivity and function.	$11,891,318
4. Restore degraded and maintain properly functioning channel structure and complexity.	$15,855,724
5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.	$5,731,272
6. Restore natural hydrograph to provide sufficient flow during critical periods.	
7. Improve degraded water quality and maintain unimpaired water quality.	$2,324,475
8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.	$104,000
Upper Mainstem John Day Total	**$48,322,789**
Totals do not include actions with potentially significant costs to be determined later, including habitat acquisition, water right purchases, and push up dam removal.	
Umatilla River Population	
1. Protect and conserve natural ecological processes.	$176,000

Population and Strategy	Total Estimated Cost
2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.	$5,280,000
3. Maintain and restore floodplain connectivity and function.	$11,191,348
4. Restore degraded and maintain properly functioning channel structure and complexity.	$12,176,285
5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.	$5,855,134
6. Restore natural hydrograph to provide sufficient flow during critical periods.	
7. Improve degraded water quality and maintain unimpaired water quality.	
8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.	
Umatilla Total	**$34,678,767**
Totals do not include actions with potentially significant costs to be determined later, including habitat acquisition, water right purchases, point source water pollution management, the Umatilla Basin Project, and forest road upgrading/removal.	
Walla Walla River Population	
1. Protect and conserve natural ecological processes.	$176,000
2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.	$3,520,000
3. Maintain and restore floodplain connectivity and function.	$9,786,240
4. Restore degraded and maintain properly functioning channel structure and complexity.	$14,696,304
5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.	$4,838,064
6. Restore natural hydrograph to provide sufficient flow during critical periods.	
7. Improve degraded water quality and maintain unimpaired water quality.	
8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.	
Walla Walla Total	**$33,016,608**
Totals do not include actions with potentially significant costs to be determined later, including habitat acquisition, water right purchases, point source water pollution management, and forest road upgrading/removal.	
Grand Total	**$512,843,328**

Information on current expenditures and expected five-year budget amounts for habitat projects by a wide range of local, state, federal agencies and non-governmental organizations (NGOs) is provided in Appendix I, Table I-2 (*Current Average Expenditures on Habitat Projects for Mid-Columbia River Steelhead*). This table provides context for the estimated costs of recovery actions and provides a basis for estimating possible levels of funding for recovery plan implementation over a given period of time. Total expected average expenditures over the next five years vary by population. For example, the Fifteenmile Creek population had the lowest expected total five-year expenditure ($3,550,000), while the Lower Mainstem John Day River population had the highest expected total five-year expenditure ($15,095,000). The total expected five-year expenditures for all populations is $103,537,000.

11.2 Time Estimate

NMFS estimates that recovery of the Mid-Columbia steelhead DPS, like recovery for most of the ESA-listed Pacific Northwest salmon and steelhead, could take 50 to 100 years. While this

recovery plan contains an extensive list of actions that need to be undertaken to recover Oregon's Mid-Columbia steelhead populations, there are many uncertainties involved in predicting the course of recovery and in estimating total costs. These include uncertainties regarding biological and ecosystem responses to recovery actions, as well as uncertainties regarding long-term and future funding. While continued programmatic actions in the management of habitat, hatcheries, hydro and harvest will warrant additional expenditures beyond the first 10 years, Oregon believes it is impracticable to estimate all projected actions and costs over 50 to 100 years, given the large number of economic, biological, and social variables involved. NMFS has a policy recommendation to focus on the first 10 years of implementation, with the proviso that before the end of this first implementation period, specific actions and costs will be estimated for subsequent years, to achieve long-term goals and to proceed until a determination is made that listing is no longer necessary.

Given the uncertainties in developing recovery cost estimates described above, Oregon is not able to estimate total or 10-year costs to recover Oregon's populations in the Mid-Columbia steelhead DPS. Table I-2, however, provides current average expenditures on habitat projects expected expenditures during the next five years. These projected five-year habitat project expenditures in Table I-2 total approximately $102 million.

In early 2008, Oregon will develop a plan for recovery project implementation, which will include project cost estimates, and identify how recovery plan implementation will be coordinated. This process is already underway as the Sounding Board discusses its future role in recovery plan implementation. Recovery costs will be revised in the future as specific project budgets are completed. The implementation plan will identify what entity or individual will carry out the recovery actions and the timeline for implementation.

Section 12 Implementation and Adaptive Management

12.1 Implementation

The successful implementation of the Oregon Mid-Columbia steelhead recovery plan recovery actions, research, monitoring and evaluation, and adaptive management process will require significant funds and the coordinated work of ODFW, State agencies, tribes, counties, irrigation districts, agriculture and private forest land managers, NMFS, U.S. Forest Service, BLM, other Federal agencies, local residents, citizen groups, utilities, other agencies, and individuals. ODFW, in coordination with the Oregon Governor's Office and NMFS, has taken the lead in developing this recovery plan; all will continue to be instrumental in its implementation. This section describes the overall framework for coordinated and cohesive implementation of the plan, including tracking, monitoring and reporting, as well as implementation of an adaptive management process.

The recovery plan identifies recovery strategies and actions using the best available science to address limiting factors and threats and recover Mid-C steelhead in Oregon. The NMFS interim recovery planning guidance (NMFS 1996) acknowledges that recovery plans are not regulatory documents, and that it is not a requirement of the ESA for any entity to implement the recovery strategy or specific actions in a recovery plan unless otherwise legally mandated. Consequently, this recovery plan is based primarily on voluntary implementation of proposed recovery actions as well as existing laws, regulations and agreements.

Many of the organizations which are currently implementing, and will implement recovery actions in the future, are not obligated to participate. The identification of an entity in the recovery actions does not necessarily require the identified party to implement the action(s) or to secure funding for implementing the action(s). It is anticipated that these organizations will choose to participate to advance their missions, as part of funding and contractual agreements, and in response to public education and outreach. In fact, there are many examples of voluntary recovery actions already being taken that support steelhead recovery. It is also acknowledged that there may be alternative actions to those proposed in this plan that may also attain recovery strategies. Actions to achieve a specific recovery strategy may vary due to logistics, funding constraints, or an organization's authorities and administrative processes.

Because of this large reliance on voluntary implementation of actions, public outreach and education will be a critical component of engaging citizens and communities to contribute to species recovery needs. Outreach and education will be conducted at all levels within the implementation framework, but will be most important at the local implementation level, specifically with watershed councils and soil and water conservation districts. Recovery plan outreach will be coordinated with outreach efforts under the Oregon Plan for Salmon and Watersheds. The public will also be invited to participate in meetings associated with recovery plan implementation. Without public interest, engagement and stewardship, the goals of this plan will not be achieved.

Oregon's recovery plan implementation framework is intended to provide a collaborative approach to implementation, science guidance and policy direction, as well as facilitate information exchange and coordination from local-level action entities to upper level decision makers and provide linkage to state, DPS and regional forums. Existing forums, groups, partnerships and involved citizens make this implementation structure possible, but additional resources and funding will be needed to make it work effectively and successfully. The basic components of Oregon's implementation framework include a Recovery Team, an Implementation Coordinator, an Implementation Team, a Technical Team, and Watershed Teams (Figure 12.1). These teams will interface with and potentially strengthen the various state agency teams associated with the Oregon Plan for Salmon and Watersheds that provide for policy, management, and monitoring of interagency Oregon Plan programs for the conservation and restoration of habitat, water quality, and salmon (http://www.oregon.gov/OPSW/). In addition, these teams will function to coordinate within the DPS implementation and adaptive management framework (Figure 12.2). The implementation framework will adapt and change as necessary to adjust to funding, available resources, and implementation needs. The roles of each of these implementation teams and the coordinator are described below.

Recovery Team: The Recovery Team provides oversight and vision to recovery plan implementation, in a similar role as the Mid-C Sounding Board served in the plan development process. This team is the responsible entity for reporting to NMFS and shares accountability for species recovery in this MU. The Recovery Team coordinates at state, federal and regional levels; makes decisions and acts on policy, funding and legislative needs; provides overall guidance to the recovery plan teams and coordinates with other domain teams and the Oregon Plan Core Team (interagency policy forum); and serves as the state's representative at the bi-state Mid-C Forum. Members of this team include representatives from the Oregon Governor's Natural Resources Office, ODFW (including the Implementation Coordinator), and the Oregon Watershed Enhancement Board. Additional membership will include interested parties from counties, tribes and federal agencies. While the Recovery Team serves a unique purpose and function, members of this Team will also be members of the Implementation Team.

Implementation Coordinator: An ODFW implementation coordinator will serve as Oregon's "MU lead" for recovery plan implementation, under the advice and guidance of the Recovery Team. The Coordinator will be a key connector to the various teams, groups, subgroups and individual entities. The Implementation Coordinator will work in conjunction with the Implementation Team and Watershed Teams to plan, schedule, track and report on action implementation, and in coordination with the Technical Team to develop, track and report on RM&E activities. The Implementation Coordinator will also be a member of the Recovery Team and a participant in the DPS Implementation and Outreach subgroups. If necessary, the Coordinator will communicate with local, state, federal or tribal hatcheries and other entities and agency staff that perform work related to anadromous fish in the MU. The Implementation Coordinator will lead the Implementation Team in its deliberations and actions, coordinate and lead annual implementation plan development and adaptive management processes, coordinate and communicate with Watershed Teams (or individual implementation entities) and the Oregon Plan Regional Management Teams (interagency regional manager forum). This MU lead will also integrate with regional forums for hydro, harvest and hatchery issues, including the FCRPS BiOp, US v OR, Northwest Planning and Conservation Council, and Columbia Basin Fish and

Wildlife Authority, through linkage with ODFW staff representatives in these forums. Actions and decisions within these forums are important for achieving successful plan implementation and recovery of Mid-C steelhead.

Implementation Team: The Implementation Team provides advice, recommendations and support to the Implementation Coordinator (chair). This Team assists in the communication and coordination with Watershed Teams or local implementation groups, development, tracking and reporting of annual implementation plans, and tracking and reporting of research and monitoring. The Implementation Team also facilitates gathering and exchange of information, identifies and pursues funding sources, and provides for public participation, education and outreach.

Team Members include members of the Mid-C Sounding Board (irrigation districts, utilities, conservation groups, federal and tribal representatives, watershed councils, SWCDs) and other local stakeholders, interest groups and governments. This diverse group represents differing perspectives, missions, and geographic areas, with the overall objective of collectively and synergistically working together to achieve and advance recovery plan goals. The Implementation Team will be staffed by a facilitator and a NMFS representative.

Technical Team: The Technical Team provides advice and guidance on technical and science issues related to monitoring, research and evaluation, data analysis, and adaptive management that supports and strengthens effective implementation of recovery plan actions. The Team will provide the framework for data and dataset gathering from diverse sources and the data management and analysis necessary for threats and viability assessments of the MPG populations. The Oregon Plan Monitoring Team (interagency monitoring forum) will interface with the Technical Team. The Technical Team will be an important MU link to the Mid-C Forum RM&E subgroup, participating in DPS status reviews and ensuring consistency in monitoring. A member of the Technical Team will serve on the Implementation Team. Members of the Technical Team will include members of the recovery plan Planning Team and Expert Panel, as well as other key state, federal, tribal, utility and private scientists and biologists, consultants, and university staff. A voluntary chair will facilitate team operations until funding can be obtained to provide remuneration.

Watershed Teams: Watershed Teams are comprised of the various local entities implementing local restoration and conservation actions via their respective authorities, mandates, missions, and work plans, and include watershed councils, SWCDs, federal and state agencies, local governments, tribes, conservation groups, and utilities. Watershed Teams will be encouraged and facilitated to form on a voluntary basis for a specific watershed, or will be collaborative partnership forums already in existence. In many cases, watershed councils currently serve this function with representation from a diversity of interest and action groups. Team chairs will be voluntary and teams will be self-directed. Collaborative teams will facilitate coordination and prioritization of actions and exchange of information within the watershed. They will provide project information to the Implementation Coordinator (or members of the Implementation Team) to support development of annual implementation schedules, plans, and reports. Collectively or individually, Watershed Teams will promote public involvement through outreach, education, and volunteer opportunities.

The Watershed Teams represent the Major Population Groups in the Oregon Mid-C MU, to include the Cascade Eastern Slopes MPG, the John Day MPG, and the Umatilla/Walla Walla MPG. However, each MPG will include two or more teams representing various populations in the MPG.

Cascade Eastern Slopes MPG: Deschutes Westside (to include Fifteenmile Creek) and Deschutes Eastside populations
John Day MPG: Lower Mainstem, North Fork, Middle Fork, South Fork, and Upper Mainstem John Day populations.
Umatilla/Walla Walla MPG: Umatilla and Walla Walla populations.

If Watershed Teams are not formed, the Implementation Coordinator and members of the Implementation Team will work with individual action entities in the watershed, as necessary.

Oregon will participate in the newly formed bi-state steelhead DPS-level Mid-Columbia Forum to ensure Oregon steelhead implementation activities are coordinated with recovery work in the other steelhead DPS management units in Washington, which are coordinated by local recovery boards (i.e., Yakima and Snake River). Oregon's Recovery Team (through its leads) and Washington's recovery boards (through their executive directors or leads) will be responsible for reporting progress to the Mid-Columbia Forum and NMFS on an annual basis, including progress in management, conservation, and research, monitoring and evaluation actions, and trends in habitat health and salmonid viability.

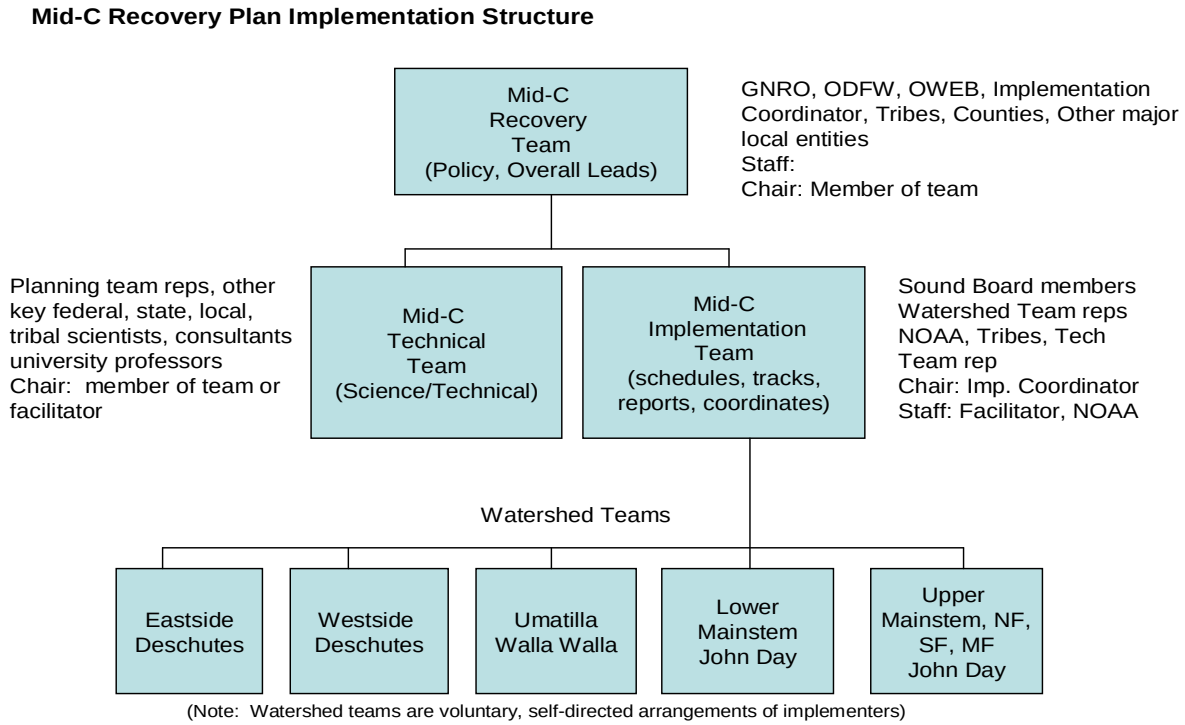

Figure 12.1. Implementation and adaptive management organizational chart for Oregon's Mid-C Steelhead Recovery Plan.

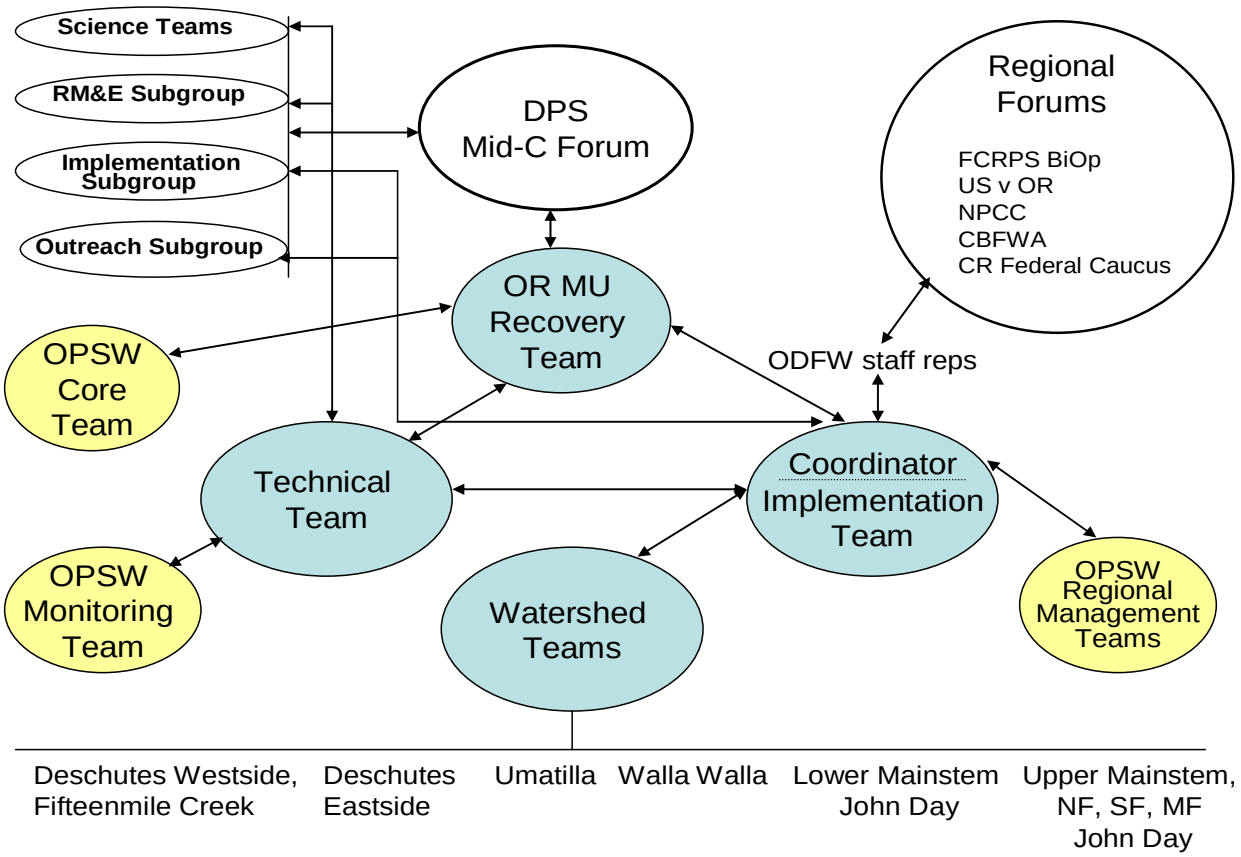

Figure 12.2. Implementation and adaptive management organizational chart for the Mid-C DPS Steelhead Recovery Plan including the Oregon components.

Oregon and NOAA will produce an implementation plan with a schedule to satisfy the requirement under the ESA. The detailed implementation plan will serve as the guidance document that describes the time-specific implementation of actions for all programs. The implementation plan will serve as the benchmark of expected milestones that allows for tracking of progress in recovery plan action implementation.

An ESA implementation plan identifies the following:

- recovery actions,
- priority for completing the actions,
- timeline and duration for completion of the actions,
- lead agency/entity to implement each action, and
- estimated cost for each action over a specified period of time.

Many of the elements of the detailed implementation plan are already covered in this recovery plan including actions, priorities, and program responsibility. The principle element that is missing is the program by program description of actions that will be completed on an annual basis. A detailed implementation schedule and plan will be completed in 2009 after Oregon and NMFS have refined and finalized the proposed recovery actions and recovery costs based on

public comments and the recovery plan is adopted in 2009. In developing this implementation plan, Oregon and NMFS will work with Oregon's Implementation Team, and in close association with the Oregon Plan Regional Management Teams (Central Regional Management Team and Eastern Regional Management Team), to identify who is responsible for carrying out recovery actions and when. Federal agencies will also need to identify how they will be involved in recovery plan implementation.

12.2 Adaptive Management

Mid-C steelhead have a complex life cycle that traverses habitats from high elevation tributaries to the open ocean. Life history strategies and life stage specific habitat requirements are complex. There are many limiting factors and threats that influence the viability of Oregon's Mid-C steelhead at all life stages. The suite of proposed management actions to address primary limiting factors and threats across the entire life cycle is extensive and diverse. Although the limiting factors and threats, as well as the management actions, have been developed based on the best available science, there remains considerable uncertainty regarding the outcomes and effectiveness of the proposed management actions as well as the status of the populations. It is this uncertainty which generates the essential need for an effective adaptive management process.

A successful adaptive management process requires that we understand how and why steelhead and their associated habitats respond to the management actions we take to address key limiting factors and threats. In addition, success requires a decision framework and process which considers new information in the development and implementation of future management actions.

One of the great challenges facing the development and implementation of an effective adaptive management strategy for Oregon's Mid-C steelhead is the extensive number of organizations that implement management actions, as well as the complexity in jurisdictional and management decision authority. There are many different organizations including state agencies, tribes, counties, irrigation districts, agriculture and private forest land managers, NOAA, U.S. Forest Service, BLM, other federal agencies, local residents, citizen groups, utilities and others that implement management actions.

Along with this implementation complexity is a parallel level of jurisdictional, management decision authority, and process complexity. There is no one single decision body that holds decision authority for management actions across all the H's. Decision authority for management actions resides across many entities including state, tribal, federal, county as well as others. Those diverse decision frameworks and processes, many independent of others, create coordination and collaboration challenges. We acknowledge that it is unreasonable to expect centralization and integration of all authorities and decision processes into a single decision framework. Our approach is to develop a collaboration and coordination process that uses the implementation structures and allows for sharing of information and decisions that influence recovery of Mid-C steelhead.

Integration of the many adaptive decision processes will occur within the adaptive management framework illustrated in Figure 12.1. The Recovery Team and the Implementation Team will serve key roles in incorporating new knowledge into future management guidance and direction. These teams will not only provide input for adaptive implementation of tributary habitat actions, they will also provide input into other regional decision forums through the Mid-C Forum and State of Oregon representatives.

In the following text, we provide a description of the various management decision processes and associated adaptive management plans that influence management actions for tributary habitat, mainstem hydrosystem, harvest and hatcheries.

12.2.1 Tributary Habitat

There is a variety of funding sources and implementing entities responsible for tributary habitat restoration actions. In all cases the funding sources and implementing entities have adaptive decision processes for prioritizing actions. It is beyond the scope of this document to present all of the processes used, thus, we provide a few examples illustrating the major ongoing decision processes, followed by a description of how the recovery plan adaptive management framework will address adaptive management for tributary habitat protection and restoration.

The Oregon Watershed Enhancement Board (OWEB) is a state agency that supports Oregon's efforts to improve water quality, strengthen ecosystems and restore salmon runs. OWEB coordinates the Oregon Plan for Salmon and Watersheds, which is an essential element of tributary habitat restoration for the recovery plan. OWEB administers grant funding programs from Oregon lottery proceeds and from federal Pacific Coastal Salmon Recovery Funds (PCSRF). These grant programs fund cooperative salmon habitat restoration for a wide variety of implementers. OWEB's strategic plan describes how the board will achieve watershed restoration. OWEB focuses on projects that approach natural resource management with a whole-watershed perspective through investments and partnerships. Priority watershed concerns addressed by grants include:

- Instream Process and Function
- Fish Passage
- Urban Impact Reduction
- Riparian Process and Function
- Wetland Process and Function
- Upland Process and Function
- Water Quantity/Irrigation Efficiency
- Road Impact Reduction

An essential element of the OWEB strategy is active implementation of adaptive management. Adaptive management is implemented in a variety of ways through strategic guidance, project review, selection and prioritization processes and emphasis on monitoring and evaluation. Review team members score and discuss applications to determine which projects to recommend for funding.

Monitoring information from the complement of different types of project monitoring efforts (e.g., baseline, compliance, status and trend, effectiveness, and validation monitoring) and the cooperative interagency Monitoring Team is used to help measure project progress and effectiveness. Oregon is able to document watershed conditions, track changes in critical habitat and species over time, and evaluate the effectiveness of conservation and restoration efforts. This diversity of monitoring approaches is essential to understanding watershed health, tracking the success of projects, and setting restoration priorities.

As a critical element in the grant funding process, the OWEB Board is kept apprised of new and emerging issues in the natural resources arena to help guide their decisions. As an example, the Board has received many presentations on climate change and its potential impacts to watersheds and salmon. This information helps to shape the decision framework within which the Board operates and its final recommendations. The OWEB Board has provided general recommendations as guidance for grant funding and overall action implementation in the watershed to strengthen the Oregon Plan for Salmon and Watersheds:

- Promote citizen involvement in the Oregon Plan
- Build creative partnerships to focus on significant ecological outcomes
- Streamline and expedite permitting for restoration projects
- Support strong leadership, interagency communication, and coordination
- Develop and implement shared priorities for restoration
- Track restoration and recovery trends and improve information accessibility
- Develop a coordinated strategy that demonstrates ways habitat restoration actions reduce the growing risk of climate change

The Northwest Power and Conservation Council's Columbia Basin Fish and Wildlife Program provides extensive funding to many habitat protection and restoration implementers in all of Oregon's Mid-C steelhead populations. The Fish and Wildlife Program was established to mitigate the effects of the Columbia River federal power system. On a periodic basis (typically every three years), the NPCC solicits and evaluates proposals for on-the-ground monitoring and evaluation projects to meet the goals and objectives of the program. Proposed projects undergo a rigorous scientific review and revision process to ensure implementation of sound and effective high priority projects that are based on best available science and use state-of-the-art restoration strategies and approaches. Integral to this process is the review of each individual proposal by the Independent Science Review Panel (ISRP). Each project is evaluated, in part, based on the project's role in contributing to an effective adaptive management process. The review process has resulted in significant changes through time in implementation strategies and actions for most habitat restoration projects.

SWCDs, Watershed Councils, and other habitat restoration implementation entities all have prioritization and adaptive change processes that are used in deciding which projects to implement. New monitoring and evaluation information is used within each of these decision frameworks to decide on priority actions, geographic locations, and specific applications. Within these processes the consideration of high priority recovery actions is important.

Although OWEB, NPCC, SWCDs, tribes, states, NGOs and others have prioritization processes and elements of adaptive management, there is a clear need for a more integrated and coordinated adaptive management approach for tributary habitat restoration. Previously in this section we described an implementation and adaptive management framework for this recovery plan. We do not envision this new framework and process to replace the other processes that are currently used, but rather a mechanism to improve collaboration, coordination and sharing of essential information for decision making. Under the guidance of the Recovery Team and the Implementation Team, the Technical Team and Implementation Coordinator will function as the core for tributary habitat adaptive management. New information, including successes and failures, will be shared throughout the framework from the watershed and technical teams upwards to the Recovery Team to allow for better decisions regarding priority actions, geographic focus areas, and application techniques. The Oregon Plan Regional Management teams play an important role in this adaptive process as they hold responsibility for managing the implementation and prioritization of many critical restoration actions.

12.2.2 Mainstem Hydrosystem

Implementation Plans and Reporting Requirements
The FCRPS BiOp requires the federal Action Agencies to continue collaboration with states and tribes in the implementation of Reasonable and Prudent (RPA) actions, progress reporting, and adaptive management using regional fora such as the Regional Implementation Oversight Group. RPA Actions 1 through 3 identify the general requirements governing the federal Action Agencies' development of implementation plans and reporting requirements. The federal Action Agencies must submit implementation plans to NOAA Fisheries in December of 2009, 2013, and 2016 that detail commitments to implement RPA actions - during subsequent years - for hydro, habitat, hatcheries, harvest, and predation (RPA Actions 4-49), and RPA actions (50-73) for Research, Monitoring, and Evaluation (RM&E).

The federal Action Agencies are required to submit Annual Progress Reports to NOAA Fisheries September 2009 through 2018 which cover hydro operations, status of physical or biological metrics monitoring, and actions implemented in the previous year, except in 2013 and 2016.

In June of 2013 and 2016, the federal Action Agencies are required to submit Comprehensive RPA Evaluation Reports to NOAA Fisheries. These reports shall review all implementation activities through the end of the previous year (as covered in the Annual Progress Reports) and compare them to scheduled completion dates in the BiOp or as modified through the Implementation Plans in 2009, 2013, and 2016. The Comprehensive RPA Evaluation will also describe the status of the physical and biological factors identified in the RPA, and compare these with the expectations in the survival improvements identified in the Comprehensive Analysis or Supplemental Comprehensive Analysis. Physical and biological factors will include new information on climate change and its effects on listed salmon and steelhead. The Comprehensive Evaluation will include a discussion of the Action Agencies' plan to address any shortcomings of current estimated survival improvements as compared to the original survival estimates identified in the Comprehensive Analysis referenced in the 2008 FCRPS BiOp.

RM&E Requirements

The 2008 FCRPS BiOp includes some research, monitoring, and evaluation (RM&E) requirements (Reasonable and Prudent Alternative Actions 50 through 73) for the federal Action Agencies (U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, and Bonneville Power Administration). These RM&E requirements are designed to provide information needed to support planning and adaptive management and demonstrate accountability related to the implementation of FCRPS ESA hydropower and offsite actions for all ESA-listed species (Evolutionarily Significant Units or Distinct Population Segments). Considerably more detail in the RM&E plans needs to be developed in the early stages of BiOp implementation. The 24 RPA actions can be categorized into nine broad strategies:

1. Monitor Status of Selected Fish Populations Related to FCRPS Actions
2. Hydropower RM&E
3. Tributary Habitat RM&E
4. Estuary and Ocean RM&E
5. Harvest RM&E
6. Hatchery RM&E
7. Predation Management RM&E
8. Coordination and Data Management
9. Project Implementation and Compliance Monitoring

Regional Implementation and Oversight Group and Technical Committees

Regional Implementation and Oversight Group (RIOG)

As described in the BiOps and related documents, the RIOG is established to provide a high level policy forum for discussion and coordination of the implementation of the FCRPS and related BiOps between the federal agencies on the one hand and states and affected tribes on the other hand. The overall purpose of the group is to inform federal, state and tribal agencies that are actively engaged in salmon recovery efforts regarding implementation issues from each sovereign's perspective. In doing so, the RIOG will serve as a forum where Basin-wide policy issues and concerns related to the implementation of the BiOps, including impacts on other Basin-wide basin programs and interests may be discussed in a collaborative manner, and to provide a forum for enhanced accountability and transparency.

The RIOG will consist of designated senior policy representatives of each of the following:

- five regional federal agencies: NOAA, BPA, Reclamation, Corps and the US Fish and Wildlife Service;
- four state governors: Montana, Idaho, Washington and Oregon; and
- Colville, Spokane, Kootenai, Warm Springs, Umatilla, Yakama, Nez Perce, Kalispel and Salish-Kootenai tribal governments (all Columbia Basin Tribes are invited to participate).

However, no agency or sovereign is compelled to participate in the RIOG because participation is by interest and choice. Some sovereigns may not have enough interest in implementation of the BiOps to warrant participation.

All decisions under the authority of the federal government will continue to be made by the appropriate federal agency with the statutory authority to make such decisions. The RIOG is a forum for interagency coordination and does not supplant existing federal, state or tribal decision-making authorities.

Technical Committees

The RIOG will be supported (groups should form in 2009) by Senior Technical Teams for hydro, habitat, hatcheries, and RM&E integration (the latter as needed) and by additional Technical Teams. The Technical Teams will include groups that have been used in the past (Technical Management Team, System Configuration Team, Water Quality Team, Corps of Engineers workgroups, etc.), as well as, new teams (geographically based Habitat and Hatchery Teams and a Predation Management Team) that will be formed in 2009. Technical information and recommendations will flow "upward" from the Technical Workgroups to the Senior Technical Workgroups to the RIOG (for adaptive management and dispute resolution) and policy guidance and technical assignments will flow "downward" from the RIOG to the Senior Technical and Technical level groups.

Together, these RIOG and Technical Committees will attempt to assure that actions required by the 2008 FCRPS BiOp are effectively implemented, performance standards are achieved, disputes are resolved, and other regional processes (NOAA Fisheries' recovery plans, US v. Oregon, Northwest Power and Conservation Council's Fish and Wildlife Program, etc.) are fully considered during the 10-year implementation of the 2008 FCRPS BiOp.

12.2.3 Harvest

Mainstem Columbia River

The parties to the *2008-2017 United States v. Oregon Management Agreement* recognize that a vigorous research and monitoring program is essential to the continued implementation and adaptive management of the harvest regimes that are envisioned in the agreement. The objective of the proposed research and monitoring is to improve the accuracy and precision of harvest management. Specific monitoring and research needs to provide information which is essential for adaptive management are identified in the agreement, and include:

- Fisheries sampling for stock composition including impacts to natural-origin fish
- Fishery effort accounting
- Natural spawning escapement enumeration including enhancements over current sampling efforts
- Run reconstruction and forecasting
- Observer programs and test fisheries
- Dam passage sampling
- PIT tag sampling
- Increased sampling effort to maintain necessary fishery sampling rates
- Evaluation of genetic stock identification methods to further improve stock identification

A Technical Advisory Committee (TAC), comprised of fishery biologists from state, federal and tribal management agencies, is established by the agreement to develop, analyze, and review data pertinent to the agreement and to make reports and technical recommendations regarding harvest management.

The parties to *US v. Oregon* agreed to work together to maintain funding for current research and monitoring programs, and to seek additional funding that are considered essential to increase certainty in the conservation effectiveness of the harvest strategies contained within the agreement. The parties also agreed to seek funding sources to assist TAC and its representatives in the performance of their functions.

Additional monitoring, evaluation and adaptive management of harvest is provided by the Endangered Species Act Section 7(a)(2) Consultation Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation on Treaty Indian and Non-Indian Fisheries in the Columbia River Basin Subject To the 2008-2017 *US v. Oregon* Management Agreement (hereafter, Fisheries Biological Opinion). The Fisheries Biological Opinion was approved by NOAA Fisheries on May 5, 2008. Section 13.4 of the Biological Opinion specifically identifies several Reasonable & Prudent Measures that emphasize in-season management actions that will ensure that incidental take of ESA-listed species, including of listed steelhead, remain consistent with the Biological Opinion. These measures specifically require that:

- Harvest impacts on listed species shall be monitored using the best available measures;
- In-season management actions taken during the course of fisheries managed pursuant to the 2008 *US v. Oregon* Agreement shall be consistent with the level of take specified in the Incidental Take Statement in the Fisheries Biological Opinion;
- NOAA Fisheries shall consult with the states and tribes to account for the catch of ESA-listed steelhead in the action area as these occur through the season; and
- NOAA Fisheries will track the results of these monitoring activities, and in particular, any anticipated or actual increases in the incidental take from those expected preseason.

Recreational Fisheries Regulation Processes (ODFW)
The procedures for promulgation of angling regulations in accordance with Oregon Revised Statute 496.162 are described in Oregon Administrative Rule 635-011-0050. This rule states that "Department staff shall continually monitor the status of fish, shellfish, and marine invertebrates and report promptly to the Director and Commission any serious or abnormal changes in health or abundance of the resource." There are three basic rule making processes used to develop angling regulations which are described below.

The "Public Process" solicits proposals for new or modified angling regulations from the public and considers these proposals for adoption along with ODFW staff proposals. The public process takes place on a four-year cycle, with the last Public Process completed for the 2009 Oregon Sport Fishing Regulations. The Public Process takes over a year to execute with staff proposals solicited 16 months before rule adoption.

During the "Interim Years" angling regulation changes are adopted without substantive changes, but there are opportunities to make rule changes to meet conservation needs, and to make any corrections or clarifications. Rules developed as part of Fish Management Plans are also considered during Interim Years. The "Interim Year" process normally begins in late April when Fish Division Staff solicit rule changes from Fish District Biologists and Fish Division Management. Rules are then adopted in August and take effect January 1 of the following year.

Angling regulations can also be changed by "Temporary Rules" (often referred to as emergency rules) which are put in place to: protect or preserve a fish species or stock experiencing depletion or drastic decline in health or abundance, or to allow anglers to harvest stocks of fish that become more abundant than expected. Temporary Rules are approved by the ODFW Director and can be put in place within 24 hours. The Commission must reaffirm the Temporary Rules at the next scheduled Commission meeting. Temporary Rules are good for up to 6 months, but any temporary rule needing to be in place longer should be adopted as a permanent rule prior to the 6-month time period.

Fisheries Management and Evaluation Plans

Under Limit 4 of the 4(d) rule (U.S. Office of the Federal Register 2000), take prohibitions do not apply to activities associated with fishery harvest activities, provided that the fisheries are managed in accordance with a NMFS-approved Fisheries Management and Evaluation Plan (FMEP) that is implemented in accordance with a letter of concurrence from NMFS. The FMEP, to be approved, must meet a number of specified criteria described in the rule. A template has been adopted for development of FMEPs that meet the required criteria (NMFS 2000).

To provide for adaptive management, Section 3.5 of the FMEP template requires the applicant to include a schedule and process for reviewing and modifying fisheries management under the FMEP (NMFS 2000). The FMEP template calls for two evaluation review processes to be identified in the FMEP (1) a regular review of fisheries (e.g., annually) and (2) a comprehensive assessment of the overall effectiveness of the FMEP (e.g., every one or two full brood cycles, depending on the listed species). The FMEP evaluation must assess the effectiveness of the FMEP in accomplishing the stated objectives over a longer period of time. This evaluation would take into account any new information that may require revisions in assumptions or management strategies (NMFS 2000).

The FMEP shall describe the process and schedule that will be used on a regular basis (annually) to evaluate the fisheries, and revise management assumptions and targets if necessary. The annual evaluation should provide (1) summaries of mortality, effort, escapement, and biological data, and (2) how well management performed in meeting the desired management targets by population (or management unit). Specific annual reporting requirements are described in the concurrence letter from NMFS to the applicant (NMFS 2000).

The FMEP shall also include a description of the process and schedule that will occur every 5 years (or one or two brood cycles), to evaluate whether the FMEP is accomplishing the state objectives. The conditions under which revisions to the FMEP will be made and how the revisions will likely be accomplished are to be included in this section. The FMEP

comprehensive evaluation must provide (1) summaries of population or management unit status relative to delisting and broad sense recovery goals at the beginning and end of the period under review; (2) a summary of the status of the ESU/DPS at the beginning and end of the period under review; (3) performance review of each element of the FMEP relative to its specific existing and any subsequent newly defined standards; (4) estimates of precision and confidence for the analyses conducted above; and (5) recommendations pertaining to management objectives, strategies, and actions including possible modification or termination of existing measures and addition of new ones (NMFS 2000).

In addition to the processes described above, NMFS requires that the fisheries managers notify and provide to NMFS any proposed fishery regulation changes that affect fisheries within the FMEP. NMFS will evaluate the proposed changes to determine if they constitute additional impacts that were not contemplated during the review and evaluation of the submitted FMEP. Depending on the species and fishery involved, these regulation changes can occur annually or in-season.

12.2.4 Hatcheries

Hatchery Scientific Review Group (HSRG)
The HSRG completed review and recommendations for all populations and hatchery programs in the Oregon portion of the Mid-Columbia Steelhead DPS. In Section 9, we characterized the HSRG recommendations and the consistency between the recovery plan actions and HSRG recommendations. In all cases, the HSRG recommendations were consistent with what had been proposed in the 2007 draft recovery plan released for public comment.

Hatchery and Genetics Management Plans
Under Limit 5 of the 4(d) rule (65 FR 42422 July 10, 2000), take prohibitions do not apply to activities associated with artificial propagation programs, provided that a Hatchery and Genetics Management Plan (HGMP) has been approved by NMFS as meeting a list of criteria that are specified in the rule. To provide for adaptive management, the HGMPs need to provide adequate monitoring and evaluation to detect and evaluate the success of the hatchery program and any risks potentially impairing the recovery of the listed ESU/DPS. Furthermore, the HGMPs need to provide for the evaluation of the monitoring data and include the potential to revise the assumptions, management strategies, or objectives that data show are needed. As part of the letter of concurrence, NMFS will describe the implementation process and reporting requirements, including annual production reports and the evaluation of monitoring data.

Limit 5 of the 4(d) rule requires NMFS to evaluate on a regular basis the effectiveness of the HGMP in protecting and achieving a level of salmonid productivity commensurate with the conservation of the listed salmonids. If the HGMP is not effective, NMFS will identify to the operators ways in which the program needs to be altered or strengthened.

The evaluation of the effectiveness of the HGMPs could lead to the reinitiation of the hatchery consultation if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the hatchery actions that may affect listed species or critical habitat in a manner or to an extent not considered in the consultation; (3) the hatchery actions are subsequently

modified in a manner that causes an effect on the listed species or critical habitat not considered in the consultation; or (4) a new species is listed or critical habitat designated that may be affected by the action.

Among other considerations, NMFS may reevaluate the HGMP if there is information indicating that genetic or ecological impacts, beyond those considered in the consultation, are occurring from the operation of the proposed artificial propagation programs. Additionally, NMFS may seek to reinitiate consultation if the HGMPs are modified based upon information: (1) developed during any subsequent review of the HGMPs that are the basis for these programs; (2) any of the other ongoing hatchery review processes such as the Mitchell Act EIS, the Columbia River Hatchery Scientific Review Group analysis; and (3) other processes such as recovery planning, and *US v. Oregon* negotiations.

12.2.5 Implementation Progress and Status Check-ins

Evaluating a species for potential delisting requires an explicit analysis of population or demographic parameters (the biological criteria) and also of threats under the five ESA listing factors in ESA section 4(a)(1) (listing factors (threats)criteria). Together these make up the "objective, measurable criteria" required under section 4(f)(1)(B). NMFS' Middle Columbia Steelhead Recovery DPS Plan summarizes the biological criteria and threats criteria that will be used to evaluate the DPS for potential delisting.

ESA Requirements for Species Status Reviews
Section 4(c)(2) of the Endangered Species Act requires that NMFS conduct a status review of Middle Columbia steelhead at least once every five years to evaluate the status of the DPS and determine whether it should be removed from the list or changed in status. Guidance for these reviews, developed jointly by NMFS and the U.S. Fish and Wildlife Service in 2006, is on the NMFS website at: http://www.nmfs.noaa.gov/pr/pdfs/laws/guidance_5_year_review.pdf. In addition, ESA section 4(g) requires that once a species has been de-listed that monitoring must be conducted in cooperation with the states for at least five years to ascertain the de-listing action.

The joint NMFS and U.S. Fish and Wildlife Service Guidance identifies the following key components of the status review process:

- a summary and analysis of available information on a given species;
- the tracking of a species' progress toward recovery;
- the recording of a deliberative process used to make a recommendation on whether or not to reclassify a species; and
- a recommendation on whether reclassification of the species is indicated.

The NMFS Northwest Regional Office will coordinate the five-year status review process with scientists from the Northwest Fisheries Science Center. Publication of a Federal Register notice announcing those species under active review is required. This notifies the public that the review is underway and requests information to assist in the review. As recovery plans are completed in the Northwest Region, there is now a need to conduct status reviews in the context of the

biological viability criteria and threats criteria described in the respective recovery plans. Addressing this need and identifying a process and methodology for carrying out the status reviews in the context of recovery planning is a high priority for NMFS.

In 2008, the Northwest Fisheries Science Center carried out a "test" status review for a selected ESU to evaluate how to best carry out the status review and what information is needed to support a robust review and status determination. Based on this preliminary status review exercise and on-going discussions between state, federal, local and tribal monitoring experts, the NMFS Northwest Region is producing a 2009 *Guidance for Monitoring Recovery of Salmon and Steelhead* listed under the ESA. This Guidance will provide recommendations for monitoring that addresses all of the viable salmonid population (VSP) criteria and the listing factors and threats. This draft Guidance is currently being finalized and will be made available to all state, Tribal, local and other entities involved in recovery plan monitoring and adaptive management programs for listed salmon and steelhead species.

NMFS has previously provided three documents describing the need for various kinds of information for determining the status of salmon and steelhead listed under the ESA:

- viable salmonid populations were described in NOAA Technical Memorandum NOAA Fisheries-NWFSC-42 (McElhany et al. 2000);
- additional guidance mainly directed toward habitat restoration monitoring has been given to states and tribes through the Pacific Coastal Salmon Recovery Fund "Performance Goals, Measures, and Reporting Framework (NMFS, December 2006); and
- the initial framework for developing monitoring is described in "Adaptive Management for ESA-Listed Salmon and Steelhead Recovery: Decision Framework and Monitoring Guidance" (NMFS, May 2007).

Three types of monitoring are needed to collect the most important information for the status review process. These include: (1) status and trend monitoring, (2) implementation (compliance) monitoring, and (3) effectiveness monitoring. The Middle Columbia steelhead Science Team, in coordination with NMFS, will work with all appropriate parties within the Middle Columbia steelhead DPS to design an appropriate monitoring and evaluation plan to ensure appropriate data is collected to track and evaluate DPS viability status and threats criteria.

NMFS scientists conducting the five-year status review will work closely with the Middle Columbia River steelhead Management Unit coordinators, DPS Science Team, and the Oregon Technical Team formed to provide science input and advice on Middle Columbia River steelhead actions, strategies, research designs, and RM&E priorities to implement the Middle Columbia River Steelhead DPS Recovery Plan. The Recovery Plan Science Team's input will be critical to ensure the most recent monitoring and evaluation data is used during the status review.

For the NMFS Middle Columbia River steelhead status review, the following information will be taken into account, as well as, other relevant information available at the time of the review:

- The biological recovery criteria (ICTRT 2007a) and listing factor (threats) criteria described in the DPS Recovery Plan
- Previous status reviews (including ICTRT 2008)
- The management programs in place to address the threats, including an evaluation of what progress these programs have made on implementing recovery strategies identified in the recovery plan. For example, how many miles of riparian restoration have been carried out relative to specific populations needing viability improvements to meet overall MPG or DPS viability goals?
- Principles presented in the Viable Salmonid Populations paper (McElhany et al. 2000)
- Best available information on population and DPS status and new advances in risk evaluation methodologies
- Other considerations, including: the number and status of extant spawning groups; the status of the major spawning groups; linkages and connectivity among groups; the diversity of life history and phenotypes expressed; and considerations regarding catastrophic risk

The Puget Sound Shared Strategy's Monitoring and Adaptive Management Plan (MAMA) for Chinook salmon provides an example for how to develop effectiveness monitoring metrics. Similar to the MAMA we will use the following questions to assist in tracking progress under major recovery strategies. Effectiveness monitoring metrics are designed to answer the following specific management questions:

- What are the key hypotheses supporting each major strategy in the Recovery Plan?
- What are the expected physical, biological changes and timeframes for those changes?
- What is the overall effectiveness of recovery actions? Is quality habitat being restored faster than it is being lost?
- Are there certain categories of recovery actions that are consistently failing or succeeding?

Effectiveness monitoring is broadly defined to encompass what is often called validation monitoring, and will address effectiveness of key strategies identified in the Middle Columbia River Steelhead Recovery Plan. The RM&E Plan addresses the following key questions:

- To what extent have strategies and actions been implemented and are they effective at meeting their objectives?
- Are recovery actions at the site, watershed *(MaSA, huc6 or other assessment scale as appropriate)* or programmatic scale producing the desired physical and biological changes?
- Are there categories of salmon recovery actions that are consistently more successful than others at meeting their objectives?

Modifying and Updating the Middle Columbia Steelhead Recovery Plan

According to NMFS' Interim Endangered and Threatened Species Recovery Planning Guidance (NMFS Recovery Guidance) (NMFS 2006), immediately following the five-year species review, an approved recovery plan should be reviewed in conjunction with implementation monitoring, to determine whether or not the plan needs to be brought up to date.

NMFS Recovery Guidance provides three types of plan modifications: 1) an update; 2) a revision; or 3) an addendum. An update involves relatively minor changes. An update may identify specific actions that have been initiated since the plan was completed, as well as, changes in species status or background information that do not alter the overall direction of the recovery effort. An update does not suffice if substantive changes are being made in the recovery criteria or if any changes in the recovery strategy, criteria, or actions indicate a shift in the overall direction of recovery; in this case, a revision would be required. Updates can be made by the Salmon Recovery Division which will seek input from the local stakeholder group prior to making any update. An update would not require a public review and comment period.

NMFS expects that updates will result from implementation of the adaptive management program for this plan. Adaptive management depends on the flow of information from the field staff to review managers and planners; hence, it requires frequent updates from monitoring and research on the effectiveness of recovery actions and the status and trends of the listed species. It may be most efficient to keep the recovery plan current by updating it frequently enough to forego the need for major revisions.

A revision is a substantial rewrite and is usually required if major changes are required in the recovery strategy, objectives, criteria, or actions. A revision may also be required if new threats to the species are identified, when research identifies new life history traits or threats that have significant recovery ramifications, or when the current plan is not achieving its objectives. Revisions represent a major change to the recovery plan and must include public review and comment period.

An addendum can be added to a recovery plan after the plan has been approved and can accommodate minor information updates or relatively simple additions, such as implementation strategies or participation plans, by approval of the field office or Regional Administrator. More significant addenda – adding a species to the recovery plan, for example – should undergo public review and comment before being attached to a plan. Addenda are approved on a case by case basis because of the wide range of significance of different types of addenda. NMFS will seek input from stakeholders on minor addenda.

For the Middle Columbia Steelhead Recovery Plan, NMFS will work with each Management Unit lead, the Mid-C Forum and Science Team to identify any changes, amendments or modifications to the Management Unit Plan which will need to be reflected in the DPS Plan. NMFS will coordinate any public notification and review of substantial changes to the Management Unit and DPS Plans with the Management Unit leaders.

State of Oregon Adaptive Management Process

The State of Oregon's Native Fish Conservation Policy identifies elements related to adaptive management that must be included in a state conservation plan. The policy states that a conservation plan will include "a process for modifying corrective strategies based upon the monitoring, evaluation and research results." The policy also identifies that a conservation plan will include "annual and long-term reporting requirements necessary to document data, departures from the plan, and evaluations necessary for adaptive management, in a format available to the public." The elements outlined previously in this chapter are designed to meet the requirements in the NFCP related to adaptive management and the successful implementation of this recovery plan. The State of Oregon will work cooperatively with NOAA to conduct implementation progress and status updates and to report the results of progress and status.

Section 13 Research, Monitoring, and Evaluation

This research, monitoring, and evaluation (RM&E) plan covers the Oregon portion of the Mid-C steelhead DPS. It describes the RM&E recommended for assessing the status and trends in population viability and for evaluating the success of management actions implemented to recover these steelhead populations. In addition, the types of monitoring approaches that are needed, current efforts underway, and additional RM&E needs are presented. Logistical and monetary limitations are understood to exist. However, this comprehensive plan will help to focus efforts towards the common goal of assessing success in population and DPS recovery.

To help identify needed monitoring and evaluation efforts, local managers were queried to identify critical uncertainties which, in their opinion, currently limit our ability to make informed management decisions. Within the context of ESA listing status, monitoring and evaluation should focus on providing measures needed for the critical evaluation of the status and trends of these populations that are informative for their recovery.

This plan is based in part on principles and concepts laid out in the NMFS guidance document, *Adaptive Management for ESA-Listed Salmon and Steelhead Recovery: Decision Framework and Monitoring Guidance (May 1, 2007)* http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/upload/Adaptive_Mngmnt.pdf. This plan also borrows from RM&E plans that were developed for Mid-Columbia subbasins and other Columbia Basin regions.

NMFS's guidance document provides a listing status decision framework (Figure 13-1), which is a series of decision-questions that address the status and change in status of a salmonid ESU/DPS, and the risks posed by threats to the ESU/DPS. Consistent with this framework, Oregon's approach focuses on providing key information to determine the condition or status of the populations for each of the four VSP parameters, and the effects of factors (and actions) on the condition or status of the populations.

The plan also follows the principles of adaptive management, the process of adjusting management actions and/or directions based on new information. Adaptive management is considered crucial for salmonid recovery programs because of the length and complexity of the salmonid life cycle, and the uncertainties involved in improving salmonid survival and status. The plan addresses adaptive management by linking monitoring and evaluation to biological and physical responses, and using these results to better design and implement of management actions.

We acknowledge repetition of objectives and methods between MPGs and populations. We expect that in some cases this comprehensive RM&E plan will be separated by MPG and population for use by managers and researches responsible for securing funding and implementing local RM&E efforts. We have developed the plan so that, when separated, the individual MPG plans will be useful as stand alone documents.

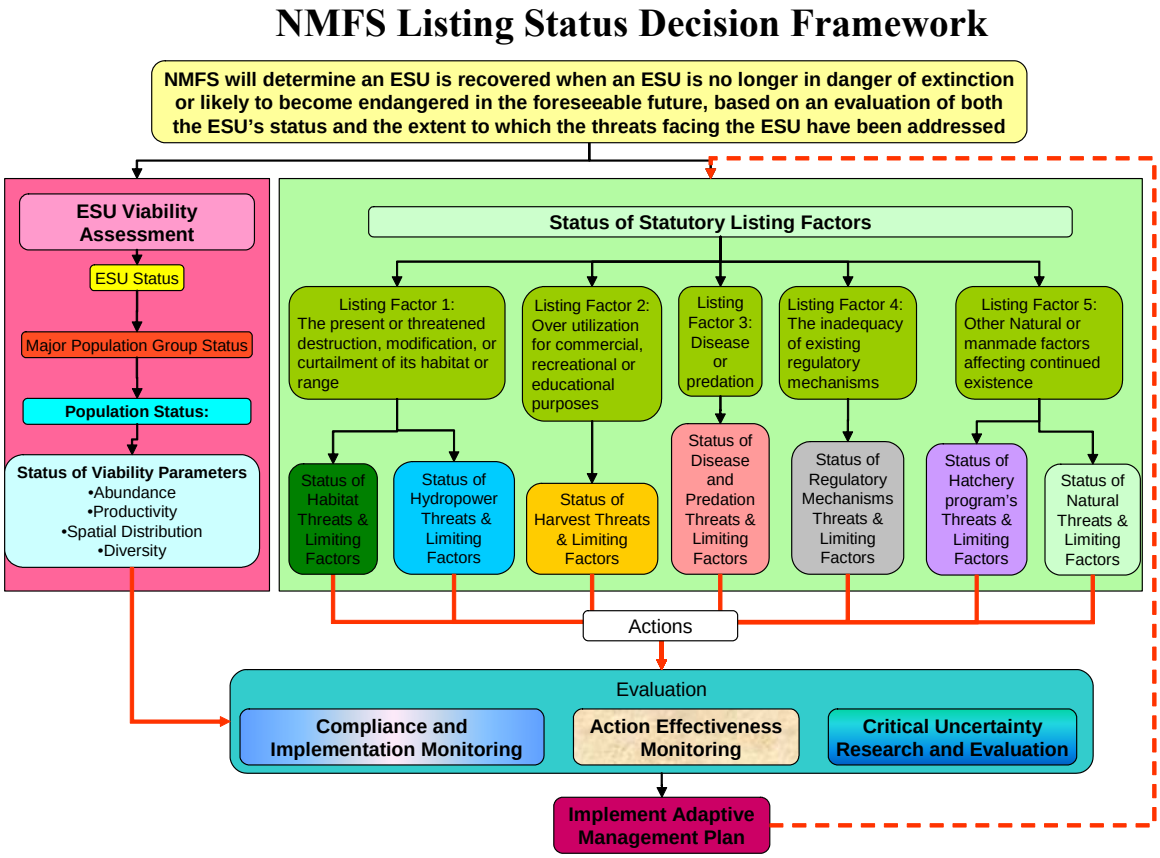

Figure 13-1. NMFS Listing Status Decision Framework.

13.1 Types of Monitoring Efforts

Several types of monitoring are needed to support adaptive management and to allow managers to make sound decisions:

- **Status and Trends Monitoring.** Status monitoring includes measures of the current state or condition of the population at any given time. Trend monitoring tracks these conditions to provide a measure of the increasing, decreasing, or steady state of a status measure through time. Status and trends monitoring includes the collection of standardized basic information used to monitor broad-scale trends over time in the status of fish populations, habitat conditions, and other ecosystem factors affecting fish. This information is the basis for evaluating the cumulative effects of management actions on fish and the aquatic and terrestrial ecosystem.

- **Action Effectiveness Monitoring.** Action effectiveness monitoring involves project-scale monitoring of local conditions to determine if implemented actions were effective in creating the desired proximate change. Action effectiveness monitoring typically is used to determine whether project- or program-specific goals were met. This type of monitoring also includes post-project monitoring to see whether the actions continue to

function as they were designed or intended. Note that status and trend monitoring may be appropriate for fulfilling these needs but that project effectiveness monitoring generally requires focused evaluations of more specific parameters directly associated with actions. Specific indicators and metrics need to be developed in plans for each category of action. Specific plans will include measurable variables or parameters to address each objective, study design (spatial and temporal scale, tests and controls, statistical criteria, etc.), data collection methods and reference examples, and analyses and decisions in response to results.

- **Implementation and Compliance Monitoring.** Implementation and compliance monitoring involves monitoring of management actions to determine if they were implemented as planned and meet established benchmarks. This monitoring is typically conducted by the groups implementing the management and restoration actions.

- **Uncertainties Research.** Uncertainties research includes scientific investigations of critical assumptions and unknowns that constrain effective recovery plan implementation. Uncertainties include unavailable pieces of information required for informed decision making as well as studies to establish or verify cause-and-effect and identification and analysis of limiting factors.

The following sections address each major population group separately. In some cases we provide specific objectives at the population scale to characterize unique monitoring needs. Specific approaches are presented that address each objective. A brief sampling design, including the spatial and temporal scale of application, is provided for each objective. Measurement variables, protocols and a description of the analysis are presented. Ongoing efforts and needed changes and enhancements are discussed for each objective. Existing and potential funding sources are identified and finally, implementation and coordination details are discussed. The techniques described for each population are not necessarily exhaustive, but are meant to be representative of those actions considered to have potential while recognizing logistical and monetary constraints.

13.2 John Day River MPG

Most of the monitoring and evaluation for the John Day River MPG is currently conducted by ODFW. Current status and trends monitoring includes spawner escapement, smolt-to-adult returns (SAR), juvenile abundance, productivity, distribution, and habitat condition. Not all populations are equally monitored but could be assessed with inference through ongoing monitoring of neighboring populations or with expansion of ongoing efforts in the populations that have inadequate monitoring. Limited rigorous effectiveness monitoring occurs and is closely tied to implementation and compliance monitoring of the numerous restoration projects. One of the critical uncertainties for this MPG is hatchery-related threats from out-of-basin hatchery fish that stray into the basin.

The five populations within this MPG (Lower Mainstem, Upper Mainstem, South Fork, Middle Fork, and North Fork) are similar in many respects and are therefore often monitored and evaluated collectively. Further, information collected from M&E efforts within one population

are often applicable to the other four. Where efforts or circumstances differ significantly among populations, differences are noted below within each objective.

Critical Uncertainties

Six critical uncertainties for the John Day River MPG that currently limit the ability to make informed management decisions have been identified by local area managers. We combined these uncertainties with those identified during the recovery planning process to produce the RM&E objectives that are addressed herein by our recommended RM&E efforts. They include:

1. Determine the current status and trend in the abundance and productivity of natural-origin spawners and compare to viability abundance criteria for each John Day population.
2. Determine the status of the spatial structure of each population based on current and historically utilized habitat.
3. Determine the status and trend in conditions of current and historically utilized habitat within each population.
4. Determine the freshwater productivity of each population relative to viability criteria and identify primary habitat factors limiting freshwater production.
5. Determine the current status and change in future status of life history and phenotypic diversity for each population.
6. Determine the effects of disease and predation on the abundance, productivity, diversity and spatial structure of the natural populations.
7. Determine the effects of hydropower on the abundance, productivity, diversity and distribution of the natural populations.
8. Determine the effects of habitat degradation and habitat restoration actions on the abundance, productivity, and spatial structure of the natural populations.

While any of these objectives can be applied to monitoring the recovery of most populations, we will identify details specific to the John Day populations and to the unique circumstances of the five John Day populations in the following recommended approaches. Circumstances and management typically do not differ greatly among the John Day populations, and therefore M&E needs are quite similar across the populations. Some of these objectives (e.g., the out-of-basin influences of hydropower and ocean environment) will remain consistent across all populations in this MPG.

Much of the information needed to monitor the status of John Day River steelhead is currently collected under the ODFW monitoring and evaluation program (Wiley et al. 2005; Wilson et al. 2005b). This plan will describe and supplement the existing programs so that the status and trend of the steelhead populations can be compared with recovery criteria. The following approaches follow those described in the evaluation framework and monitoring guidance set forth in the Adaptive Management for ESA-Listed Salmon and Steelhead Recovery draft document (NOAA 2006) and PNAMP management guidelines.

13.2.1 Lower Mainstem, North Fork, Middle Fork, South Fork, Upper Mainstem John Day Rivers Populations

Objective 1: Determine the current status and trend in the abundance and productivity of natural-origin spawners and compare to viability criteria for each John Day population.

The status of a population is determined by estimating the VSP parameters previously described in this recovery plan. These parameters include adult abundance, population productivity and growth rate, spatial structure, and diversity. The status of these parameters is compared to the population-specific recovery criteria resulting in an overall determination of the status of the population, MPG, and DPS. This is a highest priority objective.

Type of monitoring effort: Long term status and trend monitoring.

Monitoring questions:

- Is the 10-year geometric mean (GM) of naturally-produced steelhead spawners in each John Day River population greater than or equal to the recovery criterion for natural spawners?
- What are the current spawner abundance and five-year trend in abundance?
- What are the current and trend in the 20-year population growth rate?
- What are the current and trend in recruits/spawner compared to the delisting goal?

Performance metrics: Spawner abundance, recruits/spawner.

Approach: Tracking the abundance of adults is an important first step in population monitoring because it integrates the entire life cycle influences on status and trends. No weirs are operated or planned in the John Day River subbasin with the exception of a small temporary weir for research on Bridge Creek in the Lower Mainstem population area. Redd surveys are therefore the only alternative to estimate annual adult abundance for recruits/spawner and trend analyses. The recommended survey design includes a spatially balanced site selection process and a rotating panel design for temporal selection (environmental monitoring and assessment protocol (EMAP) approach; Stevens and Olsen 2004). ODFW currently uses this approach to estimate annual spawner escapement to the entire John Day River subbasin. Redds are counted bi-weekly on 2-km reaches selected by using a four-year rotating panel design with 50 randomly selected reaches sampled per year in the John Day River MPG. Ideally, sampling using this design would also be conducted at the population scale which would require additional samples to achieve greater accuracy and precision. In addition, index areas specific to the population that were established in 1966 are sampled annually by ODFW managers. These index data were originally used to estimate viability criteria and continue to provide valuable long-term trend information. A census redd count of a representative population outside of the basin is also conducted to establish a fish/redd ratio. Redd count surveys are currently conducted by walking and/or floating all streams within the index (one-time annual counts) and randomly selected reaches (bi-weekly counts, ≥ 3 counts/year). A fish/redd ratio is estimated by counting spawners passed above a weir (outside of the John Day River subbasin) and subsequent spawning ground redd

surveys, of similar design to those conducted in the John Day, of all known utilized habitat above the counting weir.

Analysis: Estimate the number of naturally produced spawners using proportions of observed naturally produced fish (unmarked) and hatchery (fin clipped) fish, total number of redds, expansion factor of surveyed stream length/available stream length, and fish/redd ratio. Calculate 10-year GM for abundance of naturally produced fish. Calculate recruits/spawner based on redd counts and estimated spawner age structure. Analyze as a time series (trend analysis).

Status: BPA currently funds the sampling of randomly selected reaches for spawning surveys at the MPG scale. LSRCP and NOAA currently fund spawner and redd counts (for fish/redd ratio) on a reference stream in the Grande Ronde River basin. State of Oregon funds index spawning ground surveys. Field work is currently implemented and coordinated primarily by the ODFW and ISEMP. Population-level sampling has been conducted for the South Fork population during 2006 and 2007 and may be rotated annually to other populations. However, additional funding would be required to conduct population-level sampling for the larger populations (Lower Mainstem, North Fork) within the MPG. Population-scale monitoring for the Middle Fork population will be initiated in 2008 as part of the intensively monitored watershed (IMW) approach. This IMW work is funded by NOAA through OWEB. Much of the Upper Mainstem population is within private property where access is limited, and therefore population-scale spawner surveys are logistically very difficult there. Similarly, private property dominates the Lower Mainstem population area and the low density stream network coupled with remote access for several major tributaries and more frequent turbid water further complicates sampling and logistics of redd surveys.

Objective 2: Determine the status of the spatial structure of each population based on current and historically utilized habitat.

This is a highest priority objective.

Type of monitoring effort: Long term status and trend monitoring.

Monitoring questions:
- What is the spatial distribution of spawning within each population?
- What is the current spatial extent and distribution of rearing habitat used by juvenile steelhead within each population?

Approach: The same EMAP of all known spawning and rearing areas as used for determining abundance of spawners is recommended and currently implemented by ODFW for refining the known spatial extent of both adult and juvenile steelhead in the John Day MPG. Fifty sites within the John Day MPG are sampled annually using a three-panel rotating panel design. Panels include annual, every four years, and one-time visit selections. All observed adult spawners and redds are geographically referenced using handheld GPS units for inclusion in a GIS. Juvenile steelhead are sampled using snorkeling or electrofishing techniques. This approach is refining current knowledge of steelhead spatial

distribution throughout the John Day River subbasin. Current sampling efforts in the South Fork population are adequate and the future sampling associated with the Middle Fork IMW will provide information needed for this population. Expanded sampling in the Lower Mainstem, North Fork, and Upper Mainstem populations will be required to get adequate population specific information.

Analysis: Data are currently analyzed as distribution data in a GIS format. The known distribution of steelhead is modified when previously unknown blockages to migration are discovered. Juvenile steelhead are evaluated as fish/pool in each study reach.

Status: BPA currently funds the sampling of randomly selected reaches for spawning surveys. BPA has eliminated funding for juvenile distribution work after 2007. Additional funding may be procured from OWEB. Field work is currently implemented and coordinated primarily by the ODFW and ISEMP. ISEMP is developing contracts with ODFW to reinstate habitat and juvenile distribution monitoring that will address sampling at population spatial scales. Additional work on juvenile fish is conducted by the USFS PACFISH Biological Opinion project on federally owned lands and by CTWSRO on tribal managed properties. The same limitations indicated above in Objective 1 are relevant here as well.

Objective 3: Determine the status and trend in conditions of current and historically utilized habitat within each population.

This is a highest priority objective.

Type of monitoring effort: Long term status and trend monitoring.

Monitoring questions:

- What is the status and trend in habitat quantity and quality throughout the John Day MPG area?
- What is the status and trend in habitat quantity and quality for each of the populations in the John Day MPG?

Approach: The same EMAP of all known spawning and rearing areas as used for determining abundance of spawners is recommended for sampling the known spatial extent and status and trend of steelhead habitat in the John Day MPG. Fifty sites within the John Day MPG are sampled annually using a three-panel rotating panel design. Panels include annual, every four years, and one-time visit selections. Habitat variables follow ODFW Aquatic Inventories design (Moore et al. 2002) and are measured at the unit and reach scale.

Analysis: Data are currently analyzed as distribution data in a GIS format. Sample sites can be associated to specific populations but sample draw was conducted to represent MPG level. Database and GIS formatting of data allow associations with land use, land vegetation coverage, and many other attributes at watershed and population scales. The survey effort needs to be expanded to provide monitoring at the population level. Current and future planned efforts are adequate for the South Fork and Middle Fork populations but not the other three.

Status: BPA has eliminated funding for basin-wide habitat work after 2007. Work is currently unfunded for most populations. Habitat monitoring will continue for Middle Fork population using NOAA/OWEB funding as part of the Middle Fork IMW. ISEMP is developing contracts with ODFW to reinstate habitat and juvenile distribution monitoring that will address sampling at population spatial scales.

Objective 4: Determine the freshwater productivity of each population relative to viability criteria and identify primary habitat factors limiting freshwater production.

This is a highest priority objective.

Type of monitoring effort: Long term status and trend monitoring for productivity and uncertainties research for limiting factors.

Monitoring questions:
- What are the current and trend in freshwater productivity measured as smolts/redd?
- What are the primary habitat factors limiting freshwater production of steelhead?

Approach: The ratio of smolts/adult is one recommended measure of freshwater productivity. Smolts are typically counted using traps as they migrate out of their natal habitat. If weirs are not present to count adults, then redd counts can act as a surrogate measure. Freshwater productivity is measured as smolts/redd or smolts/adult. Trapping with rotary screw traps (RSTs) and mark-recapture are currently used to estimate smolt abundance for significant portions of three populations (South Fork, Middle Fork, Upper Mainstem) in the John Day MPG. Similar efforts have been attempted for the North Fork population with limited success due to physical constraints. The structure of the watershed for the Lower Mainstem population precludes effective sampling of smolts with traps because the tributaries are disperse and enter the Mainstem where it has very large discharge during seasonal flow events. Redd counts are estimated using the previously mentioned approach and an EMAP sampling framework. Sample draws for redd surveys need to be directed at the population segments above smolt trapping locations. Actual freshwater productivity estimates are derived estimates not direct measures. For example, egg-to-smolt survival requires an estimate of the number of eggs deposited by individual females or deposited in each redd. Parr-to-smolt survival can be estimated by capturing a representative number of parr in their rearing habitat, PIT tagging them, and then monitoring their recapture at the downstream smolt traps. Migration survival can similarly be estimated by monitoring detections of PIT-tagged individuals as they pass through PIT tag detection facilities.

Identification of factors limiting freshwater production by RM&E efforts provides much needed direction for restoration efforts and is best explored using an uncertainties research approach. Several physical and biological factors can potentially limit production. Therefore, a multivariate or hierarchical approach may be appropriate for identifying factors. For example, data from habitat surveys can be combined with data from long-term monitoring of discharge and temperature and fish growth and distribution information to identify factors potentially limiting productivity. Often, simple presence/absence

information of parr or adults can be examined in the context of existing habitat information and used to initially deduce and explore more complex predictive relationships.

Analysis: Smolt abundance is estimated using RSTs and mark/recapture techniques (Thedinga 1994, Steinhorst 2004). Survival and productivity measures are calculated ratios of abundance from one life stage to another.

Status: BPA currently funds trapping of smolts and spawning surveys for redd counts. NOAA and OWEB will fund future work for identifying limiting factors under the IMW approach for the Middle Fork John Day River. With current efforts there will be estimates for the South Fork and Middle Fork populations. Efforts will have to be expanded to collect information for the other populations. Similar efforts, funded by NOAA and BPA, to estimate freshwater productivity are planned for an IMW on Bridge Creek, a tributary of the Lower John Day River. Smolts-redd estimate are not logistically feasible for the Lower Mainstem and North Fork populations. Outflowing waters are too large for efficient trapping of smolts using RSTs and commingling of smolts from other populations would introduce additional complications for unique identification. It may be feasible to monitor a representative portion of the North Fork population (above Desolation Creek, for example) if additional funds become available.

Objective 5: Determine the current status and change in future status of life history and phenotypic diversity for each population.

This is a high priority objective.

Type of monitoring effort: Long term status and trend monitoring.

Monitoring questions:
- What proportion of steelhead spawners in the John Day MPG are out-of-basin hatchery strays?
- What is the origin of out-of-basin strays?
- What is the population-level genetic composition of the John Day MPG and of individual populations?

Approach: The John Day River basin lacks facilities to capture adult steelhead. Determination of out-of-basin strays will therefore rely on identification of hatchery-marked adults observed on spawning ground surveys, in creel surveys, from incidental catches, and from detections of PIT tags at PIT tag antenna arrays. See also Objective 6 for harvest monitoring.

To determine population-level genetic composition for the MPG, genetic data that allow an objective determination of population structure are required. Age-0 *O. mykiss* from four representative streams in each population segment have been sampled for three consecutive years beginning in 2005. A minimum of three cohorts were sampled using non-lethal fin tissue for DNA analysis. Populations will be characterized using a suite of nuclear DNA markers, including both microsatellite loci (variable-number simple-sequence repeats) and

non-coding single nucleotide polymorphisms (SNPs), or base substitutions assayed via restriction enzyme analysis (Moran et al. 1997).

An EMAP of all known spawning areas is currently employed in the entire John Day River MPG. Fifty sites within the John Day MPG are sampled annually using a three-panel rotating panel design. Panels include annual, every four years, and one-time visit selections. ODFW managers also continue to annually visit pre-determined and long-standing index sites for spawners. These index surveys continue a long-term trend dataset that was initiated in the 1960's. The number of marked (adipose fin clip) and unmarked (presumably natural-origin) fish are visually identified on all spawner surveys. All observed carcasses marked with a fin clip are sampled for coded-wire tags to determine the presence of a coded-wire tag and hatchery origin. Expanded sampling efforts are recommended to provide population specific hatchery fraction information.

Because there are no permanent weirs in the John Day River basin, the operation of semi-permanent PIT tag antenna arrays is critical for the identification of the origin of hatchery strays. PIT tag monitoring should be accomplished near the downstream extent of watersheds, near RSTs, to monitor the passage of tagged adults. These antennas can serve a dual purpose by also aiding in the determination of the capture efficiency of RSTs.

Analysis: Estimating the proportion of out-of-basin strays is a simple comparison of the number of marked and unmarked spawners and carcasses observed. Direct comparisons can then be made with recovery criteria. DNA tissue samples are analyzed by NMFS using known microsatellite markers. Microsatellite loci are analyzed using pairwise FST comparisons to estimate levels of gene flow and to identify geographic areas that contain genetically differentiated populations. Genetics monitoring is conducted under the NMFS Columbia Basin-wide steelhead genetics monitoring program.

Status: Spawning ground surveys are implemented and coordinated primarily by the ODFW with input from ISEMP participants. BPA currently funds spawning ground surveys for EMAP reaches and state funds are used for index surveys. Genetic analysis is implemented and coordinated collaboratively between ODFW and NMFS Northwest Science Center. Federal funds are used for genetic stock analysis.

There are currently no creel surveys conducted in the John Day River subbasin. Current evidence suggests that out-of-basin hatchery strays is a particular problem for the Lower Mainstem population. There appears to be a negative correlation between distance from the mouth of the John Day River and presence of hatchery strays. The scope of surveys is currently inadequate to make population specific estimates of the proportion of spawners that are hatchery origin.

As of 2009, semi-permanent antenna arrays are operated at McDonald Ford on the Lower John Day River, on the South Fork John Day River, Middle Fork John Day, and on Bridge Creek. The latter three are operated as part of the ongoing IMW studies by ISEMP and ODFW. The McDonald Ford array is operated by Biomark, Inc. in cooperation with NOAA and ODFW.

Objective 6: Determine the effects of disease and predation on the abundance, productivity, diversity and distribution of the populations.

This is a moderate priority objective.

Type of monitoring effort: Status and trend monitoring.

Monitoring questions:

- What is the prevalence of whirling disease in the John Day River basin and what is its influence on the natural steelhead populations?
- What is the predation rate and predatory impact of introduced fishes in the John Day River on juvenile steelhead?
- What is the effect of predation from piscine predators in the Columbia River migration corridor on juvenile steelhead originating from the John Day River?
- What is the effect of predation from avian predators in the Columbia River migration corridor on juvenile steelhead originating from the John Day River?

Approach: The current distribution and influence of whirling disease on wild steelhead populations is not fully understood. Representative sentinel stations should be established and monitored through time for each population to measure prevalence and intensity of infection rates of the disease. Infection, or the presence of *Myxobolus cerebralis* DNA, is detected by polymerase chain reaction (PCR) analysis. A logical place to locate initial sentinel tests would be in locations where hatchery strays are known to be prevalent because they are a known vector of transmission from infected watersheds in northeast Oregon (Sollid et al. 2004). Sentinel stations should then be placed near the mouths of important tributary and mainstem habitats occupied by fry and parr life history stages of steelhead. While all populations in the John Day have some susceptibility to disease, the prevalence of hatchery strays and habitat conditions in the Lower Mainstem population area likely make this population more vulnerable than those upstream. The initial focus of study should be in the Lower Mainstem population.

ODFW currently conducts annual collections of smallmouth bass *Micropterus dolomieui* in the John Day River using angling techniques. Collected stomach samples are analyzed for the presence of juvenile salmonids. These data could be incorporated into a bioenergetics model to derive a population-level consumption estimate imposed by introduced fishes. Sampling of predatory fish diets should occur during times and locations when and where their distribution overlaps with juvenile steelhead. Interpretation of the predatory impact in the migration corridor should be conducted from methods established in published literature (Ward et al. 1995, Fritts and Pearsons 2006).

To evaluate avian predation, colonies are monitored for presence of PIT tags originating from specific populations (Collis et al. 2001). Bioenergetics models are used to expand tag recoveries at colonies to population-level impacts (Antolos et al. 2005). We acknowledge that both the Columbia River mainstem piscine predator and avian predator monitoring needs are outside the scope of this plan. However, we encourage adequate monitoring of these limiting factors and threats.

ODFW currently PIT tags 4,000 juvenile steelhead migrants each year in the John Day River basin for estimation of SAR. Determining the fate of PIT tags in this database should be utilized for examining the influences of migration corridor predation.

Analysis: The proportion of SAR attributable to predatory mortality could be estimated from the predation bioenergetics modeling results. Infection rates of sentinel fish from disease would provide some indication of the potential impacts of whirling disease.

Status: ODFW currently tests opportunistically for the presence of diseases in juvenile salmonids submitted as mortalities from rotary screw traps and other sampling operations from the John Day River basin. PIT tagging of juvenile steelhead is currently completed by the ODFW with funding from the BPA. The whirling disease foundation, whirling disease initiative, and Oregon Sea Grant are potential funding sources for whirling disease investigations. Investigations of predation in the migration corridor have been conducted by many agencies with various funding sources including BPA and USACE. We encourage the continuation of the piscine and avian predation monitoring.

Objective 7: Determine the effects of hydropower on the abundance, productivity, diversity and distribution of the natural populations.

This is a high priority objective.

Type of monitoring effort: Long term status and trends.

Monitoring questions:

- What is the effect of Columbia River hydropower operations on juvenile steelhead outmigrating from the John Day River populations?
- What is the effect of Columbia River hydropower operation on returning adult steelhead originating from the John Day River populations?

Approach: PIT tags have been used successfully to measure the influence of hydropower operations on migrating salmonids (Berggren et al. 2006, Schaller et al. 2007). ODFW has cooperated with the CSS study by PIT tagging steelhead smolts as they migrate out of the John Day River Basin. These PIT-tagged fish are subsequently monitored for detections at FCRPS facilities along the migration corridor at both juvenile and adult life stages using Data Access in Real Time (DART) and PIT Tag Information System (PTAGIS) databases. Detection probabilities of juvenile salmonids migrating downstream at FCRPS facilities are modeled using the Survival Under Proportional Hazards (SURPH) analytical tool (Lady et al. 2003). Adult detection (purportedly 100%) is currently available at ladders on several dams, including Bonneville and McNary, and is expected in the near future at The Dalles and John Day dams.

Analysis: Juvenile survivals at each FCRPS facility can be estimated using the SURPH model. Adult survival between facilities will soon be possible by comparing detections at adult ladder facilities along the migration corridor. Rates can be expanded to population-level impacts using the relative number of fish PIT tagged and smolt abundance estimates

generated from mark-recapture at RSTs. Adult detections within the John Day River basin, subsequent to those in the Mainstem Columbia River, will be used to determine the relative proportion of successful migrants from each migration strategy outside of the basin.

Status: ODFW currently PIT tags emigrating smolts and monitors their detections at mainstem hydropower facilities. Coordination with comparative survival studies (CSS) occurs with the Fish Passage Center. Currently, juvenile steelhead are PIT tagged representing three populations (South Fork, Upper Mainstem, and Middle Fork) in the John Day. Estimates derived for these populations would be representative for the remaining John Day populations. NMFS and Biomark operate a developmental PIT tag antenna array on the Lower John Day River. This array will allow partial detection of PIT-tagged fish migrating through the lower John Day River.

Objective 8: Determine the effects of habitat degradation and habitat restoration actions on the abundance, productivity, and spatial structure of the natural populations.

This is a high priority objective.

Type of monitoring effort: Status and trend monitoring; implementation and compliance monitoring; effectiveness monitoring.

Monitoring questions:

- Status & Trend Monitoring—What is the current status and trend of steelhead habitat?
- Implementation and Compliance Monitoring—Has the management action been implemented in the prescribed manner and achieved its objectives?
- Effectiveness Monitoring—Have the management actions significantly influenced the viability of John Day River steelhead populations?

Approach: Status and trend monitoring at the subbasin and population scale is best conducted by using a spatially explicit sampling approach such as the EMAP approach developed by the EPA. Measured habitat variables vary depending on the specific question addressed but are directed at those closely related to salmonid requirements, targeted for restoration, or identified as limiting recovery. Remote sensing (e.g. thermal infrared (TIR) imagery; light detecting and ranging, (LIDAR); and spatially referenced color imagery) is also appropriate and typically addresses spatial scales at watershed or larger landscapes. We typically use ODFW aquatic inventories which include riparian, within channel and physical properties.

Compliance monitoring of restoration projects incorporates record keeping and reporting of activities. Compliance monitoring should be primarily conducted by the implementing party and should include any parameters indicated in related work statements. Although some compliance monitoring is currently underway, there is need to expand at the project scale and for aggregation to assess at the population scale.

Effectiveness monitoring can be approached at the watershed and project spatial scales. IMWs are currently used in some places for the watershed scale. Effectiveness monitoring should preferably be directed at measures of abundance, survival, growth, etc. of steelhead or

abiotic or biotic factors limiting their recovery. A modified before-after-control-influence (BACI) design (including spatial replication) is recommended for measuring the effectiveness of active restoration activities (Jones & Tonn 2004). For passive restoration activities, a BACI design that monitors trends through time may be appropriate. If comparisons are made to reference or control sites, they should be under similar environmental conditions experienced by the treatment site but outside the influence of treatment activities. Restoration action implementing entities must coordinate with monitoring groups prior to scheduled activities—preferably years in advance to allow measurement of pre-treatment variables. Temporal scales must account for delays due to life history and life cycle timeframes.

Analysis: Direct comparisons of measured parameters with recovery criteria can be made. Otherwise, measures at smaller scales will need to be scaled up to determine if they would have desired responses at the population level.

Status: Implementation monitoring is currently conducted by the groups that implement the activities (e.g. ODFW, CTUIR, CTWSRO, watershed councils, etc.). ODFW currently conducts limited effectiveness monitoring of selected restoration projects within the John Day River basin. IMWs were established in the Middle Fork John Day River and Bridge Creek on the Lower John Day River in 2007. Remote sensing is typically conducted by professional consultants. Funding from BPA, OWEB, NOAA, and other sources has supported past and current activities. There is limited implementation monitoring underway and a significant need to compile information across projects for assessment at the population scale.

13.3 Umatilla/Walla Walla Rivers MPG

Steelhead restoration activities in the Umatilla subbasin include supplementation of the endemic steelhead population, harvest management, and habitat, flow, and passage improvement projects. The "Comprehensive Research, Monitoring, and Evaluation Plan for Umatilla Subbasin Summer Steelhead and Chinook Salmon" (Umatilla RM&E plan; CTUIR and ODFW 2006) is a detailed plan for obtaining information needed to assess the performance and evaluate the effectiveness of these habitat restoration, harvest management, and hatchery programs. The RM&E aspects of this plan are designed to assess the current efforts and test new strategies for the supplementation and restoration of steelhead and the establishment and enhancement of commercial and recreational fisheries. Due to the lack of pre-treatment data, managers rely primarily on status and trend data and comparison to out-of-subbasin reference populations to assess the success or failure of management strategies and to make adaptive management decisions.

Most of the monitoring and evaluation for the Umatilla/Walla Walla Rivers MPG is currently conducted by ODFW and CTUIR. Status monitoring is performed for all projects in the Umatilla subbasin, including natural production, hatchery evaluation, and juvenile outmigration and survival. Proposed natural production status monitoring includes abundance indices for juveniles (parr and smolts), adult abundance, recruits per spawner, estimated redd numbers, life history characteristics, as well as flow, temperature, and habitat data to assess the success of flow augmentation and stream restoration work. Hatchery evaluations include the monitoring of

smolt-to-adult returns, smolt-to-adult survival, catch contribution, catch distribution, and straying rates. Juvenile outmigration monitoring (which was discontinued in 2007 due to BPA budget cuts, then re-started in 2009) includes abundance of outmigrating smolts, travel timing, and survival rates to downstream dams. In addition, the fishery is monitored using creel surveys and marine fishery observations to estimate the contribution of Umatilla River fish to the commercial and recreational fisheries. RM&E for the two Oregon populations within this MPG are addressed separately below.

13.3.1 Umatilla River Population

Critical Uncertainties
Seven critical uncertainties for the Umatilla River population that currently limit the ability to make informed management decisions have been identified by local area managers.

1. What are the status and trends of steelhead and their habitat in the Umatilla basin?
2. What are appropriate and effective rearing and release strategies for summer steelhead reared at Umatilla Fish Hatchery?
3. Will the historical summer steelhead fishery be sustained by hatchery releases of summer steelhead?
4. To what extent will hatchery summer steelhead released in the Umatilla contribute to out-of-subbasin fisheries?
5. To what extent will supplementation alter the genetic diversity and life history characteristics of the native steelhead population?
6. To what extent will supplementation enhance natural production of summer steelhead?
7. How will habitat protection and enhancement actions influence abundance, productivity, life history diversity, and long-term sustainability of Umatilla steelhead?

We used these uncertainties and others identified during the recovery planning process to produce the monitoring and evaluation objectives and the recommended M&E efforts. We list the priority level of each objective from highest to low, with a monitoring and evaluation focus on the highest priority activities. This does not mean that criteria ranked as moderate or low are not important to monitor. Rather, it means that limited resources will be applied to monitoring those aspects of recovery that are most important. Monitoring of moderate and low priority criteria will occur as resources are available. This plan does offer possible metrics and methods for monitoring medium and low priority criteria. Monitoring objectives listed as highest or high priority address population and environmental status, natural production, the hatchery program, flow, passage, and other habitat actions and fisheries.

We combined the aforementioned uncertainties with those identified during the recovery planning process to produce the RM&E objectives that are addressed herein by our recommended efforts. Not all objectives are associated with each population segment. The objectives include:

1. Monitor and assess the status and trends of abundance and productivity of natural- and hatchery-origin adult steelhead.

2. Determine the status of the spatial structure of the population based on current and historically utilized habitat.
3. Monitor and assess the abundance, timing, life history characteristics, and in-stream survival of out-migrating steelhead.
4. Determine the current status and change in status of life history and genotypic diversity in the population.
5. Identify and assess factors limiting viability of Umatilla River steelhead.
6. Determine the status and trend of current and historically utilized steelhead habitat in the Umatilla subbasin.
7. Determine the influence of the current hatchery supplementation program on the natural population.
8. Monitor and assess the impact of flow enhancement on steelhead survival, habitat, and migration.
9. Determine the effect of mainstem hydropower operations and operational improvements on viability of Umatilla River steelhead population.
10. Determine the effect of harvest on the abundance, productivity, diversity, and distribution of the natural population.
11. Determine the effect of predation on the abundance, productivity, diversity, and distribution of the natural population.
12. Monitor production, survival, harvest and spawning of hatchery-origin steelhead.
13. Determine the transmission and effect of disease on the abundance, productivity, diversity and distribution of the natural population.

Some of the information needed to monitor the status of Umatilla summer steelhead is currently collected under the ODFW and CTUIR monitoring and evaluation program as described in the Umatilla RM&E plan, while limited monitoring activities that address the effectiveness of irrigation screening are also conducted by the Bureau of Reclamation. The research, monitoring, and evaluation objectives and approaches that follow are primarily from the Umatilla RM&E plan (CTUIR and ODFW 2006). Some of these objectives have been supplemented so that the status and trend of the steelhead population can be compared with recovery criteria. More detailed information on approaches and analysis is contained in the Umatilla RM&E plan.

Objective 1: Monitor and assess the status and trends of abundance and productivity of natural- and hatchery-origin adult steelhead.

Adult returns to Three Mile Falls Dam (TMFD) are critical for monitoring the status and long-term trends of steelhead in the Umatilla subbasin (Critical Uncertainty No. 1). Monitoring trends in productivity metrics will be critical to assessing the performance of the Umatilla subbasin fish restoration program. These measures will also be used in stock-recruitment models to estimate natural production capacity of the subbasin. This is considered a highest priority objective.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:
- What are the annual abundance and time-series trends in abundance?

- Is the 10-year GM of naturally-produced steelhead spawners in the Umatilla subbasin greater than or equal to the recovery criterion for natural spawners?
- What are the current and trend in the 20-year population growth rate?
- What are the current and trend in smolts/spawner?
- What are the current and trend in adult recruits per spawner?

Performance metrics: Number of natural- and hatchery-origin adult returns to the Umatilla River, run timing of natural- and hatchery-origin adult returns, smolts-per-spawner, adult recruits per spawner.

Approach: Numbers of adult natural- and hatchery-origin returns are currently enumerated by trap counts and video monitoring at the TMFD (RM 3.7) fish ladder. A complete count of escapement past TMFD is obtained, as all returning adults must use this fish ladder. During trapping, fish are routed into a sorting complex. During sorting, data, disposition, and number trapped by sex, age class (classified by fork length), and marks are collected. Fish are also examined for presence of coded-wire tags. Additional age, length, and CWT information is obtained when broodstock collected at TMFD are spawned and from snouts collected in the Umatilla River fishery. The natural origin of unmarked steelhead is cross-checked by examining scale patterns on all unmarked fish collected for broodstock or sampled in fisheries and on the spawning grounds. Harvest is monitored below TMFD to obtain an estimate of returns to the mouth of the Umatilla River. A roving creel survey is used to count and contact anglers in the steelhead fishery. During video enumeration, total counts of steelhead are obtained from review of the video tapes. During the video review, about 50% of steelhead can be classified as hatchery or natural by the presence or absence of an adipose fin, respectively. Origin of the unidentified steelhead, and age, sex, and mark composition of video monitored steelhead are estimated as their mean percent composition from trapping periods immediately before and after the video period.

Analysis: Counts of adult returns to TMFD plus estimated harvest below TMFD are combined to estimate the number of natural- and hatchery-origin fish that return to the mouth of the Umatilla River. Counts of adults in combination with other measures are used to estimate key metrics of survival (smolt-to-adult survival, pre-spawn mortality) and productivity (smolts-per-spawner, adult recruits-per-spawner ratios). In-basin freshwater productivity has been estimated as the number of smolts-per-spawner from spawner abundance estimates and smolt abundance estimates collected by the BPA-funded Umatilla Smolt Outmigration and Survival Project. Adult-to-adult productivity is measured as recruits-per-spawner ratios using spawner abundance data and estimates of total adult spawner production resulting from each brood year.

Status: Adult and smolt estimates are currently funded. BPA currently funds counts at TMFD, creel surveys, and harvest estimates. Returns have been enumerated at TMFD using an electronic fish counter from 1966-1983 and mark-recapture methods from 1983-1987, after which a trapping and collection facility was constructed. All returning adults were trapped until the 1999 return year, after which alternating trapping-video enumeration was implemented. Funding for smolt abundance was discontinued in 2007, then re-started in 2009.

Objective 2: Determine the status of the spatial structure of the population based on current and historically utilized habitat.

Spawners can escape differentially to each watershed due to habitat conditions, pre-spawn mortality, and stochasticity. The production of juveniles can vary among watersheds due to spawner abundance, spawner productivity, habitat quality, habitat quantity, egg mortality, fry mortality, or parr mortality. An understanding of spatial and temporal variance in both spawner and juvenile distribution is therefore necessary to address several of the critical uncertainties. This is a highest priority objective.

Type of monitoring effort: Long-term status and trends monitoring.

Monitoring questions:

- What is the spatial arrangement of the occupied spawning areas within the population boundaries?
- What is the distribution and density of spawners on the spawning grounds?
- What is the current spatial extent and distribution of rearing habitat used by juvenile steelhead?
- What is the distribution of juveniles on the rearing grounds?

Performance metrics: Spawner distribution, redd distribution, spawn timing, rearing distribution, juvenile density and distribution.

Approach: Sampling will be conducted throughout all known spawning and rearing habitat. Sample site selection design will follow an EMAP protocol (Stevens and Olsen 2003, 2004; www.epa.gov/emap). Redds are enumerated using multiple-pass visual surveys of the selected sample reaches. The location of each redd will be georeferenced. Although few carcasses are recovered, carcasses will be measured and weighed, and a scale sample will be collected for age, growth and origin analysis.

Enumeration of juvenile out-migrants on Meacham Creek, a major tributary to the Umatilla River, started with a mark-recapture project in 2009. Habitat restoration conducted under CTUIR's Meacham Creek Habitat Enhancement Project will be evaluated for effectiveness using smolt production ratios as performance measures. It is hypothesized that Meacham Creek smolt production will make up a larger proportion of the Umatilla Basin's total smolt production as habitat restoration efforts come to fruition.

Juvenile survey reaches will be randomly selected within watersheds using the same EMAP protocol. Sampling will be stratified by increasing intensity in watersheds that are receiving supplementation, flow, or habitat treatments. At least thirty juvenile sites will be surveyed annually. This sample size approaches the practical maximum for field efforts, surpasses the sample size required to detect geographic patterns in community structure related to and independent of habitat variability, far exceeds the sample size needed to detect habitat changes in each watershed (Roper et al. 2003), and should be sufficient to detect a 20-50% change in salmonid densities per annum at the watershed scale.

Analysis: Annual estimates of density will be produced for each life-history stage and watershed. A geostatistical analysis will be conducted using population and habitat data to estimate fish-habitat relationships and to produce a geostatistical stock assessment of spawners and juveniles. Associative, trend, and descriptive analyses will be used to monitor changes in spawner and juvenile populations across space and time. Detailed analysis to be conducted is located in the detailed methods section of the Umatilla RM&E Plan.

Status: Spawner abundance data are collected by the Umatilla Natural Production Project. Spawner monitoring is funded by BPA and is ongoing. Trapping to enumerate juvenile out-migrants on Meacham Creek began in 2009. Summer steelhead index sites have been surveyed in the Umatilla for more than 10 years.

Objective 3: Monitor and assess the abundance, timing, life history characteristics, and in-stream survival of out-migrating steelhead.

An estimate of smolt abundance for natural-origin steelhead in the lower Umatilla River is essential to answering critical uncertainties related to natural production capacity and within subbasin productivity. In addition, an understanding of migration success and survival is necessary to identify in and out-of-subbasin limiting factors (including environmental conditions, flow, fish habitat, hatchery rearing and release strategies, predation, and passage difficulties) and estimated loss by life stage for natural- and hatchery-origin steelhead. This objective addresses Critical Uncertainties numbers six and seven. This is a high priority objective.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:

- What are the abundance, timing, and in-stream survival of out-migrating steelhead?
- What are the life history characteristics of out-migrating steelhead?

Performance metrics: Migration parameters, abundance, survival, and life history characteristics (including age, size and condition) of emigrating smolts.

Approach: Smolt abundance will be estimated for naturally-reared steelhead emigrating from Meacham Creek to TMFD, and for smolts from the lower Umatilla River, using fish collection and trapping efficiency on lower Meacham Creek and at TMFD. Smolt survival and migration parameters (timing, duration and travel speed) will be monitored for naturally- and hatchery-reared species using PIT tags and remote interrogation at Three Mile Falls and lower Columbia River dams. Juvenile life history characteristics including smolt outmigration timing, length, age, condition and smolt status will be collected.

An incline plane trap set in West Extension Canal is currently utilized to capture emigrating juvenile salmonids in the lower Umatilla River. The trap is located within the juvenile bypass facility off TMFD. Trapping is conducted between February and June, and coincides with the primary smolt emigration period. Fish are enumerated by species, race and origin (natural or hatchery). Scales are collected on a subsample of natural summer steelhead for age analysis and developmental (smoltification) stage for all species is assessed by visible

brightness and the presence or absence of parr marks. All smolts captured during fish sampling are interrogated for PIT tags. To improve total outmigration estimates, CTUIR's Natural Production Monitoring and Evaluation Project will enhance PIT tag detection rates at TMFD by installing improved detectors on the smolt bypass structure on the west side of the dam and in the adult fish ladder on the east side of the dam.

Analysis: Smolt survival estimates have previously been calculated using the Migrant Abundance Method (Burham et al. 1987 and Dauble et al. 1993) and the SURPH 2 model (http://www.cbr.washington.edu/). Environmental variables including water discharge, flow, temperature and water clarity in the lower river will be monitored and relationship to smolt survival and/or migration success will be assessed using regression and correlation analyses. Associative and trend analyses will be used to evaluate outmigration.

Status: Smolt abundance estimates for the Umatilla River basin were provided by the BPA-funded Umatilla Smolt Outmigration and Survival Project until 2007, when funding was discontinued. Funding was re-established for that project in 2009. Funding was obtained by CTUIR from BPA to estimate Meacham Creek smolt abundance and survival beginning in 2009.

Objective 4: Determine the current status and change in status of life history and genotypic diversity in the population.

Natural steelhead production in the Umatilla River basin is supplemented by hatchery-raised fish that spawn in natural environments. However, the artificial propagation of fish and manipulation of breeding structures includes genetic risks that may compromise the goal of supplementation (Currens and Schreck 1995). It is important to monitor the genetic characteristics of natural and hatchery-produced fish to insure that the artificially produced fish resemble the wild population genetically, that adequate effective population sizes are maintained to prevent catastrophic genetic drift, and that outbreeding depression does not reduce the reproductive success of the entire population. This objective addresses Critical Uncertainties numbers five and six. This is a high priority objective.

Type of monitoring effort: Long term status and trend monitoring.

Monitoring questions:

- What proportion of steelhead spawners are out-of-basin hatchery strays?
- What is the origin of out-of-basin strays?
- What are the population-level genetic characteristics of the Umatilla River steelhead population?
- What is the status of life history patterns and variation in the Umatilla steelhead population?

Approach: Numerous life history metrics are monitored in the natural- and hatchery-origin steelhead populations: adult and juvenile migration timing, growth rates, age structure, sex ratios and size at age. A subsample of natural-origin juveniles is PIT-tagged on the spawning

grounds for outmigrant detection at TMFD and Columbia Mainstem facilities. Scales of natural-origin juveniles can be sampled during EMAP surveys and lower river trapping.

We will collect genetic samples from 100 returning adults of both natural- and hatchery-origin collected at TMFD. In addition, juvenile samples have been collected for three years (2005-2007) from multiple locations in the basin. Genetic samples will consist of fin clips, which will be immediately preserved in alcohol. Sampling will be initially conducted for five years to determine changes in the performance metrics over a generation and assess the periodicity of additional sampling.

Analysis: Migration timing and age structure are assessed by distribution comparisons. Age and growth analysis will be conducted and associative models will be used to evaluate growth of natural- and hatchery-origin fishes from each release site and watershed.

The genetic samples will be analyzed using microsatellite and/or allozyme analysis to determine the genetic diversity among returning natural- and hatchery-origin adults, the genetic distance between natural- and hatchery-origin adults, and the effective population size of the natural-origin adults within the Umatilla subbasin.

Status: Monitoring of hatchery-origin steelhead that stray into the Umatilla River is conducted by the BPA-funded Umatilla Hatchery Monitoring and Evaluation Project. Genetics samples are collected by the Umatilla Natural Production Project, with samples processed by Columbia River Inter-Tribal Fish Commission fish geneticists.

Objective 5: Identify and assess factors limiting viability of Umatilla River steelhead.

Limiting factors analysis is the process by which factors affecting population productivity, capacity, diversity and spatial structure are identified. As conditions are improved through management actions, and limiting factors are addressed, it is essential to re-assess limiting factors to guide future actions. This objective addresses Critical Uncertainty number seven. This is a high priority objective.

Type of monitoring effort: Long term status and trend monitoring.

Monitoring questions:

- What environmental factors limit steelhead productivity in the Umatilla subbasin?

Approach: We have developed an improved version of EDT and AHA (All-H Analyzer) which is more representative of Oregon's Mid-C steelhead. The revised EDT model will be updated in the future as habitat actions begin to improve conditions and additional data are available. We will use the EDT model to re-assess limiting factors.

Analysis: Limiting factors and the capacity of the Umatilla subbasin will be analyzed every five years as part of regular evaluation activities. A multi-factor spatially explicit model (EDT and improved AHA) of the Umatilla subbasin will be used to estimate mortality in Umatilla, Columbia, and marine life-history stages.

Status: Ongoing, but will need additional funding for the future.

Objective 6: Determine the status and trend of current and historically utilized salmonid habitat in the Umatilla subbasin.

This recovery plan identifies a set of management actions that will increase natural production and harvest opportunities in the Umatilla subbasin through habitat restoration and protection, flow augmentation, passage restoration, and hatchery supplementation. There are a number of habitat-based RM&E information needs that must be addressed if the benefits of these management actions are to be effectively detected with sufficient power. Information from this objective addresses Critical Uncertainty number seven. This is a high priority objective.

Type of monitoring effort: Long term status and trend monitoring.

Monitoring questions:

- What is the status and trend in steelhead habitat quantity and quality throughout the Umatilla subbasin?
- What are the spatial distribution and quantitative features of Umatilla subbasin steelhead habitat?

Approach: A variety of complementary habitat monitoring activities are regularly conducted in the Umatilla subbasin to capture variance in physical, biological, and chemical conditions. The sampling regime of these activities has varied from continuous monitoring of flow and temperature, to decadal monitoring of riparian conditions. Monitoring has focused on factors that are not primarily controlled by upstream conditions so that measurable improvements can be detected in important elements of salmon habitat. Habitat recovery will primarily be measured in terms of regrowth of the riparian vegetation, vegetation and channel structure, and in-stream cover. In addition, vegetative recovery is related to improvements in bank stability and channel morphology, therefore geomorphic characteristics will also be monitored. These broader parameters, though not useful for project specific monitoring, are more important when tracking comprehensive subbasin-wide recovery. The spatially explicit sampling approach (EMAP) of all known spawning and rearing areas is recommended for sampling the known spatial extent and status and trend of steelhead habitat in the Umatilla subbasin. Representative sites within the subbasin are sampled annually using a three-panel rotating panel design. Panels include annual, every four years, and one-time visit selections. Habitat variables follow ODFW Aquatic Inventories design (Moore et al. 2002) and are measured at the unit and reach scale.

Analysis: Data are analyzed as distribution data in a GIS format. Sample sites are associated to specific major spawning and rearing areas. Database and GIS formatting of data allow associations with land use, land vegetation coverage, and many other attributes at watershed and population scales.

Status: BPA currently funds two Umatilla River Anadromous Fish Habitat projects; one managed by ODFW to improve and monitor habitat and the other managed by CTUIR to

increase our understanding of the spatial arrangements of physical processes that create and maintain critical habitats for Pacific Salmon in the Umatilla River basin and nearby basins.

Objective 7: Determine the influence of the current hatchery supplementation program on the natural population.

The reproductive success and genetic characteristics of hatchery-reared fish can be different from those of naturally-reared individuals or populations (Reisenbichler and McIntyre 1977). These differences stem in part from the environment of hatcheries, and in part from the artificial selection associated with the hatchery environment. The problem can in theory impact population growth (productivity of the natural-origin population) even when endemic stock is used and traditional stock domestication is avoided (Chilcote 2003; Reisenbichler et al. 2003). This objective provides information that addresses Critical Uncertainty numbers five and six. This is a high priority objective.

Type of monitoring effort: Long term status and trend monitoring.

Monitoring questions:

- Does supplementation alter the life history or genetic characteristics of the natural steelhead population?
- To what extent will supplementation enhance natural production of summer steelhead?
- Are residualization rates of hatchery releases greater than those of naturally-spawned fishes?
- Do the ecological relationships of hatchery-reared steelhead negatively impact naturally-reared steelhead?

The goal of supplementation is to enhance natural production by increasing survival of hatchery-origin fish, resulting in an increase the number of spawners in natural environments. However, the artificial propagation of fish and manipulation of breeding structures includes genetic risks that may compromise the goal of supplementation (Currens and Schreck 1995).

The hatchery supplementation program is managed to minimize potential unintended impacts on the life history characteristics of the native steelhead population. It is assumed that the use of natural-origin fish for broodstock will result in hatchery fish that mimic the behavioral characteristics of native fish, thus minimizing potential unintended impacts of the supplementation program. Since no pre-supplementation life-history information is available for pre- and post-supplementation comparisons, managers need to rely on long-term monitoring to detect shifts in native steelhead life history. However, the challenge of this approach is distinguishing whether these shifts are attributable to natural variability or hatchery supplementation.

Hatchery-origin fish are usually released at sizes and conditions which differ from their natural-origin counterparts. Sexually mature residualized fish can compete with returning anadromous adults for mates, and can compete with resident fish or pre-migrant juveniles for ecological resources. Recent studies by the Yakima-Klickitat Fisheries Program suggest that hatchery practices can be modified to decrease residualization rates if problems are detected.

Similar work should be conducted to determine the extent and impacts of hatchery fish residuals on the natural population.

Potential unintended negative impacts of hatchery supplementation to the life history and genetic characteristics of the endemic steelhead population in the Umatilla subbasin is a primary management concern. The management strategy for reducing risk of unintended impacts to the natural-origin steelhead population is to implement hatchery production protocols that maximize life history and genetic diversity of hatchery-origin steelhead. If protocols achieve their goal, smolt migration and adult life history characteristics expressed by hatchery-origin steelhead should mimic those of natural-origin steelhead, and reduce the risk of unintended impacts to the natural-origin steelhead population when hatchery-origin steelhead spawn naturally.

Ideally, assessing whether hatchery supplementation negatively impacts life history and genetic characteristics of the naturally population is best accomplished by a pre/post supplementation comparison of these characteristics. However, no pre-supplementation data are available to provide a baseline for pre/post comparisons. Therefore, the approach should be to monitor life history characteristics and assess whether smolt and adult life history and genetic characteristics expressed by hatchery-reared steelhead are similar to those expressed by naturally-reared steelhead and detect changes if they occur. These data can be used to assess population viability by measuring life history diversity.

The Umatilla Fish Hatchery has used endemic steelhead stock for more than a decade. Nonetheless, it is not possible under the current RM&E approach to validate the long-term success of hatchery-origin fishes, or to estimate the relative reproductive success of hatchery- or natural-origin individuals. Due to increasing concern for the welfare of endemic populations, the reproductive success and genetic characteristics of Umatilla steelhead remains a critical uncertainty. Pedigree studies are being used in a variety of subbasins to answer a number of questions. These endeavors are costly and resource intensive, but may provide essential management information. Pedigree studies can demonstrate the relative productivity of natural and hatchery fish in the environment and aid in determining the effectiveness of a supplementation program.

Approach: Polymorphic microsatellite loci have been used in a variety of studies to determine parentage and population structure (O'Reilly et al. 1998; Bernatchez and Duchesne 2000; Letcher and King 2001; Eldridge et al. 2002). The technique and its application have been thoroughly reviewed (Wilson and Ferguson 2002). Microsatellite analysis can be used to estimate the relative reproductive success of natural- and hatchery-origin steelhead, the long-term reproductive success of hatchery-origin steelhead, and the genetic characteristics of both stocks.

Two parallel studies have been proposed for the evaluation of long-term reproductive success at the watershed level. A weir is planned for the mouth of Iskuulpa Creek to sample returning adult steelhead. Adult anadromous returns, resident redband trout, and juvenile progeny will be sampled and genotyped for 16 microsatellite markers. This sampling regime will be followed for ten years, the completion of two full steelhead generations. This

pedigree analysis will be used to assess and compare the relative and long-term reproductive success of hatchery x hatchery (H x H), hatchery x natural (H x N), and natural x natural (N x N) crosses from Umatilla Mid-C summer steelhead.

In addition the testing of a new technique for the evaluation of progeny parentage is currently proposed. Hatchery-origin female returns will be injected with strontium chloride hexahydrate ($SrCl2 \cdot 6H2O$) in solution. This will serve as a mark of hatchery female parentage. These injections have been shown to elevate progeny Sr/Ca ratios in the otolith primordia. A subsample of progeny above the weir would be sacrificed, and their otoliths extracted. The proportion of "elevated" vs. normal Sr:Ca ratios would be used to estimate the fraction of offspring from hatchery- vs. natural-origin mothers.

We have completed an initial analysis to assess if nearby unsupplemented populations in the John Day Basin can serve as reference populations for the Umatilla supplementation monitoring. There is a high degree of correlation in the pre-hatchery treatment time period between Umatilla steelhead and the John Day populations for both abundance and productivity. We will use the John Day populations as reference populations to assess changes in abundance and productivity that result from the long-term hatchery supplementation program.

Residualized steelhead are currently planned to be sampled during EMAP surveys. Residuals would be classified based on the presence of a fin clip or wire tag for hatchery fish. Their distribution and abundance should be measured across the Umatilla watershed.

We will monitor and compare smolt and adult migration timing, ocean residency age structure, and adult sex ratios of natural- and hatchery-origin steelhead. Migration timing of steelhead smolts will be monitored via detection of PIT-tagged fish at TMFD, John Day, and Bonneville dams. Adult run timing of steelhead to the Umatilla River will be monitored by trap and video enumeration at TMFD and in-subbasin creel surveys below TMFD. Ocean residency age structure and adult sex ratios of steelhead will be monitored during adult trapping and handling operations at TMFD.

Ocean residency age and sex ratios of natural- and hatchery-origin adult steelhead are monitored during trapping at TMFD. Migration timing of natural- and hatchery-origin steelhead smolts is compared by calculating the percent of the run that passes TMFD, John Day, and Bonneville Dams on a weekly basis, and testing for a statistically significant difference. The same method is used to compare migration timing of natural- and hatchery-origin adult steelhead that pass TMFD. The proportions of the natural- and hatchery-origin runs that were one- and two-year ocean residents, male and female, and male and female by ocean age will also be compared.

Analysis: Umatilla adult steelhead samples are analyzed by the Columbia River Inter-Tribal Fisheries Commission cooperative genetics program at the Hagerman Fish Culture Experiment Station using microsatellite loci that have been optimized for steelhead studies. Juvenile samples are analyzed by NOAA Fisheries as a part of the Columbia basin-wide genetic monitoring program. Samples are analyzed for each brood and return year.

Genotypes are assembled using 16 microsatellite markers. Parentage is estimated using a variety of exclusion, likelihood, pair-wise relatedness, and genetic similarity algorithms (Wilson and Ferguson 2002). The relative and long-term reproductive success of hatchery x hatchery (H x H), hatchery x natural (H x N), and natural x natural (N x N; including steelhead x steelhead and steelhead x redband trout) crosses will be evaluated in the controlled escapement experiment in Iskuulpa Creek.

Status: Partially funded by BPA and implemented by CTUIR and ODFW.

Objective 8: Monitor and assess the impact of flow enhancement on steelhead survival, habitat, and migration.

Considerable effort and resources are directed at flow restoration in the Umatilla River. Umatilla flow management programs are considered a Columbia Basin success story due to the cooperative efforts between CTUIR, BLM, and the various water-rights managers in the subbasin. However, some of the direct benefits to fish have not been quantified. While the relationships between flow restoration and trap-and-haul work are comparatively straightforward, the relationship between increased flow and increased spawning and rearing habitat has not been directly studied. Additional flow restoration activities including the Phase III flow exchange project are receiving considerable attention. Baseline effectiveness monitoring is needed to understand the added benefits to fish that these future flow programs would bring to the subbasin. This objective provides information that addresses Critical Uncertainty number seven. This is a high priority objective due to the cost and scale of the flow enhancement efforts.

Type of monitoring effort: Effectiveness monitoring.

Monitoring questions:

- What is the impact of flow enhancement on steelhead survival and frequency of steelhead transport?
- What is the effect of flow enhancement on the availability of spawning and rearing habitat?
- What is the effect of flow enhancement on steelhead migration?

A major passage restoration project is planned for the Umatilla Mainstem at Feed Canal (Harza Engineering Company 1999). Experience has shown that not all passage restorations are successful, so project effectiveness monitoring is warranted upon completion of construction and beginning of operations. The efficacy of two additional fish passage facilities, the Boyd Hydro and Maxwell Dams, is uncertain due to a lack of data associated with these recently renovated structures. Passage at these facilities needs to be evaluated.

Adult and juvenile fish passage facilities at irrigation diversions in the Umatilla mainstem were reconstructed from 1988 to 1994. Effectiveness of the updated facilities has previously been evaluated. Juvenile passage evaluation was conducted by ODFW (Knapp and Ward 1990; Knapp 1992; Cameron and Knapp 1993; Cameron et al.1994, 1995, 1997; Walters et al. 1994), adult passage evaluation was conducted by CTUIR (Kutchins 1990; Kissner 1992,

1993; Volkman 1994, 1995; Contor et al. 1996, 1997), and Nigro and Ward (1986) evaluated channel modification below Three Mile Falls Dam. These studies identified two passage impediments in the Umatilla mainstem and recommended potential corrective measures.

Performance metrics: Percent of juvenile and adult returns which pass through the lower river volitionally, during enhanced flows, and those requiring transport, survival from TMFD to spawning, and spawning distribution.

Approach: We will monitor and report the percent of juvenile and adult returns which pass through the lower river volitionally, during enhanced flows, and those requiring transport. This computation will include an adjustment to account for transit time from enumeration at TMFD to when their migration through the flow-enhanced river reach is completed. These adjustments will be based on estimates of juvenile and adult migration speeds available from adult radio tracking studies conducted from 1994-1996 (Volkman 1994 and 1995, Contor et. al 1996 and 1997) and smolt migration monitoring from the recently funded smolt outmigration and monitoring project..

Logistical difficulties impede assessment of survival benefits from flow enhancement for smolts migrating through the lower Umatilla River. A potential approach for assessing benefits to smolt migrants is a tier III treatment and control experiment, where the treatment is smolts volitionally migrating past the juvenile trapping and transport facility at RM 27 during flow enhancement and the control is smolts trapped at RM 27 and transported to the river mouth (simultaneous to tagging of treatment fish).

Juvenile habitat utilization and summer steelhead spawning will be monitored in the Umatilla mainstem during annual EMAP surveys. Summer stream temperatures will be monitored in collaboration with BOR and CTUIR water quality programs. Habitat quantity will be monitored continuously as a function of stream flow throughout the supplemented reaches of the Umatilla River.

Adult steelhead could be collected and radio-tagged at TMFD using standardized handling techniques. Fixed site radio telemetry receivers would be placed at key passage barriers to monitor migration around these obstructions. Baseline estimates of passage and delay are available for various flow regimes (Contor et al. 1995, 1996, 1997, 1998).

Analysis: Habitat potential will be modeled regularly using a spatially explicit model of habitat quality and quantity such as EDT, facilitating the evaluation of the relative impacts of various flow management regimes, including the implementation of Phase III flow exchange.

The benefits of flow augmentation will be analyzed based on comparative performance of the lower and middle Umatilla mainstem reaches as indicated by habitat, rearing, and spawning metrics. Data collected will be compared to the baseline data to evaluate the effectiveness of the passage restoration projects.

Status: BPA funds the CTUIR managed Umatilla Fish Passage Operations project, which collects data on juvenile and adult steelhead passage in relation to flow. BPA also funds the

ODFW managed Umatilla Smolt Outmigration and Survival Project. Monitoring of adult steelhead migration past potential barriers, using radio telemetry, occurred in 2008 and 2009, Funding is needed to investigate relationships between flow and juvenile habitat use.

Objective 9: Determine the effect of mainstem hydropower operations and operational improvements on viability of Umatilla River steelhead population.

This is a high priority objective.

See John Day MPG for *Timeline, Monitoring Questions, and Approach*.

Objective 10: Determine the effect of harvest on the abundance, productivity, diversity, and distribution of the natural-origin population.

Restoring and optimizing fishery opportunities are a primary goal of local and regional fishery managers. However, this can be a challenging due to changes in fishing effort, run sizes, catch and harvest that are likely to occur as environmental and anthropogenic conditions vary and the fisheries restoration program matures. In addition, fisheries are also managed to keep unintended impacts to natural and hatchery production and non-target species within acceptable limits. This objective addresses Critical Uncertainty number four. This is a high priority objective.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:

- What is the annual harvest rate that occurs outside of the Umatilla River subbasin?
- Do summer steelhead return at a level of abundance adequate to support annual fisheries?
- What is the annual harvest rate that occurs within the Umatilla River subbasin?
- What is fishing effort, catch, and harvest for tribal and non-tribal fisheries in the Umatilla River?
- Are harvest goals met and do management actions optimize fishing opportunities while meeting production and population objectives?

Much of the impetus for the Umatilla supplementation and reintroduction programs are tribal and non-tribal harvest mitigation. Steelhead fisheries take place throughout most of the mainstem Umatilla River using a diversity of fishing gear. Tribal fisheries mostly occur upstream within the CTUIR Reservation and consist of a subsistence fishery using gaffs or dipnets and a recreational fishery using rod-and-reel. Non-tribal fisheries occur from Pendleton downstream to the river mouth using rod-and-reel, with most effort, catch, and harvest concentrated below TMFD. Creel data provide information needed to determine whether harvest goals are achieved or exceeded, enumerate fish removed from the run below TMFD, and assess how to optimize fishing opportunities through adaptive management. Accurate run size predictions allow managers and program staff to plan appropriate broodstock collection, harvest, spawning escapement, and CWT recovery strategies in advance. Run predictions are integrated into co-management of the Umatilla Subbasin Fishery Program through the development of an annual plan for hatchery and subbasin

operations. Harvest estimates for Umatilla subbasin-origin fish in out-of-subbasin fisheries provide essential data to track status and trends of fish populations, provide a full accounting of all hatchery production and rearing strategies, compare recruits-per-spawner ratios of natural- and hatchery-origin fish, and evaluate alternative hatchery production and release strategies.

Approach: Out-of-basin harvest contributions are currently grouped by three main fishery areas: ocean, Columbia River, and in-subbasin fisheries. The number of adults harvested by individual hatchery groups and the total number for all hatchery groups by run year are reported. A database of recoveries by brood year contributions is also maintained.

Annual out-of-subbasin harvest is reported for tribal and non-tribal ocean, Columbia River, and subbasin fisheries. In out-of-subbasin fisheries that are selective for hatchery-origin fish, harvest of hatchery-origin fish are estimated from CWT recoveries reported on the Pacific States Marine Fisheries Commission CWT database. In out-of-subbasin fisheries, which are not selective for hatchery-origin fish, harvest of natural-origin fish is estimated based on exploitation rates of hatchery-origin fish.

Tribal fisheries are monitored using roving creel surveys, phone surveys, and volunteer fishing journals. Non-tribal fisheries are monitored using a combination of stratified roving creel surveys and "punchcard" data from anglers who turn in their salmon and steelhead harvest cards. Harvest estimated from creel surveys is used to monitor the developing fisheries in the Umatilla River to assess harvest potential and whether annual harvest goals are met. Overall harvest goals are listed in Table 2 of the Umatilla RM&E plan, and harvest goals for varying run sizes are currently under development. Creel information on spatial and temporal patterns of fishing effort, catch, and harvest are used to assess whether fisheries are optimized within the constraints of natural production and population objectives.

Creel surveys in the non-tribal fishery are composed of three main components: 1) angler counts, 2) interviews to obtain information on catch rate, harvest rate, gear types, and angler demographics, and 3) collection of biological, mark, and CWT information from catch. A roving creel survey is used to count and contact anglers in the steelhead fishery. The lower river is surveyed from September 15 to April 15, and the upper river from January until April 15. Fishing effort is typically very low in the lower river from February through April.

Correlation models have been developed for preseason prediction of steelhead run size to the Umatilla River. Correlations for steelhead ($r = 0.87$) run size to the Umatilla River are based on forecasted steelhead run sizes to Bonneville Dam (Upriver A-run for steelhead). The steelhead model is updated in early-September after the Upriver A-run to Bonneville Dam has been counted.

Analysis: Ratios between punchcard and creel data are used to estimate harvest in the river reach from TMFD upstream to about RM 37 that is logistically difficult to access and survey. Geographically and temporally stratified variance in the tribal and non-tribal catch and harvest estimators are based on the variances of the fishing effort and catch and harvest rates. Effort, catch, and harvest are estimated monthly for steelhead.

Analysis follows Malvestuto (1996) for the field work and Cochran (1977) for creel survey data by expanding subsamples by sample strata and proportional coverage rates. Similar expansions are used to extrapolate tribal wide harvest estimates based on postseason interviews. Catch-per-unit-effort is estimated directly from interview responses and fishing journals. Total fishing effort is estimated based on time period, week period, and site encounter probabilities.

Status: Partially funded by BPA. ODFW has monitored the non-tribal steelhead fishery on the Umatilla River since 1992, and the out-of-subbasin harvest estimates are determined by the hatchery M&E project.

Objective 11: Determine the effect of predation on the abundance, productivity, diversity, and distribution of the natural-origin population.

The objective is moderate priority because predation has not been identified as a key limiting factor.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring question:

- What are the predation rate and predatory impact of introduced fishes in the Umatilla River on juvenile steelhead?

Approach: Annual collections of smallmouth bass and other piscine predators in the Umatilla River could be conducted using angling techniques. Collected stomach samples would be analyzed for the presence of juvenile salmonids. These data could be incorporated into a bioenergetics model to derive a population-level consumption estimate imposed by introduced fishes. Sampling of predatory fish diets should occur during times and locations when and where their distribution overlaps with juvenile steelhead.

Analysis: Interpretation of the predatory impact in the migration corridor should be conducted from methods established in published literature (Ward et al. 1995, Fritts and Pearsons 2006). The proportion of total mortality (e.g. SAR) attributable to predatory mortality could be estimated from bioenergetics modeling results.

Status: Currently unfunded and not implemented.

Objective 12: Monitor production, survival, harvest and spawning of hatchery-origin steelhead.

Monitoring survival and disposition of all hatchery fish through all life stages provides fundamental information required to assess what changes may be needed if management objectives are not met. Information on the magnitude of losses at each life stage also assists managers to determine priorities for changes. Adaptive management actions may involve aspects of the hatchery program or changes to fish restoration programs, harvest regulations, and hydrosystem management within or outside of the Umatilla subbasin.

In 1994, following ESA section 7 consultations concerning the effects of straying by non-native hatchery-origin fish, NMFS set an interim standard to limit stray, non-native hatchery-origin fish to 5% of any naturally spawning population (Grant 1997). To achieve this management standard and provide the necessary information needed to develop risk containment strategies for straying, all hatchery production which has the potential to stray into spawning areas of ESA-listed populations needs to be adequately marked, and monitoring programs must be present in ESA areas to recover marked fish. In addition, adaptive management of the Umatilla subbasin fisheries restoration program may have potential to reduce straying by adjustments in the timing of flow enhancement, and increased capabilities for flow enhancement if Phase III water exchange is implemented. This M&E objective is focused on providing information needed to monitor standard hatchery production goals, adaptive management of the Umatilla subbasin hatchery program, and straying of hatchery production fish into areas with ESA-listed steelhead populations.

Release sites for smolts in a hatchery steelhead supplementation program are typically located high in a subbasin, in or near tributary streams that are targeted for supplementation. In contrast, harvest oriented hatchery programs typically release steelhead smolts in lower mainstem reaches of a subbasin. In the case of the Umatilla subbasin steelhead supplementation program, hatchery smolt releases in Meacham Creek are intended to provide the Meacham Creek spawning aggregate with additional hatchery-reared spawners. Hatchery smolt releases into the Umatilla mainstem lower in the subbasin at Minthorn (RM 64) and Pendleton (RM 56) have a dual harvest-supplementation intent. They are intended to enhance fisheries in the upper Umatilla mainstem while providing "Middle Umatilla" tributaries with additional hatchery-origin spawners.

The Birch Creek watershed is managed as a native steelhead sanctuary. Adult escapement was monitored for a number of years by CTUIR and ODFW, and fraction was consistently less than 5%. Periodic monitoring of spawning escapement to Birch Creek is warranted to determine if straying and the hatchery fraction remain at low rates. This is a high priority objective because of the assumed benefits and high degree of uncertainty in the management action.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:

- Are hatchery returns achieving the goals of the comprehensive plan?
- Are recruits-per-spawner ratios higher for hatchery-origin compared to natural-origin steelhead?
- What is the number of hatchery-origin returns that stray?
- What percent of returns stray into the Snake and upper Columbia River basins?
- Does hatchery supplementation result in increased natural production of steelhead?
- What proportion of steelhead spawners in the Umatilla subbasin is derived from the hatchery program, and what is their distribution?

Performance metrics: For all hatchery production and release strategies: annual numbers of smolts produced, smolt-to-adult survival by brood year; number of adults produced by brood

year, annual number of adult returns, and annual and brood year harvest and number of natural spawners.

Approach: Routine in-hatchery production and survival is monitored by hatchery staff and reported to the statewide ODFW hatcheries database. This M&E objective primarily describes monitoring activities conducted outside of the hatchery. Survival of hatchery-origin fish during the smolt migration life stage is currently monitored by detection of PIT-tagged smolts in the lower Umatilla River and at John Day and Bonneville dams in the Columbia River. Adult production, SAS, harvest, and straying of all hatchery production and release groups are monitored using CWTs. Adult returns to the Umatilla subbasin for all hatchery production and release groups are monitored using CWTs recovered within the subbasin.

Repeated spawning ground surveys could provide a future measure of the presence of hatchery (fin-clipped) steelhead in the Birch Creek watershed during the spawning season. While actual fish observations may be low, repeat spawning ground surveys on the John Day River have demonstrated that visual surveys are feasible. This approach is much more logistically and financially feasible compared to the operation of a new weir and adult trap.

Rearing and release history of hatchery steelhead returns to the Umatilla subbasin is monitored using CWTs recovered from all locations within the subbasin. Of particular regional interest is the identification of non-Umatilla origin hatchery groups that enter the Umatilla River in spring that will likely spawn with ESA listed Umatilla steelhead.

Recruits-per-spawner ratios of hatchery-origin steelhead over time must be substantially higher than those of natural-origin steelhead for hatcheries to be a viable tool for fisheries restoration. If this is not the case, more adult production will be realized by leaving hatchery broodstock in the river to spawn naturally. The number of additional adults produced by hatchery programs also must be great enough to overcome potentially lower productivity (reproductive success) when they spawn naturally compared to natural-origin fish.

Numbers of adult parents will be known from spawning records for hatchery-origin fish, but will require estimation for natural-origin steelhead. Spawning information is documented in annual reports produced by the CTUIR Umatilla Hatchery and Satellite Facilities O&M Project (BPA Project # 83-435). Numbers of natural-origin parents are from counts at TMFD. Adult progeny from a brood will return over multiple years. Number of progeny per brood for hatchery-origin fish is estimated from abundance and age information acquired by CWT recoveries. Number of progeny per brood for natural-origin steelhead that return to TMFD is estimated by collecting scales for age analysis to apportion adult returns by brood year. Numbers of natural-origin steelhead harvested in non-selective fisheries is estimated by creel surveys for Umatilla subbasin fisheries and by using CWT recoveries of harvested hatchery-origin fish as a surrogate for harvest of their natural-origin counterparts in out-of-subbasin fisheries. For out-of-subbasin harvest, it is assumed that the age classes of the natural-origin fish harvested out-of-subbasin are equal to the age composition of returns to the Umatilla River. Monitoring straying of adult steelhead from the Umatilla subbasin

hatchery is conducted by marking steelhead with a CWT and analyzing out-of-subbasin CWT recovery data.

Analysis: Up until 2004, in-basin survival of hatchery salmonids was estimated using the Migrant Abundance Method (Burham et al. 1987 and Dauble et al. 1993). Commencing in 2005, in-basin and out-of-basin survival for natural and hatchery steelhead was estimated using the CRISP and SURPH models. The Umatilla Outmigration and Survival study is no longer funded, thus these estimates are not currently available.

Testing for significant differences in survival rates is conducted annually and over five-year periods. Smolt survival estimates generated by SURPH include a point estimate and associated variance.

Relative survival of PIT tagged groups from valid comparisons to TMFD, and John Day and Bonneville Dams were compared in the past. PIT tag information is currently submitted and recovery data obtained from the PSMFC database. Number, travel time, and length at PIT-tagging are recorded for each release group at all reporting observation sites.

To determine number of adult progeny produced per brood for natural- and hatchery-origin steelhead, calculate P:P ratios for both natural- and hatchery-origin fish as total number of adult progeny produced divided by total number of adult parents that spawned.

Numbers of adults which are recovered at terminal locations outside of the Umatilla subbasin (spawning grounds, hatcheries, and adult traps) can be reported for the following areas: Snake River Basin, Columbia River Basin above McNary Dam, Columbia River Basin below McNary Dam, and all other locations. No steelhead with CWTs have been recovered at out-of-subbasin terminal locations to date.

Status: Partially funded by BPA.

Objective 13: Determine the transmission and effect of disease on the abundance, productivity, diversity and distribution of the natural-origin population.

The overall goal of the fish health program is to release fish into the Umatilla subbasin that are known to have a healthy disease history during rearing to minimize impacts on naturally- and other hatchery-reared fish. This is a low priority objective because disease effects have not been identified as a limiting factor.

Type of monitoring effort: Long-term status and trend monitoring.
Monitoring questions:

- What are the prevalence and level of pathogens in natural- and hatchery-origin steelhead?
- What are the magnitude and pathways of disease transmission between hatchery- and natural-origin steelhead?
- What is the prevalence of whirling disease in the Umatilla River basin, and what is its influence on the natural steelhead populations?

Performance metrics: Pathogen prevalence and levels in natural- and hatchery-origin steelhead.

Approach: The health of hatchery-origin fish should be monitored starting with broodstock and continuing through rearing and release of juveniles. Natural fish health is assessed on mortalities encountered during parr, smolt, and spawner monitoring activities. If possible, all sampling, diagnostic, and statistical analyses will conform to the Integrated Hatchery Operations Team and the Pacific Northwest Fish Health Protection Committee guidelines. All monitoring is consistent with the ODFW fish health policy and the native fish conservation policy.

All raceways of each species and stock at Umatilla Hatchery are monitored monthly for fish health. Monthly monitoring consists of examining five fresh-morbid or moribund fish from each raceway for systemic and gill bacteria on TYE-S agar. In addition, monthly inspections include microscopy of gill tissue and body scrapings for parasites and gill condition from a minimum of five fish. Sixty fish are tested annually for *Myxobolus cerebralis,* the causative agent of whirling disease. Within four weeks of transfer from the hatchery, tissues from grab-sampled fish are examined for virus on cell cultures from a minimum of 10 fish per raceway. Gill and body scrapings are examined by microscopy from a minimum of three fish per lower raceway at Umatilla Hatchery. In addition, prior to their liberation from acclimation facilities most groups of fish are examined from each acclimation pond as in the monthly monitoring protocols described above.

A minimum of 60 broodstock fish are examined for culturable viruses as per fish health section bluebook methods. This includes ovarian fluid and pyloric caeca/kidney/spleen samples from all broodstock for this program. All broodstock mortalities are examined for culturable systemic viruses using TYE-S agar.

Currently, fish health personnel examine naturally-reared fish that are submitted for analysis. Submissions consist of mortalities from naturally-reared juveniles obtained from smolt traps and parr collected during juvenile fish sampling. Disease examinations include testing for *M. cerebralis,* IHNV, and other culturable viruses.

Analysis: Analysis of samples will follow standard protocols defined in the latest edition of the American Fisheries Society "Fish Health Blue Book" (Procedures for the Detection and Identification of Certain Fish Pathogens).

Status: Partially funded by BPA, partially implemented.

13.3.2 Walla Walla River Population

Summer steelhead are currently the only natural population of anadromous fish in the Walla Walla subbasin. Steelhead restoration and management programs in the Walla Walla subbasin include hatchery actions, harvest management, and habitat, flow, and passage improvement projects. Artificial production programs for steelhead include a Lyons Ferry Hatchery steelhead harvest mitigation program and an experimental endemic steelhead mitigation program in the

Touchet River population. The "Comprehensive Aquatic Research, Monitoring and Evaluation Plan" (RM&E plan, Appendix AD3 in the Walla Walla Subbasin Plan) outlines a strategy for obtaining information needed to assess the performance and evaluate the success of these restoration programs.

The research, monitoring, and evaluation objectives and approaches that follow are from the RM&E section of the Walla Walla Subbasin Plan (2004). To date, a comprehensive Walla Walla subbasin RM&E plan, including critical uncertainties, has not been agreed upon by all agencies, however research priorities are listed in the Subbasin Plan and in this report. Some of the monitoring and evaluation activities described in this plan are ongoing. However, several currently unfunded activities are proposed in this plan to address key information gaps and improve ongoing efforts. These proposed activities include modification of ongoing monitoring, critical uncertainty research, and innovative study approaches.

Status monitoring is performed at multiple scales for summer steelhead in the Walla Walla subbasin. Natural production status monitoring includes abundance indices for juveniles (parr and smolts), number of returning adults, estimated redd numbers, as well as flow, temperature, and habitat data to assess the success of flow augmentation and stream restoration work. Hatchery and natural production evaluations include the monitoring of smolt-to-adult returns, smolt-to-adult survival, catch contribution, catch distribution and straying rates, and experimental releases of juveniles and spawners. Juvenile outmigration monitoring includes the number of outmigrating smolts, travel timing, and survival to downstream dams. In addition, the fisheries are monitored using creel surveys and marine fishery observations to estimate the contribution of Lyons Ferry Hatchery fish to all commercial, subsistence and recreational fisheries.

The objectives of status monitoring are to describe existing habitat conditions and population status, and to assess trends over time. The NOAA Fisheries RM&E plan (NOAA 2003) calls for status monitoring to document progress toward recovery of listed populations. Repeated measurements (temporal replicates) are taken over time to quantify change. Existing population conditions are compared to performance standards as established in the appropriate recovery or master plans.

The Walla Walla EDT model was parameterized during the subbasin planning process without extensive empirical data for the subbasin. In all cases, empirical data were used if available. However many habitat attributes were rated based on local knowledge and best scientific judgment. It is clear that there is significant uncertainty in how well the data represent habitat and fish assemblage conditions. Improving the quality of habitat data is an important step in improving future modeling efforts. Improved data quality can be achieved by collecting additional empirical data and future efforts should focus on the following recommended attributes.

1) Those attributes with the greatest importance in EDT model results (e.g. maximum width, gradient, habitat type inventories, large wood, bed scour).
2) Those that are within the priority protection or restoration stream reaches identified in Section 9.

3) Data that are limited for attributes which have a broad (subbasin wide) effect on population or habitat status (passage at obstructions, water quality, others).
4) Attributes identified as primary limiting factors in Section 8.

The general M&E framework for the Walla Walla subbasin is guided by the need to fill data gaps and establish a better understanding of the baseline habitat conditions including the characteristics of passage, flow, substrate and ecological interactions which most directly impact the production of steelhead. The overall goal of monitoring and evaluation efforts will be to address, at a minimum, those critical areas for VSP analysis as described by NOAA Fisheries. Specific performance measures were identified for the four VSP areas:

1) *Adult abundance*: Run size to the basin (this can be greatly impacted by out-of-subbasin effects but is critical to monitoring population status). Estimates or enumeration of escapement to the spawning grounds including hatchery fish and harvest within the subbasin (hatchery harvest and incidental hooking mortality of natural-origin fish). Out-of-basin harvest and mortality may limit recovery.

2) *Juvenile:* Smolt production at the population scale to reflect freshwater survival and production within the basin. It will be critical in modeling population response to habitat restoration actions.

3) *Diversity:* Genetic characterization, phenotypic diversity, life history pathways (juvenile and adult), and artificial propagation effects (hatcheries).

4) *Spatial Structure:* Distribution of juveniles and adults within the population, habitat limiting factors by life stage.

5) *Productivity:* Population growth rate or potential – smolts per spawner, natural-origin recruits-per-spawner, and population growth rate.

Monitoring of these key VSP parameters and their various performance metrics is described in the RM&E objectives that follow.

Objective 1: Monitor and assess the status and trends of abundance and productivity of hatchery- and natural-origin steelhead.

Adult abundance estimates to the Walla Walla River population are a critical metric for monitoring the status and long-term trends of this steelhead population. Monitoring trends in the performance metrics listed below will be critical to assessing the performance of the Walla Walla subbasin fish restoration program. These measures will also be used in viability analyses to estimate productivity and natural production capacity. Adult monitoring in the Walla Walla River is limited by the absence of a trap or ladder near the mouth of the river. Therefore, total returns to the Walla Walla River population are estimated from counts at Nursery Bridge and expansions of these counts to unsurveyed areas in the remainder of the population. Expansions are based on habitat capacity relationships and there is considerable uncertainty. Traps exist in

the middle-upper reaches of each drainage. Facilities at the Bennington Dam fish ladder require improvements to function for effective fish enumeration. This is a highest priority objective.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:

- What is the annual steelhead spawner abundance in the Walla Walla and Mill Creek watersheds?
- Is the 10-year GM of natural-origin steelhead spawners in the Walla Walla population greater than or equal to the recovery criteria for natural-origin spawners?
- What are the current and trend in the 20-year population growth rate?
- What are the current and trend in smolts/spawner?
- What are the current and trend in adult spawner-to-spawner ratios?

Performance metrics: Number of hatchery- and natural-origin adult spawners in the Walla Walla population, run timing of hatchery- and natural-origin adult returns, smolts-per-spawner, adult spawner-to-spawner ratios.

Approach: Numbers of adult hatchery- and natural-origin returns will be enumerated by trap counts, as well as by visual redd surveys. Current traps/monitoring stations in the basin include Nursery Bridge, Bennington Dam ladder, and the Yellowhawk fish weir. A complete count of escapement past these locations could be obtained, but several of the facilities require improvement.

CTUIR will sponsor a design investigation to study the feasibility and technical requirements of placing a video-sonar adult monitoring system at or near the mouth of the Walla Walla. The study will cover design and maintenance requirements for a system, and will recommend best-available technology for such a system. If implemented the system would greatly aid management in understanding total abundance of adult returns to the Walla Walla, run timing and environmental correlates of migration in the lower river. In addition, CTUIR will work with USACE to improve fish monitoring equipment and protocols on Bennington Dam as described by Tice (2004). Improvements may include the use of visual, sonar, and lasers to acquire a more complete count of fish passing the facility.

Analysis: Counts of adult returns in combination with other metrics described in later M&E objectives (harvest, straying, spawner abundance, and smolt outmigrant abundance) will be used to estimate key metrics of abundance, survival (smolt-to-adult survival, pre-spawn mortality) and productivity (smolts-per-spawner, adult spawner-to-spawner ratios).

Status: Partially funded, ongoing.

Objective 2: Monitor and assess the distribution and density of spawners and juveniles.

An understanding of spatial and temporal variance in both spawner and juvenile production and productivity is necessary to estimate a variety of performance measures. Improved accounting of adults into the upper Mill Creek is needed. This is a highest priority objective.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:

- What are the annual distribution and abundance of spawners and redds in each watershed?
- What are the spatial distribution of the occupied spawning areas and density of spawners within the population boundaries?
- What are the current spatial extent and distribution of rearing habitat used by juvenile steelhead?
- What are the relative abundance and distribution of juvenile steelhead, by age, seasonally throughout the basin?

Performance metrics: Spawner spatial distribution, spawn timing, and rearing distribution.

Approach: Sampling will be conducted for steelhead within their spawning and rearing habitat. The sampling design will follow a modified EMAP protocol. Spawner surveys will be randomized by tributary and reach for randomly selected reaches. Index reaches have been established for most of the subbasin. Juvenile surveys will be randomized by watershed, or stratified where randomization is undesirable. Annual estimates of density will be produced for each life-history stage, watershed, and at the population-scale.

Electrofishing, seining, and trapping will be used to quantify the abundance of juvenile salmonids at the reach scale. The sampling universe for juvenile surveys will be the EDT reaches developed for subbasin planning. We will use these reaches and watershed delineations to allocate sampling across the subbasin.

Instead of attempting to populate traditional statistical models, we will use a geostatistical estimator of population variance to project juvenile stock assessments across watersheds based on annual juvenile fish surveys. We will survey permanent index sites in each target watershed using multiple pass depletion electrofishing, snorkeling, and seining between barrier nets. Habitat conditions of the index sites will be estimated every 3 to 10 years, and the wetted width and volume of each site will be determined annually. An additional 2-5 sites will be randomly selected using a spatially balanced algorithm (Stevens and Olsen 2003, 2004). Within each reach sampling sites will be distributed randomly where possible, but will conform to landowner requests and trespassing laws. Fish communities and habitat information will be sampled at each randomly selected site. A draft site selection is currently under development and review by EPA's EMAP laboratory for the Walla Walla subbasin. Thirty permanent index sites and at least an additional thirty randomly selected sites will be sampled each year. This sample size approaches the practical maximum for field efforts, surpasses the sample size required to detect geographic patterns in community structure related to habitat variability, far exceeds the sample size needed to detect changes in each watershed (Roper et al. 2003), and should be sufficient to detect a 50% change in salmonid densities per annum at the watershed scale. Approximately five to ten percent of the catch will be PIT-tagged for survival and outmigration monitoring. This will provide a sample for the assessment and monitoring of within-subbasin survival of salmonids using detections at Columbia River PIT-tag detectors and the within-subbasin rotary screw traps.

Spawner surveys will be conducted during the appropriate spawning and holding season. Effort will be allocated using a stratified randomization of EDT reaches based on known and historical spawning habitat. Redds will be enumerated as an index of spawner abundance using multiple-pass visual surveys of the spawning grounds. The location of each redd will be georeferenced. The condition of each redd and any observed spawner activity will be noted. Each observed redd will be flagged by marking tape on adjacent vegetation to avoid re-sampling.

Steelhead survey efforts will be stratified using index sites that have five- to ten-year datasets. Each site will be visited annually and receive at least three passes each year. An additional two to six randomly selected reaches will be surveyed annually using multiple-pass visual observations. The co-managers are currently working to develop a rolling panel or continuous survey methodology for summer steelhead and bull trout.

Analysis: A geostatistical analysis will be conducted using population and habitat data to estimate fish-habitat relationships and to produce a geostatistical stock assessment of spawners and juveniles. Associative and trend analyses will be used to monitor changes in spawner and juvenile populations.

Status: Spawner monitoring is funded and ongoing; juvenile surveys are funded and implemented.

Objective 3: Monitor and assess the abundance, timing, life history characteristics, and in-stream survival of out-migrating steelhead.

An estimate of smolt abundance for natural-origin steelhead in the lower Walla Walla River is essential to answering critical uncertainties surrounding natural production capacity and within-subbasin productivity. In addition, an understanding of migration success and survival is necessary to identify in and out-of-subbasin limiting factors (including environmental conditions, flow, fish habitat, hatchery rearing and release strategies, predation, and passage difficulties) and estimate loss by life stage for hatchery- and natural-origin fish. This is a highest priority objective.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:
- What are the abundance, timing, and in-stream survival of out-migrating steelhead?
- What are the life history characteristics of out-migrating steelhead?

Performance metrics: Migration parameters, abundance, survival, and life history characteristics (including age, size and condition) of emigrating smolts or migrants.

Approach: Total population smolt abundance will be estimated for natural-origin steelhead emigrating from the Walla Walla River using a rotary screw trap. In addition, estimates of outmigrant abundance will be obtained for the upper Walla Walla and Mill Creek rivers using rotary screw traps. The Bootstrap method with 1,000 iterations will be used to derive a

variance. Smolt survival and migration parameters (timing, duration and travel speed) will be monitored for hatchery- and natural-origin fish using PIT tags and remote interrogation at the lower screw trap and Columbia River dams.

Environmental variables including water discharge, flow, temperature, and water clarity in the lower river will be monitored. Juvenile life history characteristics including smolt emigration timing, length, age, health, condition and smolt status will be collected.

Analysis: Smolt survival estimates will be calculated using the Migrant Abundance Method (Burham et al. 1987 and Dauble et al. 1993) and the SURPH 2 model (http://www.cbr.washington.edu/). The binomial test will be used to test for significant differences in detection between comparable release groups of hatchery-reared fish. The relation of environmental variables to smolt survival and/or migration success will be assessed using regression and correlation analyses. Associative and trend analyses will be used to evaluate outmigration.

Status: Partially funded, modification and expansion of ongoing activities are needed.

Objective 4: Monitor and assess the residualization of hatchery- and natural-origin steelhead.

Hatchery-reared fish are released at sizes and conditions that differ from their naturally-reared counterparts. Sexually mature residualized fish can compete with returning anadromous adults for mates, and can compete with resident fish or pre-migrant juveniles for ecological resources. Recent studies suggest that hatchery practices can be modified to decrease residualization rates if problems are detected. The purpose of this work will be to determine the extent and impacts of residualism, whether hatchery practices produce greater-than-natural residualization rates, and to provide some potential corrective measures. This is a moderate priority objective.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:
- What is the distribution and relative abundance of hatchery steelhead residuals?
- Are residualization rates of hatchery releases greater than those of natural-origin fishes?

Performance metrics: Residualization rates.

Approach: The WDFW Snake River Lab and Fish Management have annually surveyed (electrofishing) the juvenile production areas of the Touchet River since 2001. Hatchery-origin summer steelhead have been captured and identified (Lyons Ferry stock or Touchet Endemic stock), and residual population estimates have been derived to assess the overall impacts. Juvenile surveys will continue into the future to monitor the residualism rates and their distribution within the watersheds to describe interactions with natural salmonids. In the Walla Walla and Mill Creek system, residualized steelhead will be sampled during juvenile surveys. Residuals will be classified based on the presence of a fin clip or wire tag for hatchery fish, and using outlier analysis for the juvenile population. Resident redband

trout populations will be similarly noted, but are recognized as part of the steelhead population (Currens and Schreck 1995; Kostow 2003).

Status: Work is funded and is currently being implemented, expansion to Walla Walla and Mill creeks is needed.

Objective 5: Monitor and assess the distribution, condition and utilization of essential salmonid habitat in the Walla Walla population.

At the macro- and micro-scales land use and riparian conditions are strongly related to in-stream conditions (Crispin et al. 1993; Stednick and Kern 1994; Chen et al. 1998). These features directly impact water quality conditions, and can alter salmonid production through ecological mechanisms (Torgersen et al. 1999; Ebersole 2002). Habitat impacts are detectable at multiple scales, and can result in decreased survival and production of juveniles (Paulsen and Fisher 2001) and decreased recruitment of spawners (Regetz 2003) at the subbasin scale.
The EMAP of all known spawning and rearing habitats is recommended for sampling the known spatial extent and status and trend of steelhead habitat in the Walla Walla subbasin. Representative sites within the subbasin are sampled annually using a three-panel rotating panel design. Panels include annual, every four years, and one-time visit selections. Habitat variables could follow ODFW Aquatic Inventories design (Moore et al. 2002) and are measured at the unit and reach scale. This is a high priority objective.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:
- What are the spatial distribution and quantitative features of the Walla Walla population essential fish habitat?
- What is the status and trend in habitat quantity and quality throughout the Walla Walla population?

Performance metrics: Quantity, quality, and utilization of essential fish habitat.

Approach: The Walla Walla Subbasin Plan identifies a set of desired future conditions that may increase natural production and harvest opportunities in the Walla Walla subbasin through habitat restoration and protection, flow augmentation, passage restoration, and hatchery supplementation. There are a number of habitat-based RM&E information needs that must be addressed if the benefits of these management actions are to be effectively detected with sufficient power. For example, the availability and distribution of quality essential fish habitat will be used to define the sampling universe of juvenile and spawner surveys. The adequacy of habitat representation in EDT will need to be evaluated. The condition and importance of several EDT habitat variables, especially bedscour and sediment load, need to be investigated.

Analysis: Spatial and numerical relationships among the habitat and salmonid variables will be used to estimate the degradation or restoration through time of essential fish habitat associated with both natural and anthropogenic disturbance; to estimate the absolute

abundance and distribution of juveniles and spawners using geostatistical expansions; to estimate the effectiveness of habitat restoration and flow augmentation projects; and, to estimate the quantitative relationship between habitat and production. Physical, biological, chemical and ecological habitat conditions will be monitored throughout the subbasin using a variety of techniques.

Status: Not funded, not implemented.

Objective 6: Identify and assess factors limiting production of Walla Walla River steelhead.

Limiting factor analysis is the process by which impairments to population viability are determined. As conditions are improved through management actions, and population limiting factors and threats are influenced, it is essential to re-assess limiting factors to guide future actions. Section 8 of this plan has a detailed limiting factors assessment. This is a high priority objective.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:

- What environmental factors limit steelhead viability in the Walla Walla population?

Approach: Limiting factors and the capacity of the Walla Walla subbasin will be analyzed every five years as part of regular evaluation activities. A multi-species spatially explicit model of the Walla Walla subbasin, such as the ICTRT matrix model and EDT-AHA, will be used to analyze life stage specific survival in Walla Walla, Columbia, and marine life-history stages.

Analysis: Analyses will be conducted with EDT-AHA and ICTRT matrix models.

Status: Not funded.

Objective 7: Assess the impact of habitat improvement and protection on steelhead viability in the Walla Walla subbasin.

Considerable resources are invested in habitat improvement measures. Most habitat improvement projects conduct some monitoring and evaluation at the project scale to determine successful project implementation. However, typically only the cumulative impacts of watershed restoration can be directly linked to increased steelhead production. The connection between Tier 1 habitat project implementation monitoring and Tier 2 effectiveness monitoring must be addressed across the spatial hierarchy of reaches and watersheds. This is a high priority objective. This is a high priority objective.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring Questions:

- Status & Trend Monitoring—What is the current status and trend of steelhead habitat?

- Implementation and Compliance Monitoring—Has the management action been implemented in the prescribed manner and achieved its objectives?
- Effectiveness Monitoring—Has the management action significantly influenced the viability of the Walla Walla River steelhead population?

Performance metrics: Habitat conditions, egg, fry, juvenile, and smolt production and survival, and smolts-per-spawner or per female. Comparison with information on survivals and smolts-per-spawner with other subbasins.

Approach: Status and trend monitoring at the subbasin and population scales is best conducted by using a spatially explicit sampling approach, such as the EMAP approach. Measured habitat variables will be the same as previously described for the John Day populations. Remote sensing (e.g. TIR; LIDAR; and spatially referenced color imagery) is also appropriate and typically addresses spatial scales at watershed or larger landscapes.

Compliance monitoring of restoration projects incorporates record keeping and reporting of activities. Compliance monitoring will be primarily conducted by the implementing entities and will include any parameters identified in related work statements.

Effectiveness monitoring can be approached at the watershed or project spatial scales, and should preferably be directed at measures of abundance, survival, growth, etc. of steelhead or abiotic or biotic factors limiting their recovery. A BACI design (including spatial replication) is recommended for measuring the effectiveness of active restoration activities (Jones & Tonn 2004). For passive restoration activities, a BACI design that monitors trends through time may be appropriate. If comparisons are made to reference or control sites, they should be under similar environmental conditions experienced by the treatment site but outside the influence of treatment activities. Restoration implementing entities must coordinate with monitoring groups prior to action implementation—preferably several years in advance to allow measurement of pre-manipulation variables. Temporal scales must account for timelags related to life history and life cycle. Derived variables include proportion of population-level parameter (e.g. abundance, production, survival) influenced by restoration activity.

Analysis: If at the appropriate scale, direct comparisons of measured parameters with recovery criteria can be made. Otherwise, measures at smaller scales will need to be combined to determine if they have the desired responses at the population level.

Status: Evaluation is partially funded; habitat monitoring is not funded and not implemented. Some projects currently conduct compliance monitoring; however, there is no ongoing effort to aggregate results at the population scale.

Objective 8: Determine the effect of disease and predation on the abundance, productivity, diversity, and distribution of the natural-origin population.

This objective is moderate priority.

Type of monitoring effort: Uncertainties research.

Monitoring questions:

- What is the prevalence of whirling disease in the Walla Walla subbasin and what is its influence on the natural steelhead populations?
- What is the predation rate and predatory impact of introduced fishes in the Walla Walla subbasin on juvenile steelhead?
- What is the effect of predation from piscine predators in the Columbia River migration corridor on juvenile steelhead originating from the Walla Walla subbasin?
- What is the effect of predation from avian predators in the Columbia River migration corridor on juvenile steelhead originating from the Walla Walla subbasin?

Approach: The current distribution and influence of whirling disease on wild steelhead populations is not fully understood. Representative sentinel stations could be established and monitored through time for each population to measure prevalence and intensity of infection rates of whirling disease. Infection, or the presence of *Myxobolus cerebralis* DNA, is detected by PCR analysis. A small incomplete survey was conducted in the late 1980's and a more complete survey is needed.

Collections of smallmouth bass and other potential predators in the WallaWalla River could be conducted using angling techniques. Collected stomach samples are analyzed for the presence of juvenile salmonids. These data could be incorporated into a bioenergetics model to derive a population-level consumption estimate imposed by introduced fishes. Sampling of predatory fish diets should occur during times and locations when and where their distribution overlaps with juvenile steelhead. Interpretation of the predatory impact in the migration corridor should be conducted from methods established in published literature (Ward et al. 1995; Fritts and Pearsons 2006).

To evaluate avian predation, colonies are monitored for presence of PIT tags originating from specific populations (Collis et al. 2001). Bioenergetics models are then used to expand tag recoveries at colonies to population-level impacts (Antolos et al. 2005).

Analysis: The proportion of total mortality attributable to predatory mortality could be estimated from bioenergetics modeling results.

Status: The whirling disease foundation, whirling disease initiative, and Oregon Sea Grant are potential funding sources for whirling disease investigations. Investigations of predation in the migration corridor have been conducted by many agencies with various funding sources including BPA and USACE. This work should continue to effectively evaluate the benefits of the proposed actions.

Objective 9: Determine the effect of mainstem hydropower operations and operational improvements on viability of the Walla Walla River steelhead population.

See John Day MPG for *Timeline, Monitoring questions, and Approach*.

Status: Specific estimates for Walla Walla population are unfunded.

Objective 10: Monitor straying of adult steelhead from the Walla Walla subbasin hatchery programs.

Adult trapping provides substantial data annually on stray fish entering the upper Walla Walla River. Currently, natural spawners in the Walla Walla River include returns originating from naturally spawning adults and from out-of-DPS strays which originate from Lyons Ferry Hatchery releases in the lower Walla Walla River. Hatchery strays were removed at Nursery Bridge Dam by trapping until 1999. Trapping was discontinued after 1999 and replaced with video monitoring. Hatchery fish currently pass above Nursery Bridge Dam to spawn naturally. Continuation of monitoring is needed to assess the annual hatchery fraction and to determine if management changes result in increases or decreases in the hatchery fraction. This is a high priority objective.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring question:

- What is the number and proportion of hatchery fish in the Walla Walla population?

Performance metrics: Number of hatchery fish and proportion of hatchery fish that spawn naturally in the Walla Walla population; percent of Lyons Ferry Hatchery releases that stray

Approach: WDFW monitors the return of summer steelhead throughout southeast Washington through adult trapping (Tucannon River, Lyons Ferry Hatchery, Lower Granite Reservoir, Touchet River, Cottonwood Creek), and spawning ground and creel surveys (sport harvest and CWT expansions can be used to estimate the number that would have returned to the project area)—all of which provide CWT recoveries of marked fish for evaluation purposes. Trapped and/or spawned broodstock fish and carcasses provide data concerning origin, stray rates, sex ratios, age composition, and mean fecundity of each year's run. Spawning ground surveys in Mill Creek provide numbers of redds, spawn timing, and distribution of fish. These surveys provide some measure of the presence of hatchery strays on spawning grounds by noting the presence of fin clips on spawners. This technique has shown some success on the surveys conducted on the John Day River subbasin. A more complete census of natural- and hatchery-origin spawners could be conducted using a weir and trap similar to that previously conducted at Nursery Bridge Dam.

Analysis: Estimating the proportion of out-of-basin strays is a simple comparison of the number of marked and unmarked spawners and carcasses observed within and outside of targeted areas for hatchery returns.

Status: Partially funded, modify and enhance existing monitoring.

Objective 11: Monitor and assess the effect of flow on the availability of spawning and rearing habitat in the mainstem Walla Walla.

Considerable effort and resources are directed at flow restoration in the Walla Walla. However, some of the direct benefits to fish have not been quantified. The relationship between flow restoration and trap-and-haul work is comparatively straightforward: proper flow through

structures and reaches allows for easy passage and a reduction in the need to trap and haul fish. However, the relationship between increased flow and increased spawning and rearing habitat has rarely been directly studied. The IFIM was used to study optimal flow conditions for a number of reaches in the Walla Walla subbasin, and these results are currently being used to guide flow restoration programs. Baseline effectiveness monitoring is needed to understand the added benefits to fish that these future flow programs would bring to the subbasin, and to determine the accuracy of IFIM in predicting habitat use under various flow conditions for priority reaches. This is a high priority objective.

Type of monitoring effort: Long-term status and trend monitoring, uncertainties research.

Monitoring questions:
- What is the effect of flow on the availability of spawning and rearing habitat in the mainstem Walla Walla?
- Are flows suitable for spawning and rearing of steelhead for each reach?

Performance metrics: Spawning and rearing habitat utilization, effectiveness of flow restoration programs.

Approach: Juvenile habitat utilization will be monitored in the Walla Walla mainstem during annual juvenile fish surveys by the CTUIR. Flow will be monitored in these mainstem reaches during fish surveys using a handheld flow meter. Habitat potential will be modeled using a spatially explicit model of habitat quality and quantity such as IFIM or life-cycle analysis, facilitating the evaluation of the relative impacts of various flow management regimes, including the implementation of flow exchange programs and climatological variability.

Analysis: The results of IFIM studies will be compared with results obtained in the field to evaluate the accuracy of the modeled flow recommendations and suggest changes when necessary.

Status: Partially funded, partially implemented.

Objectives 12: Develop models for pre-season estimation of Walla Walla River returns to facilitate management of subbasin fisheries.

Accurate run size predictions allow managers and program staff to plan appropriate broodstock collection, harvest, spawning escapement, and CWT recovery strategies in advance. In addition, models describing return timing can be used in the evaluation of flow management regimes in-season. These models are relatively simple to develop, but require datasets that cover several years or even many decades to be relatively accurate. In general the results of much of the long-term monitoring work will be used to produce these models. This is a low priority objective.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:

- What is the annual estimated run size of summer steelhead to the Walla Walla River mouth?
- Can the run size of steelhead be estimated accurately prior to adult returns, and how can the predictor be improved?

Performance metrics: Run size forecast.

Approach: Correlation models have been developed for preseason prediction of steelhead run size to the Columbia River. Local models must be constructed to predict the timing and size of anadromous runs to the Walla Walla. A variety of metrics (including marine conditions, flow conditions, outmigrant abundance, etc.) are collected as part of regular status and trend monitoring or out-of-basin monitoring. These variables can be used to develop run predictors for all steelhead. Detailed methods for this exercise are under development, and are not discussed below.

Analysis: We use multivariate regression analyses to develop predictive models.

Status: Funded, ongoing.

Objective 13: Quantify fishing effort, catch, and harvest for tribal and non-tribal fisheries in the Walla Walla River.

Much of the impetus for the Walla Walla supplementation and reintroduction programs and the WDFW sponsored steelhead hatchery programs is tribal and non-tribal harvest mitigation. Creel or catch-card data are needed to provide information to determine whether steelhead harvest goals are achieved or exceeded, to enumerate fish removed from the run, and to assess how to optimize fishing opportunities through adaptive management. A properly designed creel survey can also provide data for determining the impact of fisheries on the natural-origin fish. This is a moderate priority objective.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:

- What are the fishing effort, catch, and harvest by gear type, and location for tribal and non-tribal fisheries in the Walla Walla River?
- What is the annual fishing mortality rate that occurs within the Walla Walla River subbasin?

Performance metrics: Fisher hours, catch, and harvest.

Approach: WDFW utilizes catch cards and a limited creel to monitor harvest. The need to expand these efforts is currently being investigated. Tribal harvest appears minimal and is currently not being monitored.

Analysis: Statistical analyses of creel survey information.

Status: Partly funded; modify and enhance existing monitoring.

13.4 Cascades Eastern Slope Tributaries MPG

The Cascades Eastern Slope Tributaries MPG includes seven steelhead populations in both Oregon and Washington. In Oregon, the populations are the Fifteenmile Creek, Deschutes West, Deschutes East, and the extirpated Crooked River (Deschutes River subbasin) populations. The MPG is unique in a number of ways compared to the others of the Mid-C steelhead DPS. It includes the uppermost expression of an adult winter-run life history (Fifteenmile Creek) in the Columbia River Basin. Impacts to survival of adult winter run steelhead can be expected to differ from the summer run fish during upstream migration through different hydro conditions and fisheries. Smolts from all populations in this MPG migrate through shorter reaches of the Columbia hydrosystem and pass fewer dams. Portions, or all, of the spawning habitat of the three populations in the Deschutes River subbasin have been blocked by hydroelectric development in the subbasin. The sampling methods used to obtain some of the VSP information for this MPG that was used in the recovery plan's viability analyses (see Section 6) are more varied and the management entities that conduct monitoring are diverse.

The most systematic population-level monitoring in the Oregon portion of the Cascades Eastern Slope Tributaries MPG has been through spawning ground surveys conducted by CTWSRO, ODFW, and USFS. This information was used to develop spawner abundance estimates for each population. These surveys had neither been conducted explicitly to represent the spatial distribution of the populations as defined by the ICTRT nor to collect the types of information ideally used to assess each population's viability and to compare current status to the desired population recovery criteria. Nonetheless, the current monitoring routines represent the foundation on which to build future status and trends monitoring that will fill information gaps identified in the viability analyses, allow future changes in VSP criteria to be tracked, and in some cases, function in part as action effectiveness monitoring. Monitoring infrastructure currently exists or has been deployed in the past in the MPG that could inform future VSP status and trend assessments including the following:

- Abundance of adult progeny on the spawning grounds (for productivity expressed as recruits-per-spawner ratios)
- Trends in abundance of juveniles and SARs
- Spatial distribution of spawners
- Diversity of life history characteristics of both adults and juveniles including differences, similarities, or changes in genetic traits

This plan describes and supplements the existing monitoring activities so that the status and trend of the steelhead populations can be compared with recovery criteria. It is not exhaustive, but generally builds on the strengths of existing monitoring efforts that could be used to update the viability assessments that were conducted and adapt existing efforts to fill missing information. A balance between an ideal monitoring effort and what is sufficient relative to costs and resources is considered. Wherever possible, attempts to integrate status and trends monitoring with action effectiveness monitoring are made.

Critical Uncertainties

Critical uncertainties for the population group that currently limit the ability to make informed management decisions have been identified by local area managers. We combined these uncertainties with those identified during the recovery planning process to produce the RM&E objectives that are addressed herein by our recommended M&E efforts. Not all objectives are associated with each population segment. For example, there is no within-basin harvest for the Fifteenmile Creek population. The objectives include:

1. Determine the current status and trend in the abundance and productivity of natural-origin spawners and compare to viability abundance criteria for each population.
2. Determine the status of the spatial structure of each population based on current and historically utilized habitat.
3. Determine the effects of out-of-basin strays on the productivity of each population relative to viability criteria.
4. Determine the status and trend in conditions of current and historically utilized habitat within each population.
5. Determine the freshwater productivity of each population relative to viability criteria and identify primary habitat factors limiting freshwater production.
6. Determine the effects of disease and predation on the abundance, productivity, diversity and spatial structure of the natural populations.
7. Determine the effect of hydropower on the abundance, productivity, diversity and distribution of the natural populations.
8. Determine what effects habitat degradation and habitat restoration actions have on the abundance, productivity, and spatial structure of the natural populations.
9. Determine the influence of in-basin harvest on the abundance and productivity of natural-origin spawners.

13.4.1 Fifteenmile Creek Population

Objective 1: Determine the status and trend in the abundance of natural-origin spawners relative to viability abundance levels.

The status of a population is determined by estimating the VSP parameters described in the recovery plan. The VSP parameters include adult abundance, population productivity or growth rate, population spatial structure, and diversity. This is a highest priority objective.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:

- Is the 10-year GM of natural-origin steelhead spawners in the Fifteenmile Creek subbasin greater than or equal to the recovery criterion for natural spawners?
- What are the current spawner abundance and five-year trend in abundance?
- What are the current and trend in the 20-year population growth rate?
- What are the current and trend in recruits/spawner compared to the recovery goal?

Performance Metrics: Spawner abundance, recruits/spawner.

Approach: Currently, abundance of adult spawners in the Fifteenmile Creek system is estimated based on observations of redds from three-pass spawning ground surveys conducted annually within each MaSA. The present sampling is statistically representative of spawning activity allowing inference to the total Fifteenmile Creek spawning population and allows annual monitoring of the distribution of spawners in each of the population's MaSAs. The sample design is a stratified random survey where each MaSA is divided into five-mile sections that cover the currently known spawning habitat. A one-mile reach is randomly selected each year from the five one-mile sections in each five-mile stratum and surveyed by foot once per week three times during spring.

Analysis: The total season's abundance of redds is estimated by summing individual redds observed in each five-mile section and expanding by the surveyed/unsurveyed proportion (approximately five-fold). A fish/redd ratio is presently estimated by counting spawners passed above a weir (outside of the DPS) and results of subsequent multiple complete area census spawning ground redd surveys.

To estimate abundance of progeny (spawning recruits), age structure is assumed to be similar to wild winter steelhead in the downstream Hood River.

Status: Currently implemented.

Objective 2: Determine the status of the spatial structure of the population based on current and historically utilized habitat.

Spatial and seasonal distribution of juveniles, their habitat use, and density within the MaSAs and MiSAs, particularly in Mill and Chenoweth creeks, are not presently well known. This is a high priority objective.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:

- What is the spatial distribution of the occupied spawning areas within the population boundaries?
- What is the current spatial extent and distribution of rearing habitat used by juvenile steelhead?

Approach: An EMAP sampling approach of all known spawning and rearing areas could be used to refine the known spatial distribution of both adult and juvenile steelhead for the Fifteenmile Creek population. Representative sites within the watershed would be sampled annually using a three-panel rotating panel design. Panels include annual, every four years, and one-time visit selections. All observed adult spawners and redds would be geographically referenced using handheld GPS units for inclusion in a GIS. Juvenile steelhead would be sampled using snorkeling or electrofishing techniques. This approach would refine current knowledge of steelhead spatial distribution for this population segment.

Analysis: Data would be analyzed as distribution data in a GIS format. The known distribution of steelhead will be modified when previously unknown blockages to migration or newly inhabited reaches are observed. Juvenile steelhead densities are determined in each study reach.

Status: Not currently implemented.

Objective 3: Determine the abundance of out-of-basin strays in the Fifteenmile Creek population relative to viability criteria.

The proportion of spawning steelhead in Fifteenmile Creek that are hatchery-origin fish is assumed to be very low, but is not known. To monitor the presence of hatchery-origin fish, additional effort during spawning ground surveys will be necessary to observe sufficient numbers of fish to develop annual estimates of hatchery fraction and hatchery fish abundance. This is a high level priority.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:

- What proportion of steelhead spawners in the Fifteenmile Creek population is derived from out-of-basin hatchery stocks?
- What is the origin of out-of-basin strays?
- What is the population-level genetic composition of the Fifteenmile Creek population?

Approach: The Fifteenmile Creek basin lacks facilities to capture adult steelhead. Determination of out-of-basin strays will therefore rely on identification of hatchery-marked adults observed on spawning ground surveys, and from incidental catches. To determine population-level genetic composition, genetic data that allow an objective determination of the population(s) structure are required. Age-0 *O. mykiss* from several representative streams in the population segment are currently sampled annually. Collection of juveniles from a minimum of four cohorts will be sampled. The population will be characterized using a suite of nuclear DNA markers, including both microsatellite loci (variable-number simple-sequence repeats) and non-coding SNPs, or base substitutions assayed via restriction enzyme analysis (Moran et al. 1997). The current monitoring program is conducted as part of the Columbia Basin-wide steelhead genetics monitoring.

Analysis: Estimating the proportion of out-of-basin strays is a simple comparison of the number of marked and unmarked spawners and carcasses observed. Direct comparisons can then be made with recovery criteria. DNA tissue samples are analyzed by NMFS using known microsatellite markers. Microsatellite loci are analyzed using pairwise FST comparisons to estimate levels of gene flow and to identify geographic areas that contain genetically differentiated populations.

Status: Spawning ground surveys are implemented and coordinated. Genetics analysis is implemented and coordinated collaboratively between ODFW and NMFS Northwest Science Center. Federal funds (NMFS) are used for genetics stock analysis.

Objective 4: Determine the status and trend of current and historically utilized habitat.

This is a high priority objective.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:
- What are the status and trend in habitat quantity and quality throughout the population area?

Approach: The same EMAP sampling approach of all known spawning and rearing areas, as described above is recommended for sampling the known spatial extent and status and trend of steelhead habitat. Habitat variables would be monitored as defined by ODFW Aquatic Inventories design (Moore et al. 2002) and are measured at the unit and reach scale.

Analysis: This type of data are analyzed as distribution data in a GIS format. Database and GIS formatting of data allow associations with land use, land vegetation coverage, and many other attributes at the population and smaller scales.

Status: Not implemented.

Objective 5: Determine the freshwater productivity of the population relative to viability abundance levels and identify primary factors limiting freshwater production.

Trapping juvenile outmigrants will help provide estimates of smolt production for the watershed, allow estimation of smolt-to-adult survival rates, and provide life history diversity information including timing, age, size, and genetic variation. This expanded monitoring effort will allow for assessment of the cumulative benefits of the habitat protection, enhancement, and restoration actions on juvenile survival and abundance in the Fifteenmile Creek population.

The Fifteenmile Creek subbasin plan identifies an "ideal" monitoring scenario where returning adults would be trapped and enumerated and a juvenile outmigrant trap would be operated near the mouth of Fifteenmile Creek. This scenario could represent a second tier to more comprehensively monitor the population. Its benefits would need to be weighed against the implementation costs. This is a highest level priority.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:
- What are the current and trend in freshwater productivity measured as smolts/redd?
- What is/are the primary factor(s) limiting freshwater production of steelhead?

Approach: The ratio of smolts/adult is the principle measure of freshwater productivity. Smolt abundance will be determined using traps. If we do not obtain adequate funding for a weir to count adults, then redd counts will be used. Freshwater productivity will be assessed as smolts/redd or smolts/adult. Trapping with RSTs and mark-recapture will be used to

estimate smolt abundance. Egg-to-smolt survival requires an estimate of the number of eggs deposited by individual females or deposited in each redd. Parr-to-smolt survival will be estimated by capturing a representative number of parr in their rearing habitat, PIT tagging them, and then monitoring their recapture at the downstream smolt traps. Migration survival can similarly be estimated by monitoring detections of PIT-tagged individuals as they pass through PIT tag detection facilities.

Analysis: Smolt abundance will be estimated using mark/recapture techniques (Thedinga 1994; Steinhorst 2004). Survival and productivity measures are simple proportions and ratios from one life stage to another.

Status: Operation of smolt and adult traps are not currently implemented.

Objective 6: Determine the effect of disease and predation on the abundance, productivity, diversity, and distribution of the natural-origin population.

This is a moderate priority objective.

Type of monitoring effort: Long-term status and trend monitoring and short-term research.

Monitoring questions:

- What is the prevalence of disease in the basin and what is its influence on the natural steelhead populations?
- What is the effect of predation from piscine predators in the Columbia River migration corridor on juvenile steelhead originating from Fifteenmile Creek?
- What is the effect of predation from avian predators in the Columbia River migration corridor on juvenile steelhead originating from Fifteenmile Creek?

Approach: The current distribution and influence of whirling disease on natural steelhead populations is not fully understood. Representative sentinel stations would be established and monitored through time for this population to measure prevalence and intensity of infection rates of whirling disease. Infection, or the presence of *Myxobolus cerebralis* DNA, is detected by PCR analysis.

To evaluate avian predation, colonies are monitored for presence of PIT tags originating from specific populations (Collis et al. 2001). Bioenergetics models are used to expand tag recoveries at colonies to population-level impacts (Antolos et al. 2005). This method requires the collection and PIT tagging of smolts originating from the Fifteenmile Creek population. The piscine and avian predation monitoring is outside the scope of this RM&E plan. However, we encourage the ongoing monitoring programs to continue their efforts to address these limiting factors and threats.

Analysis: The proportion of total mortality (e.g., SAR) attributable to predatory mortality could be estimated from bioenergetics modeling results. Infection rates of sentinel fish from disease would need to be related to actual mortality rates experienced in the natural population. If this were determined then mortality rates resulting from disease could be

estimated as a proportion of freshwater mortality (i.e., egg to smolt mortality) although some delayed mortality may also occur (Sollid et al. 2004).

Status: Not implemented at the population level.

Objective 7: Determine the effect of hydropower on the abundance, productivity, diversity, and distribution of the Fifteenmile Creek population.

This is a moderate priority objective because the population resides above only one dam.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:

- What is the effect of Columbia River hydropower operations on Fifteenmile Creek steelhead smolts?
- What is the effect of Columbia River hydropower operation on returning Fifteenmile Creek adult steelhead originating from Fifteenmile Creek?

Approach: PIT tags have been used successfully to measure the influence of hydropower operations on migrating salmonids (Berggren et al. 2006; Schaller et al. 2007). PIT-tagged fish are monitored for detections at FCRPS facilities along the migration corridor at both juvenile and adult life stages using DART and PTAGIS databases. Detection probabilities of juvenile salmonids migrating downstream at FCRPS facilities are modeled using the SURPH analytical tool (Lady et al. 2003). Adult detection (purportedly 100%) is currently available at ladders on several dams including Bonneville, and is expected in the near future at The Dalles.

Analysis: Juvenile survivals at each FCRPS facility can be estimated using the SURPH model. Adult survival between facilities will soon be possible by comparing detections at adult ladder facilities along the migration corridor. Rates can be expanded to population-level impacts using the relative number of fish PIT tagged and abundance estimates generated from mark-recapture at RSTs.

Status: This method would require the collection and PIT tagging of smolts originating from the Fifteenmile Creek population. Systematic PIT tagging of juveniles in Fifteenmile Creek is not implemented.

Objective 8: Determine the effect of habitat degradation and habitat restoration activities on the abundance, productivity, and distribution of the Fifteenmile Creek population.

This is a highest priority objective.

Type of monitoring effort: Long-term status & trend monitoring, implementation and compliance monitoring, and effectiveness monitoring.

Monitoring questions:

- Status & Trend Monitoring—What are the current status and trend of steelhead habitat?
- Implementation and Compliance Monitoring—Has the management action been implemented in the prescribed manner and achieved its objectives?
- Effectiveness Monitoring—Have the management actions significantly influenced the viability of the Fifteenmile Creek steelhead population?

Approach: Status and trend monitoring at the subbasin and population scale are best conducted by using a spatially explicit sampling approach, such as the EMAP approach developed by the EPA. Measured habitat variables will be the same as previously described for the John Day populations. Remote sensing (e.g., TIR imagery, LIDAR, and spatially referenced color imagery) is also appropriate and typically addresses spatial scales at watershed or larger landscapes.

Compliance monitoring of restoration projects incorporates record keeping and reporting of activities. Compliance monitoring will be primarily conducted by the implementing entity and will include parameters identified in related work statements. Effectiveness monitoring can be approached at the watershed or project spatial scales. IMWs are one example of the watershed approach. Effectiveness monitoring should preferably be directed at measures of abundance, survival, growth, etc. of steelhead or abiotic or biotic factors limiting their recovery. A modified BACI (Smith 2002) design (including spatial replication) is recommended for measuring the effectiveness of active restoration activities (Jones & Tonn 2004). For passive restoration activities, a BACI design that monitors trends through time may be appropriate. If comparisons are made to reference or control sites, they should be under similar environmental conditions experienced by the treatment site but outside the influence of treatment activities. Restoration implementing entities must coordinate with monitoring groups prior to action implementation—preferably several years in advance to allow measurement of pre-manipulation variables. Temporal scales must account for timelags related to life history and life cycle.

Analysis: If collected at the appropriate scale, direct comparisons of measured parameters with recovery criteria can be made. Otherwise, measures at smaller scales would need to be scaled up to determine if they would have desired responses at the population level.

Status: Implementation monitoring is currently conducted by the groups that implement restoration activities.

Objective 9: Determine the effect of in-basin harvest on the abundance, productivity, and diversity of the Fifteenmile Creek population.

Under current fisheries regulations, adult steelhead cannot be legally retained in any of the minor Columbia River tributaries (Fifteenmile, Mill or Chenoweth creeks). Further, Fifteenmile Creek is closed to all recreational winter steelhead fishing, including catch and release. The Fifteenmile Creek population is subject to target and incidental fishery impacts in sport, commercial, and tribal fisheries occurring in the mainstem of the lower Columbia River and in Bonneville Reservoir. Passage rates of winter steelhead through mainstem fisheries, past the dams, and through the reservoirs are not known with any certainty at a population level. Run

timing of Bonneville Reservoir and upstream summer steelhead populations can overlap with winter run populations. This is a moderate priority objective.

Type of monitoring effort: Long term status and trends

Monitoring questions:

- What is the stock composition of adult steelhead populations in the mainstem Columbia River during winter and early spring?
- What is the annual fishing mortality rate that occurs outside of the Fifteenmile Creek subbasin?

Approach: Passive monitoring of representatively PIT-tagged steelhead ascending Bonneville Dam and The Dalles Dam will help monitor run timing and stock composition. Enhanced stock composition monitoring using GSI methods will also add valuable information. Enhancing catch sampling in the fisheries will aid in partitioning harvest rates among mixed-DPS and MPG populations across the winter and early spring seasons.

Analysis: See Objective 8.

Status: Not implemented at the population level.

13.4.2 Eastside and Westside Deschutes River Populations

Major spawning areas of two populations, Deschutes River Eastside and Deschutes River Westside, are routinely monitored for abundance and spatial distribution of spawning adults (redd counts from spawning ground surveys). Abundance of steelhead in the Westside MaSAs in the Warm Springs River is determined based on a count at the Warm Springs NFH barrier. The extirpated Crooked River population is not addressed in this RM&E plan; however, monitoring was previously discussed in Section 9. Both extant populations use the mainstem of the Deschutes River for spawning and rearing, and the area delineation separating the two is the mainstem Deschutes River near the mouth of Trout Creek. Portions of both populations' historical range are blocked by the Pelton-Round Butte Complex. Round Butte Hatchery produces a Deschutes-origin hatchery stock of steelhead to mitigate for the blocked habitat. Recent FERC hydropower re-licensing negotiations have resulted in the beginning of an effort to restore steelhead upstream of Round Butte Dam focusing particularly on Whychus Creek. Significant numbers of hatchery steelhead from outside the subbasin enter the Deschutes River annually and some are known to remain within the Deschutes and its tributaries to spawn, but the actual rate or numbers are not known with certainty. The Deschutes River and its tributaries (particularly those of the Deschutes Westside steelhead population) support large numbers of resident redband trout (*O. mykiss*), and a blue ribbon trout fishery is a major attraction to the Deschutes River.

These subbasin characteristics present unique challenges to monitoring the VSP parameters for each of the two steelhead populations. The monitoring activities which provided the data used to assess the viability of each population (see Appendix B) are described briefly below, including recommended improvements needed for better status and trends monitoring of viability

parameters specific to each population. Because steelhead status and trend monitoring in the subbasin is so interrelated with gaining insight to critical uncertainties and tracking the effectiveness of major recovery actions, this monitoring overview addresses population status and trend monitoring, action effectiveness monitoring, and critical uncertainties research in combination. The main monitoring issues identified in order of priority by local fisheries managers include:

1. Straying: What is the cause and origin of strays in the Deschutes? Has introgression with strays impacted the genetic characteristics of natural-origin steelhead in the Deschutes? How many strays are overwintering in the Deschutes, entering spawning tributaries, spawning in the main stem Deschutes, and what are the effects on fitness? What is the fall back rate for non-Deschutes hatchery and natural fish that pass above Sherars Falls?
2. Population structure of Eastside vs. Westside: Is their a difference in the two populations and the stock-recruit function?
3. Reintroduction: Which stocks should be used as broodstock (Eastside vs. Westside)? What would be the effects on the founding population? What will the effect of competition of juvenile *O. nerka* and *O. mykiss* be? If sockeye are successful in the reintroduction, what will be the effect of large numbers of juvenile sockeye in the lower Deschutes? How successful will the steelhead reintroduction be?
4. Resident *vs.* anadromous: What is the relationship between the two, causative mechanism for either life history, and is competition an issue? What influence does the abundant resident population have on the steelhead populations?

Objective 1: Determine the status and trend in the abundance of natural-origin spawners and compare to viability abundance criteria for the Deschutes River populations.

The critical uncertainties in characterizing the abundance of each spawning population and abundance of adult progeny (recruits) returning to spawn to estimate abundance and productivity (spawner to spawner ratio) are threefold:

1. The unknown abundance of fish that spawn in the mainstem Deschutes River and their relative contribution to the Westside and Eastside populations.
2. The abundance and origin of hatchery steelhead that spawn naturally and the inability to enumerate adult progeny and assess the degree of risk from out-of-MPG hatchery spawners.
3. Annual population-specific information on freshwater and saltwater adult age at return is unavailable to partition natural-origin spawners into broodyear of origin.

Presently, all of the major spawning areas of the two populations in the Deschutes River are surveyed annually for presence of steelhead adults and redds with varying degrees of spatial coverage. In addition, adult weirs are fished on most major spawning tributaries. Observations from these surveys and weir counts are used to estimate the abundance of redds in each major spawning area and to characterize the degree of occupancy (spatial distribution). These surveys are neither statistically designed nor conducted systematically and inferences are made to unsurveyed areas. This approach has weaknesses because there is no validation of the

relationship of spawner density in surveyed and unsurveyed areas. Modifying the present spawning ground surveys is needed to assure observations of redds are statistically based.

Alternatively, a stratified random spawning ground survey similar to that used in the Fifteenmile Creek subbasin could be conducted in the MaSAs of Buckhollow, Bakeoven, Trout, and Shitike creeks. If the present surveys are changed, appropriate fixed sites could be maintained to allow for calibrating historical data, and allow flexibility for local project-level action effectiveness monitoring such as for habitat improvement actions. Intensity of present single pass spawning ground survey effort could possibly be redistributed to multiple passes over a smaller proportion of the spawning area than is presently surveyed. To monitor spawning activity in the mainstem of the Deschutes River, spawning ground surveys would need to be conducted either by air or boat. To date, only two single pass aerial surveys of spawning steelhead have been conducted. This is a highest level priority.

Type of monitoring effort: Long term status and trend monitoring.

Monitoring questions:

- Is the 10-year GM of natural-origin steelhead spawners in the Westside and Eastside populations greater than or equal to the recovery criterion for natural spawners?
- What are the current spawner abundance and five-year trend in abundance?
- What are the current and trend in the 20-year population growth rate?
- What are the current and trend in recruits/spawner compared to the recovery goal?

Performance metrics: Spawner abundance, recruits/spawner.

Approach: Where weirs are absent, redd surveys are the only alternative to estimate annual adult abundance for recruit/spawner and trend analyses. The recommended survey design is a spatially balanced site selection and a rotating panel design for temporal selection (EMAP approach; Stevens and Olsen 2004). Ideally, sampling using this design would also be conducted at the population scale which would require a separate sample draw and additional samples. Redd count surveys would be conducted by walking and/or floating all streams within the index (one-time annual counts) and randomly selected reaches (bi-weekly counts, $\geq$ 3 counts/year).
Analysis: Estimate the number of naturally produced spawners using proportions of observed naturally produced fish (unmarked) and hatchery (fin clipped) fish, total number of redds, expansion factor of surveyed stream length/available stream length, and fish/redd ratio. Calculate 10-yr GM for abundance of naturally produced fish. Calculate recruits/spawner based on redd counts and estimated spawner age structure. Analyze as a time series (trend analysis).

Status: State of Oregon funds index spawning ground surveys. An EMAP approach for spawning ground surveys has been previously proposed by ODFW and approved by the ISRP and NPCC, but BPA failed to fund the proposed monitoring.

Objective 2: Determine the status of the spatial structure of each population based on current and historically utilized habitat.

This is a highest level priority.

Type of monitoring effort: Long term status and trend monitoring

Monitoring questions:

- What is the spatial distribution of the occupied spawning areas within the population boundaries?
- What is the current spatial extent and distribution of rearing habitat used by juvenile steelhead?

Approach: The same EMAP sampling protocol of all known spawning and rearing areas as used for determining abundance of spawners is recommended for refining the known spatial extent of both adult and juvenile steelhead. Representative sites within the subbasin will be sampled annually using a three-panel rotating panel design. Panels include annual, every four years, and one-time visit selections. All observed adult spawners and redds are geographically referenced using handheld GPS units for inclusion in a GIS. Juvenile steelhead are sampled using snorkeling or electrofishing techniques.

Analysis: Data would be analyzed as distribution data in a GIS format. The known distribution of steelhead is modified when previously unknown blockages to migration are discovered. Juvenile steelhead are evaluated as fish/pool in each study reach.

Status: Not implemented nor funded. The same limitations indicated above in Objective 1 are relevant here.

Objective 3: Determine the effects of out-of-basin strays on the productivity of each population.

Hatchery strays, especially from out-of-subbasin hatcheries, pose a significant threat to wild summer steelhead populations in the Deschutes subbasin. The large influx of out-of-subbasin stray summer steelhead may contribute maladapted genetic characteristics to the wild summer steelhead populations in the Deschutes River subbasin. While Round Butte Hatchery origin summer steelhead contribute to this problem, their abundance is much less and they are genetically more similar than the large number of out-of-subbasin strays. The cumulative effect of this genetic introgression may contribute to reduced productivity of the wild populations.

ODFW completed and submitted a comprehensive study plan to investigate the impact of strays. Implementing ODFW's study plan to investigate the reproductive success of stray hatchery and wild steelhead in the lower Deschutes River would address uncertainties of the magnitude of straying, its actual effect on wild populations in the Deschutes River, as well as provide a tool to exclude hatchery steelhead from either Buckhollow or Bakeoven creeks in the future. Completion of ODFW's study objectives would determine the number of stray hatchery steelhead entering Bakeoven and Buckhollow creeks, degree of introgression between hatchery and natural fish, relative reproductive success, and the influence of hatchery fish on natural productivity.

Improved monitoring of stray hatchery fish in the Deschutes River has regional significance in the Columbia Basin. For example, efforts underway in the Snake River Basin through the Lower Snake River Compensation Plan to decrease and monitor stray rates of Snake River hatchery steelhead will require both knowledge of which fish stray, at what rates, and whether efforts taken to modify stray rates are effective. The management and operation of the FCRPS, specifically barging, may be increasing the rate of straying of salmon and steelhead originating upstream of the Mid-C steelhead DPS. Quantifying this potential effect and monitoring effectiveness of efforts to reduce straying will require continued monitoring of straying into the Deschutes, as well as the ability to identify outmigrating juveniles in the mainstem Columbia and their migration experience (in river or barged). Implementing the Columbia Basin Fish and Wildlife Program's Comparative Survival Study plan for steelhead tagging would contribute significantly to improving information related to straying.

A coalition of Deschutes River fisheries managers has been working together to address a number of population identification issues using genetics techniques. Continuing this effort will greatly help to inform population structure and genetic characteristics of summer steelhead in the Deschutes River subbasin. A recent draft of a project plan outlines the scope of future work (personal communication, D. Hand, USFWS, CRFPO). In FY2002, the U.S. Fish & Wildlife Service obtained funding for part of the Federal Columbia River Power System biological assessments, opinion and hatchery operations. In FY 2004, the Columbia River Fisheries Program Office (CRFPO) secured additional funding for population monitoring. This "add-on" was to lend additional support to on-going monitoring & evaluation projects as well as help answer additional questions associated with hatchery operations and impacts to the Deschutes basin native fish community. On-going evaluations include: 1) population dynamics and genetics of hatchery- and natural-origin spring Chinook salmon in the Warm Springs River and Shitike Creek; 2) evaluating the reproductive success of hatchery spring Chinook salmon outplanted into Shitike Creek; 3) evaluating the ecological interactions between hatchery- and natural-origin fish; and, 4) assessing the population structure of summer steelhead trout in the Deschutes River and potential impact from out-of basin hatchery strays.

Additional unanswered questions were developed by the ICTRT (2003). In identifying independent populations of listed steelhead in the Interior Columbia River Basin, they noted that limited information existed to evaluate genetic differences between steelhead occupying the tributaries on the east and west sides of the lower Deschutes River below the Pelton-Round Butte Dam complex. Concurrently, the Pelton-Round Butte Fish Reintroduction Committee expressed interest in developing a better understanding of steelhead population structure in the lower Deschutes in order to determine the best donor stock for reintroduction above the dam complex. A series of meetings among ODFW, CTWSRO, CRFPO, and the Abernathy Fish Technology Center identified a variety of issues and information needs regarding steelhead in the Deschutes. In response to the various discussions, the CRFPO and the Pelton-Round Butte Fish Reintroduction Committee organized a meeting to bring together all interested parties and identify issues of concern. This group agreed on a set of overall study objectives and drafted a phased implementation approach:

1. Augment existing information to develop an understanding of the population structure and genetic variability among steelhead occupying tributaries and the mainstem Deschutes River downstream of the Pelton-Round Butte Complex;
2. Evaluate the effect of out-of-basin strays on the Deschutes River populations (rate of strays and reproductive contribution of strays); and,
3. Provide information pertinent to brood stock selection that would assist with efforts to reintroduce steelhead to currently inaccessible portions of the middle and upper basin.

As adult fish begin returning from reintroduction efforts upstream of Round Butte Dam, they too will need to be distinguished from the Deschutes RBH stock and the Westside and Eastside wild populations. Studies may need to be implemented to assure the fidelity of these reintroduced fish to their parent stream. A draft reintroduction plan (personal communication, M. Gauvin, CTWSRO) includes key metrics to monitor fish passage above Round Butte Dam and the reintroduction effort. This monitoring should be integrated with monitoring of the other populations including Round Butte Hatchery steelhead, with emphasis on smolt-to-adult return rates, harvest rates (or impacts) in the Deschutes River, counts of returning adults by species and sex at Round Butte Dam, spawn timing and success (redd counts) by species and subbasin; and adult recruits per spawner. This is a highest level priority.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:

- What proportion of steelhead spawners in the Deschutes subbasin are out-of-basin hatchery strays?
- What is the origin of out-of-basin strays?
- What is the population-level genetic composition of the Deschutes populations?

Approach: Presence of hatchery fish by origin is monitored at trapping facilities in the Deschutes subbasin. Steelhead ascending Sherars Falls are sampled routinely and tagged for run-to-the river population abundance estimates. Hatchery-origin fish are captured, removed, and examined for hatchery of origin at Bakeoven, Buckhollow, Trout and Shitike creeks, and at Pelton trap and Warm Springs NFH. Fish can also be examined in creel surveys. All observed fish marked with a fin clip can be sampled for the presence of a coded-wire or PIT tag to determine hatchery origin. Where spawning ground surveys are conducted, the number of marked (adipose fin clip) and unmarked (presumably natural-origin) fish will be visually identified and enumerated. This information is important to monitor the potential magnitude and origin of hatchery straying. The rate at which fish observed at Sherars Fall eventually fall back and leave the Deschutes River system and continue migrating to their parent stream remains unknown. Although funding is not available, there is a need to conduct a radio telemetry project to assess fall back rates.

A number of recent and future actions will allow better monitoring of the magnitude of straying into the Deschutes River and the effectiveness of actions to control stray rates. The Sherars Falls trap is now equipped with PIT tag detection capability and will allow adult detection of both fish PIT-tagged as juveniles and released in the Deschutes River subbasin and those tagged and released outside of the Deschutes. If sufficient numbers of hatchery

summer steelhead were representatively tagged throughout the Columbia Basin, a better understanding of the rate at which out-of-population hatchery fish descend Sherars Falls could be developed. Implementing the Columbia Basin Fish and Wildlife Program's Comparative Survival Study plan for steelhead tagging would contribute to monitoring stray rates in the Deschutes. The recent effort to representatively PIT tag all LSRCP hatchery steelhead will greatly enhance the ability to estimate fall back. Fish that pass above Sherars Falls and are later detected migrating up the Columbia River above the Deschutes will provide better estimates of fall back rates. Repeating Columbia River mainstem radio telemetry studies, with additional effort to track steelhead that enter the Deschutes River further upstream and longer throughout the winter and possibly spring, would help to quantify the stray rate upstream of Sherars Falls.

To determine population-level genetics composition for the MPG, genetics data which allow an objective determination of the population(s) structure are required. Age-0 *O. mykiss* from several representative streams in each population segment have recently been sampled. Collection of juveniles from a minimum number of cohorts (3-4) is recommended using non-lethal fin tissue for DNA analysis. Population genetics will be characterized using a suite of nuclear DNA markers, including both microsatellite loci (variable-number simple-sequence repeats) and non-coding SNPs, or base substitutions assayed via restriction enzyme analysis (Moran et al. 1997).

Analysis: Estimating the proportion of out-of-basin strays is a simple comparison of the number of marked and unmarked spawners observed. Direct comparisons can then be made with recovery criteria. DNA tissue samples are analyzed by USFWS using known microsatellite markers. Microsatellite loci are analyzed using pairwise FST comparisons to estimate levels of gene flow and to identify geographic areas that contain genetically differentiated populations.

Status: Ongoing or planned, but efforts need to be enhanced.

Objective 4: Determine the status and trend in conditions of current and historically utilized habitat for each population.

This is a high level priority.

Type of monitoring effort: Long term status and trend monitoring.

Monitoring questions:

- What is the status and trend in habitat quantity and quality in the Deschutes Eastside and Westside populations?

Approach: Similar to other watersheds, we would use an EMAP sampling protocol as previously described for the John Day populations. Habitat variables follow ODFW Aquatic Inventories design (Moore et al. 2002) and are measured at the unit and reach scale.

Analysis: Data will be analyzed as distribution data in a GIS format. Database and GIS formatting of data allow associations with land use, land vegetation coverage, and many other attributes at watershed and population scales.

Status: Not implemented and currently unfunded.

Objective 5: Determine the freshwater productivity of each population relative to viability criteria and identify primary habitat factors limiting freshwater production.

No quantitative time series of smolts per adult or smolt-to-adult survival rates have been developed to represent Deschutes River populations across multiple generations. This type of information is important to monitor productivity and segregate tributary productivity from the migration and ocean life stages. This metric allows for better understanding of the productive potential of steelhead in the Eastside and Westside populations. Productivity appears to be inherently low in the Westside population relative to other Columbia Basin summer steelhead populations (see Section 7). It is hypothesized that interactions with the abundantly naturally occurring resident *O. mykiss* may limit steelhead production. Presently, juvenile outmigrants are trapped annually in the Warm Springs River and near the mouth of Trout Creek. With a more accurate method of determining spawner abundance in Trout Creek and smolt abundance estimates from the Warm Springs River, an index of smolts/adult or smolts/redd would be available for each population. This is a highest priority objective.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:
- What are the current and trend in freshwater productivity measured as smolts/redd?
- What are the primary factors limiting freshwater production of steelhead?

Approach: The ratio of smolts/adult is a recommended measure of freshwater productivity. Smolts are typically counted using traps as they migrate out of their natal habitat. If weirs are not present to count adults, then redd counts can act as a surrogate. Freshwater productivity will be measured as smolts/redd or smolts/adult. Trapping with RSTs is currently being conducted on the Trout Creek tributary. Egg-to-smolt survival requires an estimate of the number of eggs deposited by individual females or deposited in each redd. Parr-to-smolt survival can be estimated by capturing a representative number of parr in their rearing habitat, PIT tagging them, and then monitoring their recapture at the downstream smolt traps. Migration survival can similarly be estimated by monitoring detections of PIT-tagged individuals as they pass through PIT tag detection facilities.

Analysis: Smolt abundance would be estimated using mark/recapture techniques (Thedinga 1994, Steinhorst 2004).

Status: Partially implemented at the tributary level. Current PIT tagging efforts on Trout Creek need to be coordinated with efforts to estimate escapement.

Objective 6: Determine the effect of disease and predation on the abundance, productivity, diversity, and distribution of the Deschutes River populations.

Out-of-subbasin strays also pose a threat to steelhead population health. About 5% of the hatchery stray steelhead have tested positive for whirling disease (Engleking 2002). This is a high level priority.

Type of monitoring effort: Disease is short term research; predation long term status and trends.

Monitoring questions:

- What is the prevalence of whirling disease in the Deschutes subbasin and what is its influence on the natural steelhead populations?
- What is the effect of predation from piscine predators in the Columbia River migration corridor on juvenile steelhead originating from the Deschutes River?
- What is the effect of predation from avian predators in the Columbia River migration corridor on juvenile steelhead originating from the Deschutes River?

Approach: The current distribution and influence of whirling disease on wild steelhead populations is not fully understood. Representative sentinel stations could be established and monitored through time for each population to measure prevalence and intensity of infection rates of whirling disease. Infection, or the presence of *Myxobolus cerebralis* DNA, is detected by PCR analysis. A logical place to locate initial sentinel tests would be in locations where hatchery strays are known to be prevalent because they are a known vector of transmission from infected watersheds in northeast Oregon (Sollid et al. 2004). Sentinel stations should then be placed near the mouths of important tributary and mainstem habitats occupied by fry and parr life history stages of steelhead.

To evaluate avian predation, colonies are monitored for presence of PIT tags originating from specific populations (Collis et al. 2001). Bioenergetics models can then be used to expand tag recoveries at colonies to population-level impacts (Antolos et al. 2005).

Analysis: The SAR attributable to predatory mortality could be estimated from bioenergetics modeling results. Infection rates of sentinel fish from disease would need to be related to actual mortality rates experienced in the natural population. If this were determined then mortality rates resulting from disease could be estimated as a proportion of freshwater mortality (i.e., egg to smolt mortality) although some delayed mortality may also occur (Sollid et al. 2004).

Status: The whirling disease foundation, whirling disease initiative, and Oregon Sea Grant are potential funding sources for whirling disease investigations. Universities, through graduate student projects, are often used for this type of research and monitoring.

Objective 7: Determine the effect of hydropower on the abundance, productivity, diversity, and distribution of the Deschutes River populations.

MPG-specific SARs and migration survival rates need to be developed for the Mid-C steelhead DPS. The Deschutes River subbasin has the infrastructure to contribute PIT-tag groups of natural-origin steelhead to this need. Recently, approximately 1,400 steelhead smolts per year have been PIT tagged and released at the Trout Creek outmigrant trap (personal communication, Tom Nelson, ODFW, Madras). The Columbia Basin Fish and Wildlife Program's Comparative Survival Study plan for PIT-tagging steelhead includes a mark group for the Warm Springs River, but it has not been implemented. Implementing the Warm Springs tagging, and supplementing Eastside PIT-tagging with juveniles from the Buckhollow-Bakeoven hatchery influence study would result in a mark group from both populations that yields statistically robust annual SARs and migratory survivals through FCRPS facilities. PIT-tag based SAR estimates are a valuable information source to partition subbasin survival rates from survival rates through the Columbia mainstem migration corridor, during estuary and early ocean life, and for returning adults to Bonneville Dam and Sherars Falls.

No quantitative time series of smolts per adult or smolt-to-adult survival rates have been developed to represent wild Deschutes River populations across multiple generations. This type of information is important to monitor the productivity. This metric would help greatly to better understand the comparative productivity of Westside and Eastside populations. This is a high priority objective.

Type of monitoring effort: Long-term status and trend monitoring.

Monitoring questions:

- What is the effect of Columbia River hydropower operation on steelhead smolt survival for the Deschutes River Eastside and Westside populations?
- What is the effect of Columbia River hydropower operation on returning adult steelhead originating from the Deschutes River Eastside and Westside populations?
- What are SAR rates for the Deschutes River Eastside and Westside populations?

Approach: PIT tags have been used successfully to measure the influence of hydropower operations on migrating salmonids (see Berggren et al. 2006; Schaller et al. 2007). ODFW has cooperated with the CSS study by PIT tagging steelhead smolts as they migrate out of the John Day River Basin. These PIT-tagged fish are subsequently monitored for detections at FCRPS facilities along the migration corridor at both juvenile and adult life stages using DART and PTAGIS databases. Detection probabilities of juvenile salmonids migrating downstream at FCRPS facilities are modeled using the SURPH analytical tool (Lady et al. 2003). Adult detection (purportedly 100%) is currently available at ladders on several dams including Bonneville and are expected in the near future at The Dalles dam.

Analysis: Juvenile survivals at each FCRPS facility can be estimated using the SURPH model. Adult survival between facilities will soon be possible by comparing detections at adult ladder facilities along the migration corridor. Rates can be expanded to population-

level impacts using the relative number of fish PIT tagged and abundance estimates generated from mark-recapture at RSTs.

Status: ODFW currently PIT tags emigrating smolts on Trout Creek. Presently, juvenile outmigrants are also trapped annually in the Warm Springs River by CTWSRO. Detections of these tagged fish at FCRPS facilities are automatically logged into the PTAGIS database. The number of smolts tagged will need to be increased.

Objective 8: Determine the effect of habitat degradation and habitat restoration activities on the abundance, productivity, and distribution of the Deschutes River populations.

This is a high priority objective.

Type of monitoring effort: Long term status and trend; long term implementation and compliance; long term effectiveness monitoring.

Monitoring questions:

- Status & Trend Monitoring—What is the current status and trend of steelhead habitat?
- Implementation and Compliance Monitoring—Has the management action been implemented in the prescribed manner and achieved its objectives?
- Effectiveness Monitoring—Have the management actions significantly influenced the viability of the Deschutes River steelhead populations?

Approach: Status and trend monitoring at the subbasin and population scale is best conducted by using a spatially explicit sampling approach such as the EMAP approach developed by the EPA. Measured habitat variables will be the same as previously described for the John Day populations. Remote sensing (TIR, LIDAR, and spatially referenced color imagery) is also appropriate and typically addresses spatial scales at watershed or larger landscapes.

Compliance monitoring of restoration projects incorporates record keeping and reporting of activities. Compliance monitoring will primarily conducted by the implementing entity and will include parameters identified in related work statements.

Effectiveness monitoring can be approached at the watershed or project spatial scales, and should preferably be directed at measures of abundance, survival, growth, etc. of steelhead or abiotic or biotic factors limiting their recovery. A modified BACI design (including spatial replication) is recommended for measuring the effectiveness of active restoration activities (Jones & Tonn 2004). For passive restoration activities, a BACI design that monitors trends through time may be appropriate. If comparisons are made to reference or control sites, they should be under similar environmental conditions experienced by the treatment site but outside the influence of treatment activities. Restoration implementing entities must coordinate with monitoring groups prior to action implementation—preferably several years in advance to allow measurement of pre-manipulation variables. Temporal scales must account for time lags related to life history and life cycle. Derived variables include

proportion of population-level parameter (e.g., abundance, production) influenced by restoration activity.

Analysis: If at the appropriate scale, direct comparisons of measured parameters with recovery criteria can be made. Otherwise, measures at smaller scales will need to be scaled up to determine if they would have desired responses at the population level.

Status: Implementation monitoring is ongoing for some programs, however, roll-up to the population level is not ongoing and some programs have limited monitoring.

Objective 9: Determine the effect of harvest on the abundance, productivity, and diversity of the Deschutes River populations.

Since 1979, recreational angling regulations have stipulated that all wild fish be released unharmed. Tribal harvest of wild steelhead since 1998 has also been restricted at Sherars Falls, where most tribal summer steelhead harvest occurs. From 1993 to 2003, the annual harvest of wild steelhead in this subsistence fishery averaged 34 fish, with a range from 0 to 135 per year (French and Pribyl 2004). Significant tribal harvest of steelhead continues to occur in the mainstem Columbia; however, the number of Deschutes origin fish harvested in this fishery is unknown.

During the past ten years (1993 to 2002) the average catch of wild steelhead in the recreational fishery from the mouth upstream to, but not including the Sherars Falls area, averaged 3,268 fish, with a range of 1,192 to 6,525 fish. Recreational angling regulations stipulated that all wild fish had to be released unharmed. During the same period the catch of hatchery origin steelhead for the same river reach averaged 2,665 fish, with a range from 779 to 5,120 fish. Most tribal summer steelhead harvest occurs in the dipnet/set net subsistence fishery concentrated at Sherars Falls. During the 10-year period from 1993 to 2003, tribal fishers at Sherars Falls had tribal regulations restricting the harvest of wild steelhead. The annual harvest of wild steelhead in this subsistence fishery averaged 31 fish, with a range from 0 to 135 per year (French and Pribyl 2004). Some limited hook and line harvest of wild summer steelhead by Tribal members does occur in areas upstream of Sherars Falls, primarily during the winter months. The number of wild summer steelhead harvested by tribal fishers in this fishery is not known. This is a high level priority.

Type of monitoring effort: Long term status and trends.

Monitoring questions:

- What is the annual fishing mortality rate that occurs outside of the Deschutes River subbasin?
- What is the annual fishing mortality rate that occurs within the Deschutes River subbasin?

Approach: Reinstating an expanded creel survey of the recreational fishery within the Deschutes River subbasin would enable an estimate of the effects of the fishery on the wild populations. Examine all fish for fin clips and external tags. Origin of out-of-basin hatchery

strays will be determined by collecting and identifying any coded-wire tags from fin-clipped fish. Fish will be scanned for coded-wire and PIT tags using portable detectors. If tags are detected, snouts from fish with coded-wire tags and those that are ventral-clipped should be removed for tag identification.

Analysis: The number of fin-clipped and natural-origin fish caught by interviewed anglers will be totaled and be used for an expanded estimate of the number of fin-clipped and natural-origin fish caught throughout season. Estimate of the incidental and/or directed fishing mortality on natural-origin steelhead will be calculated using published literature values. Proportion of total mortality imposed by fishing mortality will be estimated when combined with additional mortality information.

Status: Voluntary returns of tags from cooperating anglers have occurred sporadically over the past several years. ODFW should provide lead with aid of tribal agencies where jurisdiction overlaps.

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