

**Taking Action on Climate Change Adaptation:
Piloting Adaptation Strategies to Reduce Vulnerability and Increase
Resilience for Native Salmonids in the Crown of the Continent Ecosystem**



Photo Source: U.S. Geological Survey, Department of the Interior/USGS, U.S. Geological Survey/Photo by Jonny Armstrong

Final Workshop Report

November 18-20, 2014 – Kalispell, Montana

For all supporting materials, please see workshop website:

<http://crownmanagers.org/adaptative-management>

***Funding generously provided by a grant from the Crown Roundtable/
Kresge Foundation through the Adaptive Management Initiative***

Organized by:



Executive Summary

Taking Action on Climate Change: A Collaborative, Large-Landscape Initiative

In late 2013, the Crown Managers Partnership, the Crown of the Continent Conservation Initiative, and The Wilderness Society came together to begin working collaboratively with one another and with their respective partners to advance Crown-wide climate adaptation projects on a variety of natural resource values. Through a series of 'Big Tent' workshops, we are facilitating conversations between state, federal, and provincial agency managers; Tribes and First Nations; non-profit conservation organizations; citizen groups; and universities to identify Crown-wide opportunities for implementing collaborative and/or complementary adaptation actions driven by a shared landscape-scale strategy.

The first 'Big Tent' workshop followed the Crown Managers Partnership Annual Forum in March, 2014. By the workshop's end, participants had identified multiple natural resource topics that represented opportunities for collaboration related to climate adaptation at the scale of the Crown:

- (1) **aquatic invasive species,**
- (2) **whitebark pine restoration,**
- (3) **cold-adapted, native salmonid species,**
- (4) **noxious weeds, and**
- (5) **prescribed fire in mixed severity fire regimes;**
- (6) **meso-carnivores** (wolverine, Canada lynx, and fisher) were added to this initial list after post-workshop meetings with the U.S. Forest Service staff and additional partners.



Figure 1. The first 'Big Tent' workshop in Missoula in March, 2014. *Photo courtesy of Ian Dyson.*

Based on subsequent feedback by workshop participants that identified **native salmonids** as the highest priority for collective action, the second 'Big Tent' workshop focused on '*Piloting adaptation strategies to reduce vulnerability and increase resilience for native salmonids in the Crown of the Continent ecosystem*', and was held in Kalispell, Montana from November 18th-20th, 2014.

The subject of this second workshop provided an opportunity to welcome additional partners into our collaborative effort, including the U.S. Forest Service's Northern Rockies Adaptation Partnership (NRAP) and the Great Northern Landscape Conservation Cooperative's (GNLCC) Rocky Mountain Partner Forum; this expansion enabled us to collectively integrate concurrent regional initiatives on native salmonids.

Collaborative efforts to reduce vulnerability and increase resilience for bull trout and westslope cutthroat trout (WSCT) across the Crown of the Continent

The primary objectives of the native salmonid workshop were to:

- Prioritize a suite of adaptation strategies and demonstration projects, for implementation both sub-regionally and across the entire Crown of the Continent Ecosystem (CCE), that anticipate and build the resilience and adaptive capacity of two key native salmonid species – bull trout and westslope cutthroat trout - to climate change and other human stressors,
- Confirm opportunities to coordinate strategies at multiple scales to enhance learning and adaptive management.

Specifically, the organizers worked together to try to facilitate a new, collaborative conversation leading to the following four outcomes by the end of the workshop:

- **Confirm a suite of targeted outcomes for native salmonid populations in the CCE**, with respect to climate change and additional anthropogenic stressors (e.g. invasives, habitat modification);
- **Identify 1-2 on-the-ground projects that could be scaled up** and applied more broadly across the Crown of the Continent Ecosystem;
- **Identify one new tactic that could be implemented as a prototype project** (with strong scientific basis used to identify appropriate geospatial location for that strategy/tactic) ; and
- **Coordinate on one Crown-wide specific tactic.**



Figure 2. Left: Erin Sexton welcoming participants on the first day of the workshop; Right: Connie Simmons, Melanie Percy, and Len Broberg using Crown-wide climate scenarios for bull trout and westslope cutthroat trout - developed by Clint Muhlfeld and Leslie Jones - during a breakout session. Photos courtesy of Stephen Legault.

Forty-five participants from 20 state, federal, and provincial agencies; Tribes; non-governmental conservation organizations (NGO's); university staff and community groups convened in Kalispell for the three-day workshop. Six large-landscape collaboratives and initiatives were also represented, including: (a) the Crown Managers Partnership, (b) Crown of the Continent Conservation Initiative, (c) Crown Roundtable, (d) Southwestern Crown Collaborative Forest Landscape Restoration Project, (e) Great Northern Landscape Conservation Cooperative, and (f) Northern Rockies Adaptation Partnership.

We began by reviewing the science available to support decision making by managers; moved into a panel framing the opportunities and challenges of managing native salmonids by different jurisdictions across the Crown; heard about long-term efforts by the Multi-State Interagency Yellowstone Cutthroat Trout Conservation Work Group to define conservation priorities for native salmonids at the landscape scale in the Greater Yellowstone Ecosystem (as an example of a regional prioritization process); listened to a panel focusing on examples of on-the-ground climate adaptation projects for bull trout and westslope cutthroat trout across the Crown; and then began in smaller groups to identify coarse- and fine-scale geographic priorities, strategies and tactics for managing bull trout and westslope cutthroat trout in the Crown. Finally, workshop participants used ecological and opportunity-related criteria to narrow down the list of potential projects that we could pursue collaboratively, and discussed opportunities and needs for implementation.

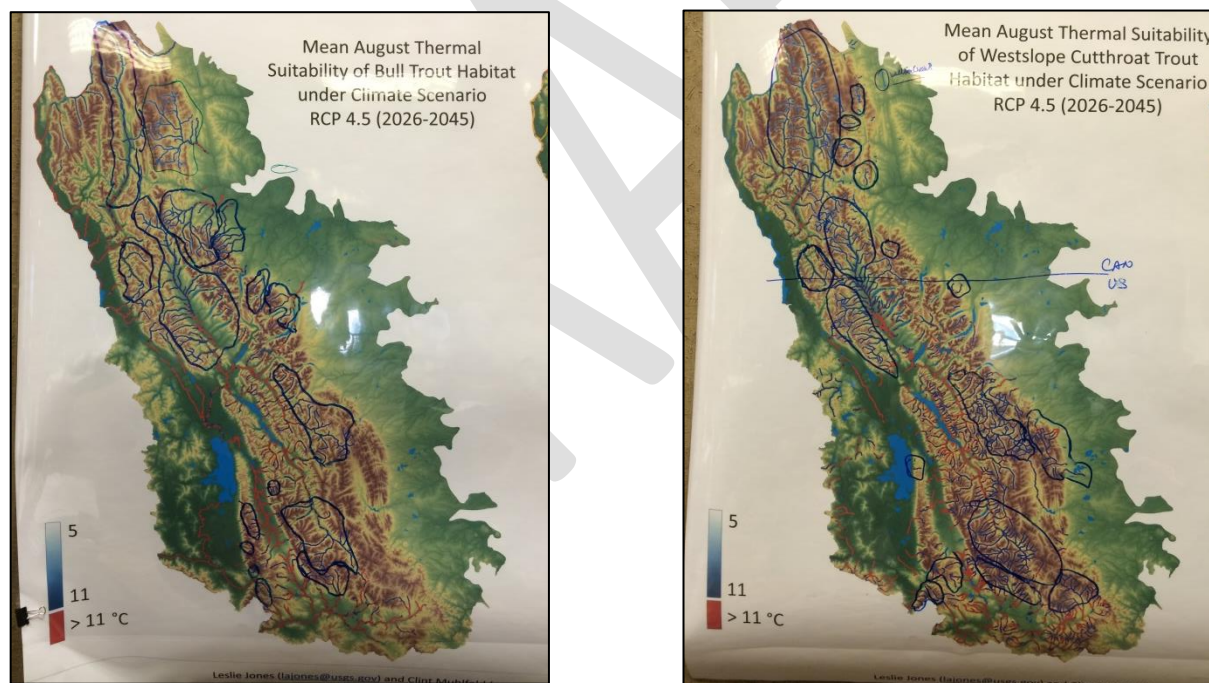


Figure 3. Climate scenarios developed by Clint Muhlfeld and Leslie Jones (U.S. Geological Survey) for the time period 2026-2045 for (left) bull trout and (right) westslope cutthroat trout at the scale of the Crown of the Continent. Workshop participants were asked to develop a list of coarse- and fine-scale geographical priorities and management strategies/ tactics for each species during consecutive breakout sessions using these models as tools. *Photos courtesy of Stephen Legault.*

The individual priorities identified by each breakout are listed below.

- Given that several of these projects could have been classified under more than one workshop goal, we have chosen to list the three workshop goals at the top of the list as a

reminder of our collective focus, and then provided the entire list of priority projects developed at the workshop below these goals;

- Additionally, we have removed "support community-based conservation efforts" from the list because of the critical importance of this component in any Crown-wide project on native salmonids moving forward.

1. **Identify 1-2 on-the-ground projects that could be scaled up and applied more broadly across the Crown of the Continent Ecosystem (CCE);**
2. **Identify one new tactic that could be implemented as a prototype project (with strong scientific basis used to identify appropriate geospatial location for that strategy/tactic); and**
3. **Coordinate across jurisdictions on one Crown-wide project.**

PROPOSED PROJECTS

PROJECT #1: Establish coordinated monitoring efforts across the CCE, including standard protocols, frameworks, and objectives, as well as a common data repository, for both fish populations and habitats.

OUTCOME: A consistent and coordinated monitoring approach will assist in the identification of highest priority native salmonid conservation and restoration projects and habitat, as well as provide real-time information feedback loops to managers to facilitate adaptive management at a Crown-wide scale.

PROJECT #2: Complete prioritization and mapping of conservation populations and key watersheds most critical to sustain native salmonids across the CCE given both existing stressors and climate change, and simultaneously work to identify and secure groundwater upwelling areas and potential coldwater refugia at fine scales; additionally, identifying important coldwater tributary entrances (where adult salmonids tend to gather) into warmer river systems falls under this category as well. For bull trout, this exercise has been completed in the Montana portion of the Crown by the US Fish & Wildlife Service in 2011 (please see Appendix I of final maps courtesy of Wade Fredenberg, USFWS).

OUTCOME: A Crown-wide prioritization of the populations and sub-watersheds most critical to conserve and restore will ensure all partners in the Crown are focused on the highest impact places and projects. At the same time, we can get started right away securing groundwater upwelling area where they already support native salmonid populations, as these have the potential to offer coldwater refugia into the future.

PROJECT #3: Develop a set of consistent strategies for suppressing non-native fish species across Crown (e.g. prevention, monitoring, response, and enforcement) that is based on lessons learned about critical uncertainties and ecological function from ongoing projects; prioritize testing of these strategies in core areas and known cold water refugia.

OUTCOME: Existing efforts by the Crown Managers Partnership focused on preventing the introduction of aquatic invasive species has demonstrated the efficiency and strength of coordinated strategies. Applying this successful model to the management of invasive trout species would help to conserve the genetic integrity and fitness of the Crown's native salmonids.

PROJECT #4: Secure the placement of fish screens on existing water diversions, including those on Saint Mary's River, and the Belly River.

OUTCOME: Existing water diversions on the Saint Mary and Belly Rivers currently entrain thousands of fish per year; this is a particular concern in light of the recent decline in bull trout population numbers in these rivers (particularly in the Alberta portion of the watershed).

PROJECT #5: Replicate, restore and/or translocate native salmonid populations to cold water refugia in priority transboundary watersheds East of the Divide (including the Oldman Watershed).

OUTCOME: A strong, transboundary, community-based effort focused on replicating, re-storing, and perhaps translocating native salmonid populations could help ensure that these species persist in these watersheds.

PROJECT #6: Implement strategic and coordinated suppression of invasive rainbow trout in the transboundary Flathead watershed, combined with exportation of best management practices to other locales;

OUTCOME: The transboundary Flathead watershed remains the “best of the best” in terms of native salmonid population distribution and abundance. A strategic and coordinated non-native suppression effort would address the largest threat to these populations.

PROJECT #7: Improve and restore native salmonid habitat in headwaters by whatever suite of interventions are appropriate locally (e.g. use of monitoring tools to identify significant point sources of sediment from roads, stream channel restoration to lower stream temperatures; replace/upgrade culverts to restore connectivity with higher elevation cooler stream segments; control water temperatures through selective cold water release from dams to offset climate change impacts; etc.);

OUTCOME: Native salmonids require clean, cold, complex, and connected habitat. Focusing habitat restoration efforts on headwater streams will help ensure the delivery of cold, clean water lower in the watershed, and increase access to cold water refugia at higher elevations into the future.

PROJECT #8: Re-establish beavers across the landscape: launch a pilot project that incorporates efforts to (a) reduce trapping of existing beaver populations (i.e. to facilitate successful dispersal events by existing populations), (b) identify policy avenues that can incentivize expansion of beaver populations in key watersheds, and (c) identify educational outreach opportunities for private landowners, agency staff, and fisheries managers (Stillwater, Montana, and Alberta);

OUTCOME: Beavers play a major role in creating complex habitats that native salmonids need to thrive, but their contribution to the landscape has diminished as a result of intensive trapping and eradication efforts. The goal here is to develop pilot projects that would foster natural or augmented expansion of beaver populations through increased tolerance and reduced trapping efforts.

PROJECT #9: Export successful bull trout translocation efforts piloted in the North Fork of the Blackfoot to other landscapes.

OUTCOME: Efforts to translocate bull trout into historic or novel habitats have seen great success in the North Fork Blackfoot watershed; exporting this successful translocation model to other landscapes (and expanding it to include westslope cutthroat trout) can help to sustain native salmonid populations in their historic (and future) range.

Workshop Participant List

NAME	AGENCY
Bray Beltran	Heart of the Rockies/ Five Valleys Land Trust
Keith Bocking	Alberta Environment and Sustainable Resource Development
Matt Boyer	Montana Fish, Wildlife and Parks
Len Broberg	University of Montana
Whisper Camel-Means	Confederated Salish and Kootenai Tribes
Anne Carlson	The Wilderness Society
Yvette Converse	U.S. Fish & Wildlife Service/ Great Northern Landscape Conservation Cooperative
Molly Cross	Wildlife Conservation Society
Bill Dolan	Crown Managers Partnership / Alberta Environment and Sustainable Resource Development
Chris Downs	Glacier National Park
Mike Durglo	Confederated Salish and Kootenai Tribes
Ian Dyson	Crown Managers Partnership / Alberta Environment and Sustainable Resource Development
Lorne Fitch	Cows and Fish: Alberta Riparian Habitat Management Society
Beth Gardner	U.S.D.A. Forest Service
Dave Hanna	The Nature Conservancy
Mark Deleray	Montana Fish, Wildlife and Parks
Sasha Harriott	Crown Managers Partnership
Shane Hendrickson	U.S.D.A. Forest Service
Linh Hoang	U.S.D.A. Forest Service
Craig Johnson	Alberta Environment and Sustainable Resource Development
Leslie Jones	USGS Northern Rocky Mountain Science Center
Ladd Knotek	Montana Fish, Wildlife and Parks
Ryan Kovach	USGS Northern Rocky Mountain Science Center
Steph Legault	Crown of the Continent Conservation Initiative
Brian Marotz	Montana Fish, Wildlife and Parks
Caryn Miske	Crown Managers Partnership/ Flathead Basin Commission
David Moser	Montana Fish, Wildlife and Parks
Clint Muhlfeld	USGS Northern Rocky Mountain Science Center
Regan Nelson	Crown of the Continent Conservation Initiative
Ryen Neudecker	Big Blackfoot Chapter of Trout Unlimited
Melanie Percy	Alberta Environment and Sustainable Resource Development
Ron Pierce	Montana Fish, Wildlife and Parks
Melly Reuling	Crown Roundtable
Mary Riddle	Glacier National Park / Crown Managers Partnership
Bruce Rieman	Clearwater Resource Council
Leo Rosenthal	Montana Fish, Wildlife and Parks
Erin Sexton	University of Montana, Institute on Ecosystems/ Crown Managers Partnership
Brad Shepard	Wildlife Conservation Society
Connie Simmons	Oldman Watershed Council
Heather Sinton	Alberta Environment and Sustainable Resource Development
Scott Spaulding	U.S.D.A. Forest Service
Amber Steed	Montana Fish, Wildlife and Parks
Lisa Talavia-Spencer	Alberta Culture and Tourism, Community Development Unit
John Weaver	Wildlife Conservation Society
Michael Young	U.S.D.A. Forest Service / Rocky Mountain Research Station

1. Welcome and Opening Remarks

Erin Sexton welcomed participants, brought greetings from the Organizing Committee and thanked the Crown Roundtable/Kresge Foundation for their generous grant funding for the workshop provided through the Adaptive Management Initiative.

Erin then provided an overview of events that led to the workshop. This overview included a brief description of the Crown of the Continent Ecosystem (CCE) and the Adaptive Management Initiative partners for this workshop: the Crown Managers Partnership, The Wilderness Society and the Crown of the Continent Conservation Initiative. Additionally, the U.S.D.A. Forest Service's Northern Rockies Adaptation Partnership, the Wildlife Conservation Society, and the U.S. Geological Survey contributed to the planning of this workshop.

An initial workshop held in March 2014 in Missoula, MT entitled "Taking Action on Climate Change – A Workshop to Develop Shared Strategies for A Shared Landscape" used a scenario planning approach to articulate possible futures for the CCE region in light of climate change. One of the results from that workshop was a list of priorities for action with respect to climate change adaptation strategies that participants believed could be addressed collaboratively at the scale of the Crown of the Continent, with local implementation. The list of priorities included the following:

- Bull trout / Westslope Cutthroat Trout (WSCT)
- Prescribed fire – Mixed severity fire regimes
- Invasives – aquatic invasive species and noxious weeds
- Whitebark pine
- Meso-carnivores (Canada lynx, wolverines, and fisher)

Erin noted that this current workshop is in response to bull trout and WSCT having emerged as participants' top priority and represents an opportunity to bring together those managers and stakeholders with common interests in both climate change and the preservation of native salmonid species. Furthermore, this workshop applies a collaborative management approach in which a shared template, shared facts and shared baseline will help identify possible shared management opportunities, objectives and outcomes. In support of this common baseline, Erin highlighted the value of partnerships and coordination across nested geospatial and temporal scales and the work of the Great Northern Landscape Conservation Cooperative (GNLCC) as it relates to climate change adaptation for cold water systems.

To conclude, Erin reviewed the workshop objectives and outcomes:

Objectives:

- Prioritize a suite of adaptation strategies and demonstration projects for implementation both sub-regionally and across the entire CCE that anticipate and

build resilience and adaptive capacity of two native salmonid species – bull trout and WSCT – to climate change and other human stressors.

- Confirm opportunities to coordinate strategies at multiple scales to enhance learning and adaptive management.

Outcomes

- Confirm a suite of targeted outcomes for native salmonid populations in the CCE, with respect to climate change and additional anthropogenic stressors (e.g. invasives, habitat modification);
- Identify 1-2 on-the-ground projects that could be scaled up and applied more broadly across the CCE;
- Identify one new tactic that could be implemented as a prototype project (with strong scientific basis used to identify appropriate the geospatial location for that strategy/tactic) ; and
- Coordinate on one Crown-wide specific tactic.

2. Participant Introductions

To encourage networking and a comfortable environment, participants were asked to introduce themselves to others at their table and answer the following question:

“What do you consider to be the most exciting opportunity for westslope cutthroat trout and bull trout in this landscape as the climate continues to change?”

After a short time, the groups reconvened as a whole and shared their responses to the question. The results were as follows:

- Connect up smaller pieces from the CCE to a larger outcome.
- Want to do what I’ve already done in my childhood: fish for the big bull trout and WSCT again.
- Re-introduce beavers.
- See, protect, and restore the native trout.
- Collective impact.
- Ensure kids have the same opportunities to enjoy native trout.
- True transboundary, cross-jurisdictional project implementation.
- Create safe genetic reserves to preserve genetic diversity.
- Manage fishing in a collaborative fashion.
- Understand interactions between nonnative and native species so we can better manage for climate change.
- Manage existing secure and protected areas to ensure species survival into the future, manage for resilience.
- Develop pilot projects that create momentum and elevate efforts to the Crown scale.
- Link science to management and policy.

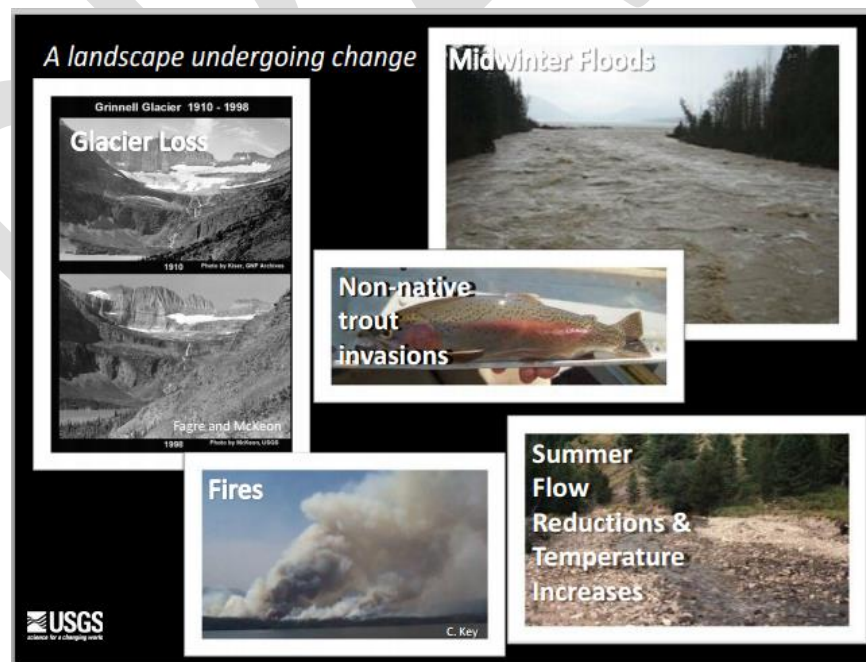
- Integrate assessment, student monitoring.
- Integrate and adaptive management at the landscape scale.
- Identify key priorities at the landscape scale.
- Watershed management.
- Non-fiber focus, [currently] too much fiber focus.
- Strategic, collaborative approach.
- Landscape-wide set of priorities, strategic prioritization.
- Invasives and climate change - where will we make a stand and invest?
- Implementation.
- Cold water refugia gives us options
- Collaborate to protect habitat (both current and future); habitat restoration under strong policy.
- Shared strategies across jurisdictions.
- Use Parks and Protected Areas to the fullest regarding conservation efforts for bull trout and WSCT.
- Proactive, not reactive.
- Open discussion around tradeoffs - "balance" doesn't mean much for fish.
- Manage cumulative effects by keeping sediment out of water - common strategies.
- WSCT - Scapegoat wilderness, re-introduction-expansion of current WSCT and bull trout population in the North Fork - Blackfoot river.
- St. Mary's – bull trout conservation protection and expansion in Upper St. Mary's.
- Understand priorities on landscape actions - do best work for species.
- Identify baseline management objectives for entire region - not just within jurisdictional boundaries.
- Pilot sub-watershed project, decrease linear features, protect habitat, engagement and education focus.
- Tools to understand how populations become adapted to local conditions.
- Wish list: better tools for managing nonnatives.

3. *Native Salmonids Across the CCE: The Science available to support decision-making*
– Clint Muhlfeld and Leslie Jones, U.S.G.S. Northern Rocky Mountain Science Center
(See Crown Managers Partnership (CMP) website for full presentation:
<http://crownmanagers.org/adaptative-management>)

Clint Muhlfeld provided a comprehensive overview of the status and trends for each species as well as a review of current and projected impacts of climate and non-climate stressors. He noted that cold, clean, complex and connected habitats are ideal for WSCT and bull trout. Genetic variation among WSCT highlight the need and value of maintaining separate demographic management strategies for different river systems and, for bull trout, conservation approaches should focus on meta-populations. He stressed the importance of recognizing the evolutionary history and need to protect ecological integrity at a meta-population scale.

Clint noted the bull trout range stretches from Nevada to the Yukon and they have been on the landscape for 12,000 years, surviving previous colder and warmer, long-term climatic cycles. Current threats for bull trout include habitat degradation and fragmentation; invasives (competition and predation by non-native brook and lake trout); over fishing; and climate change; as well as rising selenium levels in the transboundary Kootenay region. The range for WSCT east of the Continental Divide includes the South Saskatchewan and Missouri river systems and west of the divide, the Upper Kootenay and Upper Clark Fork river systems. WSCT faces many of the same threats as bull trout including habitat degradation and fragmentation resulting from forestry, mining and oil and gas industry activity and urbanization; over fishing, and climate change; although hybridization with rainbow trout is recognized as a critically important threat to this species.

Clint further noted (*see slides, below*) the science indicates the CCE is warming at 2-3 times the rate of the global average and that by 2030, glaciers are no longer predicted to exist in Glacier National Park. Flow regimes are also changing with climate shifts, with peak flows occurring earlier annually, lower base flows during the summer, and stream temperatures increasing. As a result of these impacts, climate change is predicted to shift the distribution, abundance, phenology and genetic diversity of Rocky Mountain salmonids. Additionally, climate warming is expected to increase fall and winter flooding, which may scour redds¹ and wash away fry in unconfined alluvial valley reaches that are known to be important for bull trout spawning. Furthermore, hybridization between WSCT and non-native rainbow trout is accelerated by climate change through decreases in spring precipitation and increases in summer temperatures, combined with distance to source population (Muhlfeld et al., 2014).



¹ A redd is a spawning nest that is built by salmonids in the gravel of streams or the shoreline of lakes.

Bull Trout in the Crown



Threats

- **Habitat degradation and fragmentation**
 - Mining, oil & gas, agriculture, forestry, urbanization
- **Invasive species**
 - Hybridization, competition & predation (brook & lake trout)
- **Overexploitation**
- **Climate change**

Cosewic (2012); USFWS 2014

Westslope Cutthroat Trout in the Crown



Threats

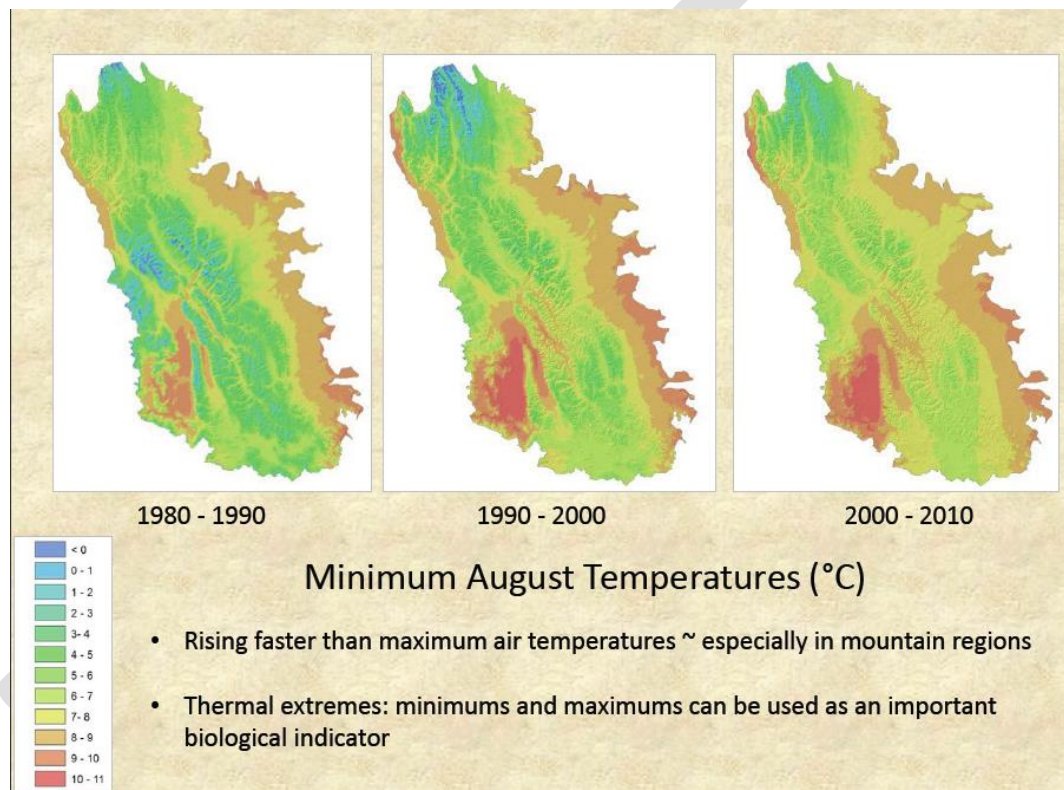
- **Invasive species**
 - Hybridization and competition with introduced trout (rainbow and brook)
- **Habitat degradation and fragmentation**
 - Mining, oil & gas, agriculture, forestry, urbanization
- **Overexploitation**
- **Climate change**

Cosewic (2006); Shepard et al. (2005)

Next, Leslie Jones shared downscaled, regional climate models and climate data available for the Crown, as well as her stream temperature modelling efforts with Crown-wide coverage. She also outlined how these models could assist in decision-making for native salmonids.

NASA Daymet Data is a high resolution (1 km x 1 km) product that is appropriate for historic and contemporary climate analysis. Leslie Jones has assembled daily Daymet parameters (1980-2013) for the Crown of the Continent. The weather parameters are: Minimum and maximum temperatures, snow water equivalent, precipitation and shortwave radiation.

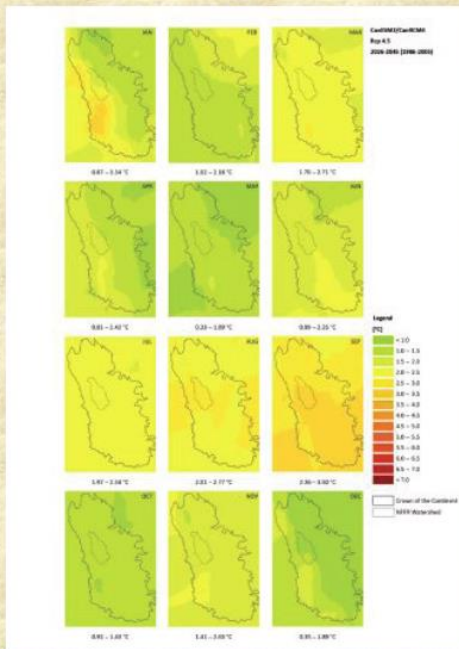
She used the data to illustrate how minimum temperatures are rising faster than maximum temperatures, especially in mountain regions, and how thermal extremes can be used as important biological indicators. Managers and conservation groups expressed much interest during the workshop in working with Leslie to use these data for their region.



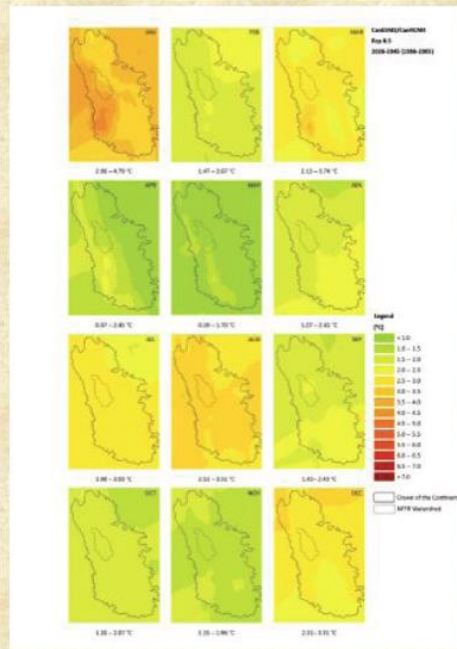
She then talked about down-scaled future climate data available for the Crown, and how change analyses are conducted. Regional downscaled climate model simulations are available from the Canadian Center for Climate Modeling and Analysis, and have been processed with Crown coverage. Predicted changes in minimum and maximum temperatures, as well as precipitation, are available and form the basis for any future climate analysis.

Regional Downscaled Climate Model: (2026-2045)

RCP 4.5



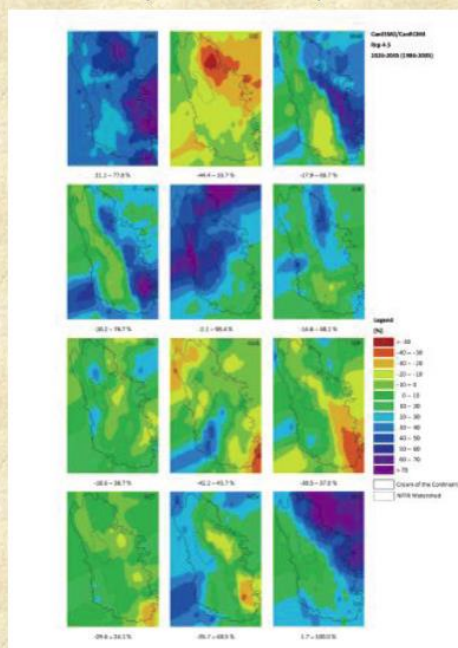
RCP 8.5



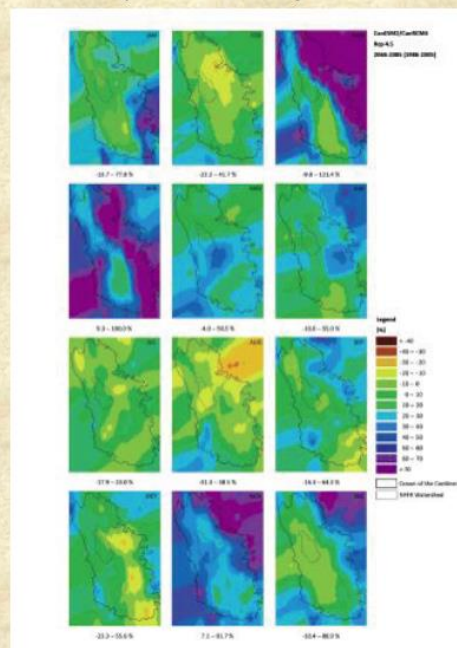
Wood, Raul. 2014.

Regional Downscaled Climate Model RCP 4.5

(2026 – 2045)



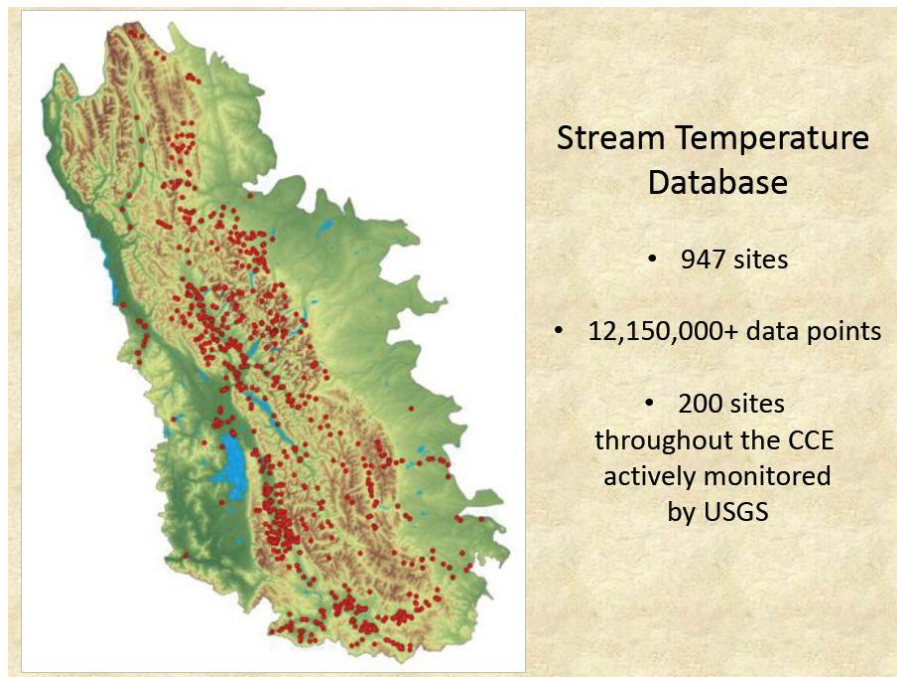
(2066 – 2085)



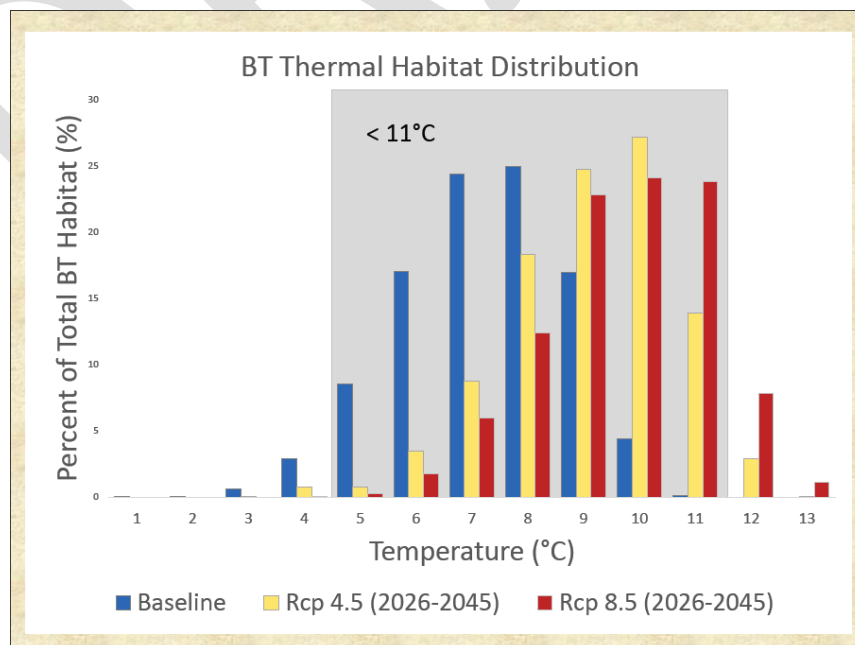
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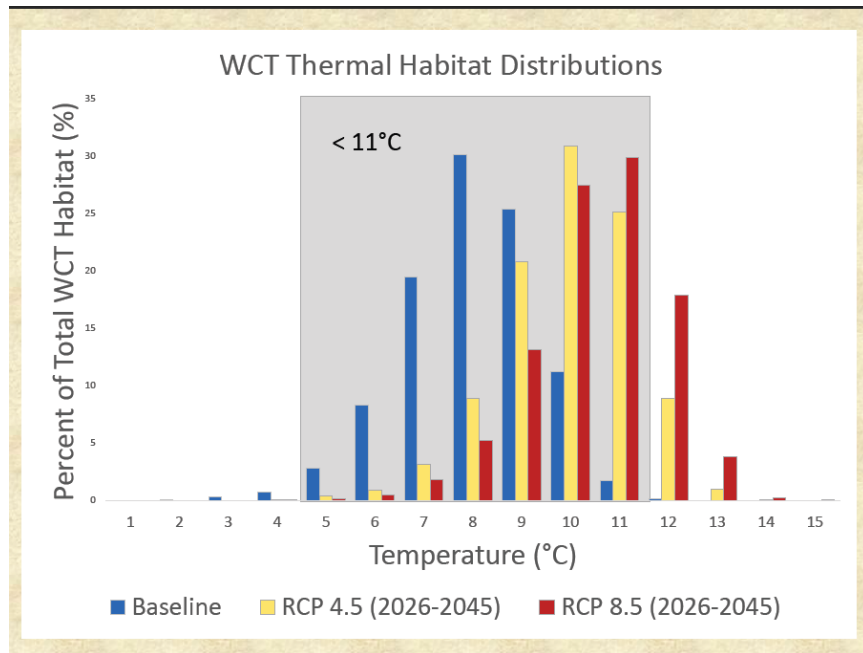
Massive efforts have focused on developing a stream temperature database for the Crown to build a historic and future stream temperature model with Crown coverage.

Management agencies throughout the United States, British Columbia, and Alberta have contributed data and currently the database consists of 947 sites with over 12,150,000 data points.



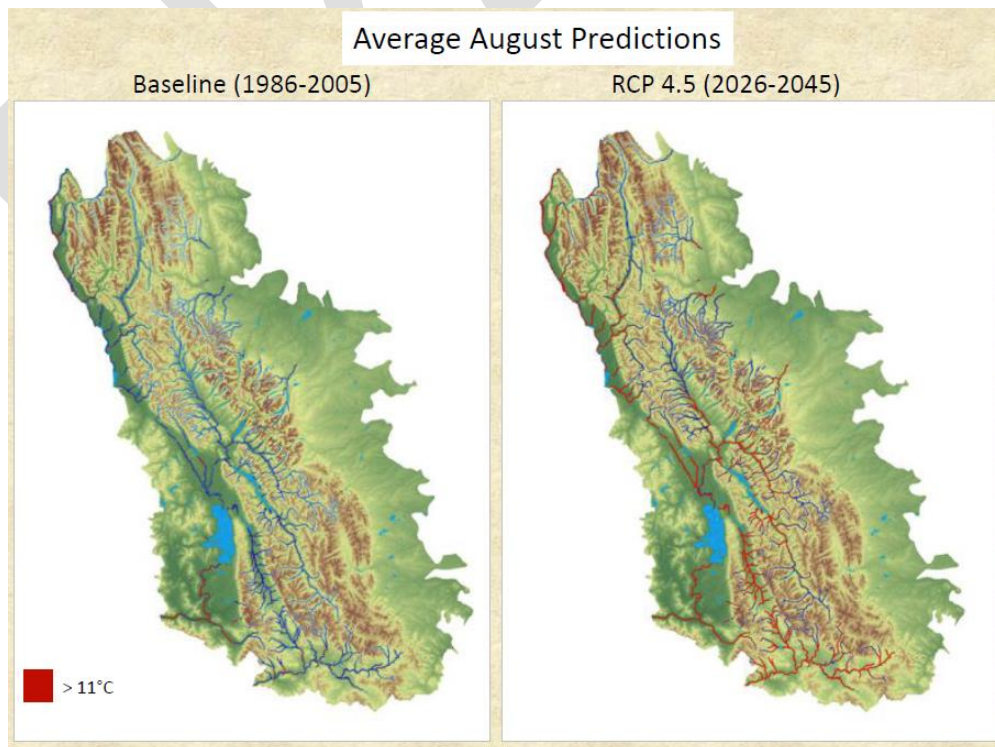
She discussed current efforts to build a daily and monthly stream temperature model, which uses high resolution climate data, as well as simulated future climate scenarios from the Canadian Center for Climate Modeling and Analysis. These model results were used to summarize current thermal habitat preferences for both bull trout and westslope cutthroat trout in the Crown.



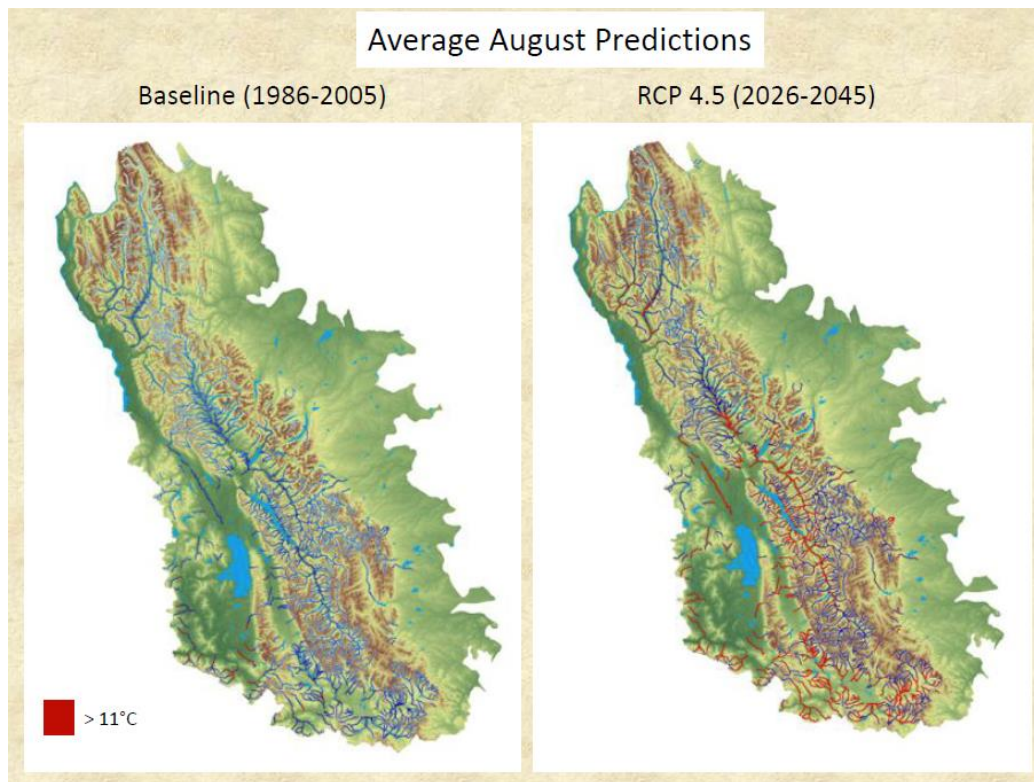


Potential habitats in the Crown that may exceed the thermal preferences of bull trout and WSCT in the future were also mapped and presented by Leslie. Specifically, these maps were used to identify potential refugia under the RCP 4.5 (2026-2045) climate scenario; and depict those watersheds in the Crown that will likely see the most warming in the future, and which watersheds may provide thermal refugia for these threatened salmonids:

Bull trout habitat:



Westslope cutthroat trout:



Details of the methodology, findings and analyses are contained within the Notes portion of the powerpoint presentation posted on the workshop website. After noting that the network of data collected is vast, Leslie made herself available through (and following) the workshop to participants interested in drilling down into particular geospatial areas of the Crown to support their ongoing work and planning.

Clint discussed the critical importance of scale and context when determining conservation priorities. He cited approaches by Shepard and Al-Chokhachy (In-progress), Haak et al. (2007), Haak and Williams (2012) and Schindler et al. (2010) that apply a matrix to identify conservation priorities which considers management goals (representation, resilience, redundancy and opportunity) and conservation objectives simultaneously (genetic life history/diversity; protection and restoration of habitats and populations; and, protection and conservation of metapopulations).

Clint concluded (*see slides, below*) by highlighting a wide diversity of bull trout and WSCT-focused conservation projects occurring throughout the CCE by a wide range of agencies, private landowners, and partners, and used tactics applied as examples for participants to consider along with the following broad conservation strategies:

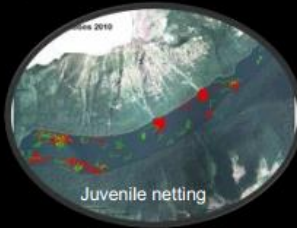
- Restore and enhance connectivity
- Reduce / eliminate nonnative species where feasible
- Restore and protect critical habitats (streams, lakes, riparian/upland areas)
- Restore and protect critical populations

- Maintain instream flows and temperatures
- Implement restrictive angling regulations where/when necessary
- Collaborate across borders and jurisdictional boundaries
- Develop a crown-adaptation plan for focal species
- Monitor to develop vulnerability assessments to increase resilience.

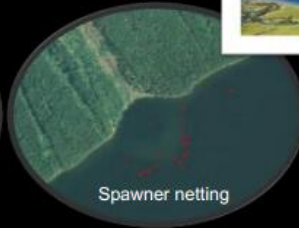
Suppression of Invasive Lake Trout to Conserve Bull Trout



Quartz Lake
Swan Lake
Flathead Lake



Juvenile netting



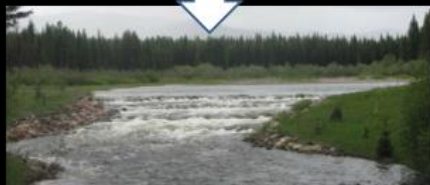
Spawner netting



Rosenthal, Fredenberg, Downs, D'Angelo, Gardner, Muhlfeld, Hansen

Restoring Connectivity – Clearwater River

Emily-A



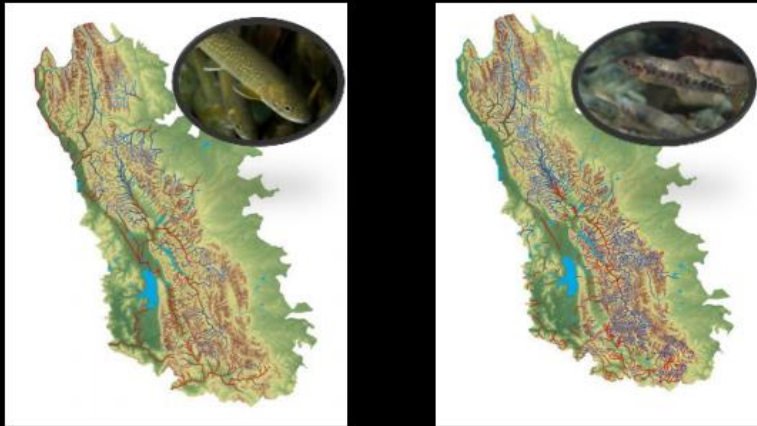
Rainy



Ladd Knotek (MFWP)

Thermal Refugia for Native Salmonids

- High elevations, northern latitudes, groundwater & glacial influenced reaches, and lakes.



Questions for Clint and Leslie:

Q. Temperature models and baseline were identified (1980-2010). They included some very hot years: how might this have affected the model outputs?

- It is the baseline period identified by the Canadian Center for Climate Modeling and Analysis.
- Additionally, by taking a 30-year average (rather than, say, a 10-year average), outlying high or low years will have less of an impact on the baseline average.

Q. In your model, you have identified alluvial valley bottoms that are important for bull trout spawning due to cold water upwelling sites. As you learn more about the attributes of these potential cold water refugia through ground-truthing, are you using this information to train your models to better identify these sites?

- Leslie is including a valley bottom covariate in the model to try to explain the cooling effects of groundwater. Specifically, she looks at these co-variates at a finer scale to inform the larger modeling efforts.

4. Panel #1 – Native Salmonids Across the CCE : Framing the Opportunities & Challenges by Jurisdiction – Introduction by Ian Dyson, Crown Managers Partnership, Moderated by Linh Hoang, U.S. Forest Service

*(See CMP website for presentations and maps provided by speakers:
<http://crownmanagers.org/adaptative-management>)*

Ian Dyson welcomed speakers and outlined the context for the panel discussion. He noted that efforts to identify opportunities for transboundary collaborative management actions benefit from an awareness and understanding of the jurisdictional context in which individual managers operate. Linh Hoang shared the three questions that panel speakers would cover in their address with workshop participants, which were:

- a) *What is the broad scale context in terms of managing these two species in your jurisdiction?*
- b) *What direction is your jurisdiction taking?*
- c) *Within the CCE, what are the organization's current priorities?*

Brian Marotz, Montana Fish, Wildlife and Parks

Authorities and Missions:

Fish, Wildlife and Parks has statute authority to manage fish in the state of Montana; protect native species for future generations; and improve hunting and fishing. In the northwestern section of the state, Bonneville Power Administration (BPA) has funded projects to mitigate the effects of big dams (e.g. Libby, Hungry Horse and others north into Canada). Aim to coordinate projects for maximum benefit.

Acts and Legislation:

- Northwest Power Act of 1980: fish and wildlife mitigation at federal dams
- Memorandum of Understanding (MOU) for Yellowstone and WSCT.
- *Endangered Species Act*, Bull Trout Recovery Plan.
- Everything is process orientated, need to be vigilant to get maximum amount of money and effort on the ground.

Operational:

Things they can do include:

- Selective withdrawal on big dams can mitigate the impact of climate variability on water temperatures.
- Rules for operating reservoirs: tweak drawdown and refill targets up and down to accommodate variability.
- Maintain floodplain function downstream of dams; improve fish passage so that fish can move upstream by improving passage at culverts and barriers.
- Creating genetic reserves where possible. Maintain important genetic strains.
- Riparian re-vegetation, ongoing in the Kootenai, do this everywhere in the CCE.
- Acknowledged an information gap regarding genetic differences in fish and how those known differences affect fish performance (survival, growth, fecundity, sustainability).
- Opportunity with the mountain lakes project to learn exactly how to make organisms more resilient.
- Creating genetic reserves in the park; i.e. using chemicals like Rotenone to eliminate non-native fish species before restoring native fish populations.
- Redband trout are native to the western portion of the CCE and provide additional conservation opportunities: US and Canada might think about moving endangered white sturgeon above the Libby Dam in the Upper Columbia River System to create a genetic reserve and maintain access to cool, unregulated streams.

Scott Spaulding, U.S. Forest Service

- Bull trout distribution is centered around Forest Service land. WSCT is more concentrated on Forest Service land. Forest Service is a multiple use agency with mining timber, recreation, economical demands and transportation as actors on the landscape. With the multiple mandates come challenges but because of large swaths of land supporting native fish the Forest Service and partners are well positioned to play a constructive role in proactive management for native fish conservation. Some of the guiding legal and management frameworks along a temporal continuum that will help support these efforts are noted below.
- ***Acts, Legislation, and Planning Efforts:***
- *Organic Act* established the forest system, emphasized fire, fiber and favorable flows of water.
- *National Forest Management Act* and *Planning Rules 1976* tell us to maintain species diversity and viability (how and what to manage).
- Climate Adaptation Planning component of the *2012 Forest Planning Rule* holds line officers responsible for climate adaptation planning at the National Forest scale.
- *Wilderness Act 1964*.
- *ESA 1973 Endangered Species Act*.
- Plans/ Strategies- INFISH, Cutthroat Trout MOU, Western Montana Bull Trout Conservation Strategy seeks to identify best places to invest and will need to feed into place-based plans. Proactively look at local populations and critical habitats.
- *Collaborative Forest Landscape Restoration Act (CFLRA)* – 2010 Congressionally-created program within the U.S. Forest Service with 23 decade-long, large-landscape, collaborative restoration projects across the United States; including the Southwestern Crown Collaborative CFLR project. Each CFLR project has a monitoring program coupled to restoration treatments, and the SWCC Aquatic Monitoring Group is moving dialogue to better understand how the Forest Service's management activities affect stream channels, watershed condition, and fish habitat.

Scott noted a need to effectively navigate and resolve “conflicting” science and uncertainty. Embrace where science agrees but also figure out where commonalities are and start working there. Guiding restoration and conservation principles could serve us well – we’ve picked up the lowest hanging fruit – how do we best prioritize where to go next? What do we need for conservation and restoration? Transitioning to Restoration Initiative – Blackfoot and Swan (RIBS) – hope this will really get us moving forward on integrative planning. Scott also noted the Occurrence Probability Maps – 1980s-2080s for the Southwestern Crown Collaborative CFLR project (available to view, posted on wall at front of room for duration of workshop).

Heather Sinton and Craig Johnson, Alberta Environment and Sustainable Resource Development

- *Fisheries Act*: enables provinces to manage populations
- *Species at Risk Act*: protection for threatened or endangered species. This act requires recovery plans and it is illegal under the Act to damage critical habitat.

- Not responsible for the management of habitats, but provide recommendations to the regulator (Federal Government is the ultimate regulator of fish habitat)
- *Public Lands Act*
- *Alberta Fishery Act*
- *Water Act*
- *Environment Protection and Enhancement Act*
- *Alberta Lands Stewardship Act*: All other acts have to align with this act
 - South Saskatchewan Regional Plan came into effect Sept 1, 2014.
 - Manages cumulative effects through environmental management frameworks.
 - Have frameworks for air quality, water quality and quantity and frameworks are being developed for biodiversity and groundwater.
 - Starting with first recreational management plan.
 - Watershed integrity, working with watershed planning and advisory councils.
 - Alberta's Climate Strategy/Adaptation Plan- strategy from 2008 is being updated, vulnerability assessment is complete.

Barriers:

- Population growth, increasing demands for resources, including recreation.
- Managing cumulative effects, currently directed mostly at water and air, needs to be directed at fragmentation and soil loss.
- Lack of political will to control recreational use on public land.
- Lack of funds (and now declining oil prices) to provide "boots on the ground".
- Jurisdictional complexity – need to work toward a common objective.
- What do you prioritize? Considering looking at "conservation rest areas" and what that might look like.

Fisheries Management Objectives:

- They are not clearly articulated for habitat.
- Do not have defined objectives of how Alberta populations should look.
- Planning for resilience in a forest management sense.

Whisper Camel Means, Confederated Salish and Kootenai Tribes (CSKT)

- *Hell Gate Treaty (1855)* main governing document established treaty rights allowing people to fish on Flathead reservation along with jurisdiction and autonomy to set and regulate fish management on their lands. Reservation is 1.3 million acres, major portions in some type of protected status.
- *CSKT Fisheries Management Plan* prioritizes WSCT and BT.
- *Aquatic Lands Conservation Act*.
- *Annual Water Quality Work Plans*.
- Comprehensive resource management plan – able to generate money off of natural resources.
- *Forest Management Plans* that are well-integrated especially around timber sales – Everyone has input; the role of the Culture committee is vital.
- Culture committee has input and examines all project proposals.

- Ordinances.
- *River Management Plan*.
- WSCT- Have an inventory of genetic status, distribution and status. Working on a reservation-specific WSCT conservation management plan. Identify conservation strategies and restoration opportunities.
- Signatories to WCT MOU.
- Flathead Lake lake trout suppression- goal is to support native trout.
- Conduct a lot of outreach: MACDAYS.org bounty contest. In fall of 2014, 13,000 invasive lake trout were caught, for example.
- Habitat restoration projects (e.g. Jocko River).
- Manage opportunity for nonnatives to hunt and fish on tribal lands.
- Les Everts is the fisheries expert from CKST.
- Majority of Flathead River banks and Jocko systems are owned by the tribes: working to keep banks intact.

Yvette Converse, U.S. Fish and Wildlife Service

- Operations: National Fish and Wildlife Refuge, Fisheries Program, Ecological Services Program are the main 3...other programs include migratory birds, Partners for Fish and Wildlife LCC's/science Applications and Law Enforcement.
- Administering the *Endangered Species Act* – four parts applicable to regulatory including Sect 4; Listing and Recovery; Section 7; Consultation on Federal Activities; Section 9: Prohibition of Take; and Section 10: Permitting for take (research and private through Habitat Conservation Plans or HCPs...e.g. Plum Creek)
- Role is to administer ESA and support partners in their compliance of the *Endangered Species Act*.
- The ESA is not a good tool for recovery/conservation because of the heavy regulatory burden to administer and the, limited funding for recovery.
- IMO ESA is not the future of conservation (too much conflict, not enough outcomes for species recovery/cons): do not look towards regulatory, think outside of the box....government agencies and NGO's are moving towards voluntary and collaborative conservation and that is being promoted at the landscape scale to promote seamless and collective priorities and networking/leveraging of conservation tools/funds/products/policy across scales
- FWS has had an emphasis on climate action and Department of Interior and Executive Branch are providing some guidance and direction for climate change adaptation, although not this is not specific or as yet, has not been institutionalized into programs. At this juncture, agencies are taking their own actions and collaborative programs allow us to integrate and align those efforts. Collaborative programs bring opportunities for alignment.

Mary Riddle, Glacier National Park

- Opportunity within the Crown to take initiative in large landscape planning.
- Scaling up, embracing large landscape level conservation.
- Final Recovery Plan – target date is summer of 2015.
- *Critical Habitat for Bull trout* delineated in 2010.

- Habitat Conservation Plans: Plum Creek, Stinson Lumber Montana DNRC lands, maintain an interest in WSCT.
- Glacier National Park has exclusive management jurisdiction over a million acres. Provides critical habitat for both species. Habitat represents population strongholds, managing in an unimpaired state.
- Work with US Fish and Wildlife Service, Tribes, National Park Service management policies that provide direction for the management of native species.
- Specific actions: reducing and eliminating additional stressors, and providing refugia.
- Building fish passage barriers, translocating native fish into climate refugia, increasing monitoring of native fish populations.
- Starting a fish management plan, many project-by-project basis efforts but need direction for the entire park.
- Collaborating with: US Geological Survey, Montana Fish, Wildlife and Parks, US Fish and Wildlife Service, working group St. Mary River near Babb. Flathead Basin Commission on water quality issues.
- Recognize that being at the center of the CCE, Glacier National Park contains important native salmonid populations and habitat refugia.

Questions:

Q. Progress in Alberta, in terms of protection and recovery, seems glacial in pace. Is there a way to increase the urgency of the efforts? Can the federal government be persuaded to issue an emergency protection order?

- Would be legally mandated approach. Turns up the urgency but not a very integrated approach.
- Example - First emergency protection order was for grouse, pump jacks were turned off.
- Might not provide long-term results / desired outcomes. Better to be proactive than reactive which is what would be under an emergency order.

Q. Recognize that conflicts exist in terms of values, e.g. with people wanting to fish for non-native species and recreate near important populations. Can you share criteria from the CSKT Culture Committee that help managers integrate different values more effectively to achieve a better outcome, as this might help non-tribal managers by providing an example. More specifically, how does the Culture Committee establish a path forward that balances many different values?

- Culture Committee provides different suggestions based on their lifetime on the land. Great to have a longstanding and historical group.
- Gives something besides just the science.
- Thinking not about the science, but about past generations, what they learned from their elders, values that have been passed on from generation to generation.

Q. NGO's are playing an increasing role in collaborative efforts at the landscape scale, while agencies are losing staff and funding. How do you see this trend evolving?

- Boundary-less behavior in the Forest Service is strongly encouraged, but need something on the ground to demonstrate success. Struggle internally with new business.
- NGO's have led the collaborative movement, government often follows; collaboration is the future way of working. Some issues we face are how we show progress in collaborative programs. How does Congress look at the effectiveness of the collaborative programs? How do you explain importance of collaboration to Congress? It helps immensely if the NGO community can step in and help explain to Congress how these relationships increase our effectiveness. Also, collaboration needs to achieve results or the pendulum may swing back a more highly regulated approach. Collaboration brings resilience to plans and activities thanks to involvement and transparency of multiple stakeholders.
- Alberta is moving toward a collaborative model. On a particular environmental management issue a recent deputy minister once asked how much of the desired outcome the government actually controlled? The answer was 2%. This led to the realization that if cumulative effects are going to be addressed you have to reach out to nonprofits, point people and collaboratives. Have realized the value of this process.
- Sub-basin plans are more resilient because of the collaborative approach.
- Agencies do not have a choice any more, if they are going to meet objectives. There are some people that are embracing collaboration and some that are not sure how to move forward.

Q. In your presentations that you have made, there are lots of mandates and a lot of planning going on. All are developing strategies for the same species and habitats. Where should managers act first, and are there ways to determine these priorities?

- Bull trout conservation Strategy for Western Montana, there were timelines associated with the actions. There are always the challenges with costs.
- Important to connect the dots, certain efforts are being pursued at more local scales, which doesn't mean that these projects and actions are not meaningful: they are. However, things that can be done at a nation and international level are vital at the meso-scale even though they might not mean anything to someone working in the field more locally. We need to engage local government in the process (e.g. make the connection with the water districts), and connect to middle ground collaborative networks. It is successful where this has been done and where it has not, the plans sit on the shelf.
- Provides alignment through *Land Stewardship Act*, public and scientists spoke and not everyone got what they want.

Workshop - Day 1 Concluded

Workshop Day 2 - November 19, 2014

1. *Defining Geographic Priorities for Native Salmonids at the Landscape Scale: An Example from the Greater Yellowstone Ecosystem* - Brad Shepard, Wildlife Conservation Society

(See CMP website for presentation including maps and decision tree:
<http://crownmanagers.org/adaptative-management>)

Brad Shepard shared the approach applied in the Greater Yellowstone ecosystem by the Multi-State Interagency Yellowstone Cutthroat Trout Conservation Work Group outlining the methods they used to define **Geographic Priorities**. The methodology was as follows:

1. Identify Conservation Populations
2. Prioritize river basins
3. Prioritize populations
4. Identify threats
5. Prioritize actions

He noted that opportunity drives a lot of what can be done in the terms of conservation and consequently they developed the following **Opportunity Criteria**:

- Reduce threats to existing conservation populations
- Take advantage of private landowner conservation
- Develop local/regional support for conservation
- Develop a cost benefit analysis

They also applied the **Management Goals** of *Representation, Resilience and Redundancy*.

Conclusions (see below slides):

- Prioritize conservation across a species entire range
 - Must have both managers and field level biologists involved
 - Consistency in criteria applied
- Hierarchical process (river basin, population actions)
- Nonnative species represent one of the biggest threats to Yellowstone Cutthroat Trout throughout their range.
- Crown is super critical for WSCT for both the US and for Canada; i.e. every river basin in the CCE is a high priority.
- Crown is really critical in the US for bull trout, although the Crown portion of their distribution in Canada may *not* be critically important to Canadian managers because this species is so widespread across Canada.

Prioritizing Conservation of Yellowstone Cutthroat Trout Across Their Range



J. Tomellari illustration

Bradley B. Shepard
Wildlife Conservation Society

Robert Al-Chokhachy
Robert Gresswell
USGS Northern Rockies Science Center

Lee Nelson and Scott Opitz
Montana Department of FWP

Dan Garren
Idaho Fish and Game

Steve Yekel and Jason Burckhardt
Wyoming Game and Fish Department

Jack Williams and Amy Haak
Trout Unlimited

Major Funding: Great Northern LCC (FWS)









TAKING ACTION ON CLIMATE CHANGE ADAPTATION for NATIVE TROUT

Acknowledgements

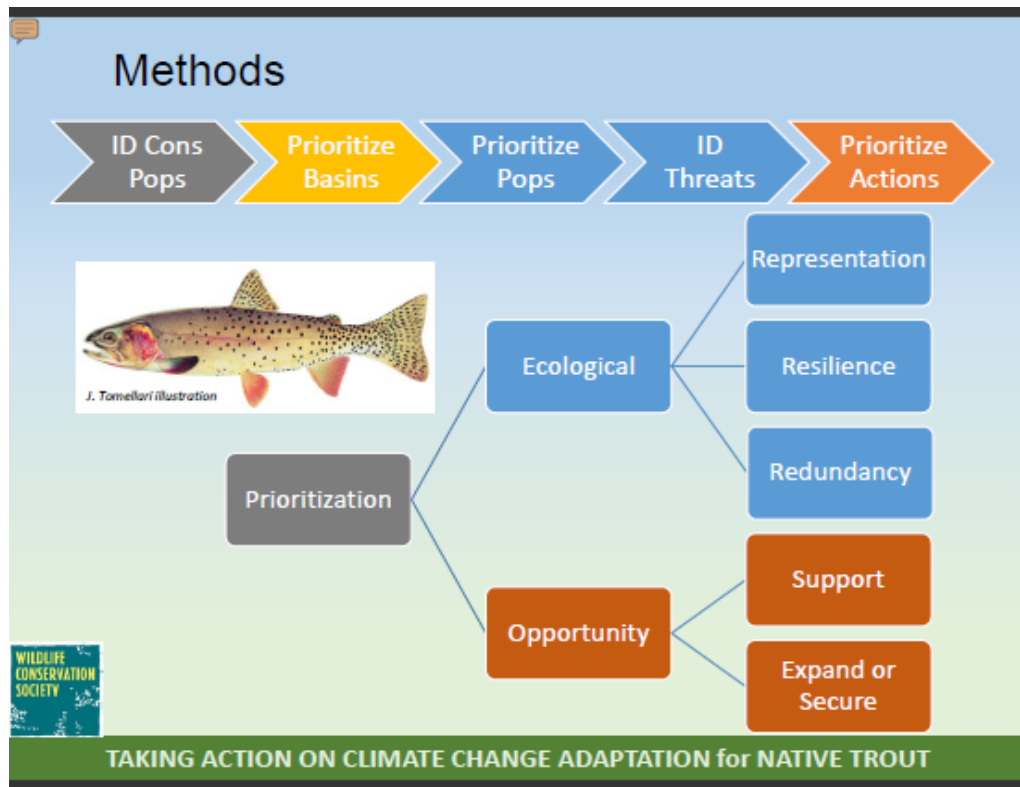
- Multi-State Interagency Yellowstone Cutthroat Trout Conservation Work Group
 - Montana, Wyoming, Idaho, Utah, and Nevada state fish management agencies
 - Forest Service, BLM, Fish and Wildlife Service, USGS, Universities, National Park Service, Greater Yellowstone Coordinating Committee
 - Wildlife Conservation Society, Trout Unlimited, American Fisheries Society, Friends of the Teton
- Great Northern Landscape Conservation Cooperative (FWS)
- Montana Fish, Wildlife and Parks – Adam Peterson (GIS and database)
- National Fish and Wildlife Foundation – Jackson Hole One Fly Foundation








TAKING ACTION ON CLIMATE CHANGE ADAPTATION for NATIVE TROUT



Questions:

Q. Cold water and flows are attributes to look for in management goals for individual populations, why not also presence or opportunity for invasives?

Invasives come in the redundancy and representation goals. Hard to quantify invasives. This will be brought into perspective in the next talk.

Q. Identify "conservation population": what is the definition?

Genetic purity is huge. Recognition that we want to conserve all genetically pure populations but also may want to include populations that are not completely pure? CCE geography, pure prioritization of WSCT has not been completed for the CCE.

Q. You've discussed a multi-jurisdictional team of field biologists for this initiative. How did you do this? What sort of governance or agreements were in place?

No governance in place, we just did it. Planning was done in the spring.

Q. Would each jurisdiction contribute funding?

No pooled funding, just services.

Q. How do you get stuff done? Governance is not always necessary and sometimes can hinder collaborative efforts.

We focused on managing things at the scale of the thing.

Q. Where do definitions for patch size come from?

They came from literature and can change. When you become spatially explicit, the game opens up. Tradeoffs become possible.

Example of using a connectivity circuit scape for large predators (e.g. Wildlife Conservation Society in the High Divide between Idaho and the Greater Yellowstone Ecosystem). Corridors are riparian areas; overlaying aquatic systems, view the systems as islands between mountain ranges. The more justification that you can provide for the value of corridors the better.

Fish sustainability index in Alberta, identifying the current presence of species. About to start that in Alberta. Challenges is speaking a common language. Northwest Power and Conservation has about 64 conservation plans in the US. Areas were ranked by genetic purity to prioritize their work. There are advantages to duplicating these efforts across the border.

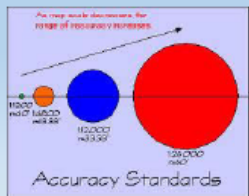
Broad Observations (see slide from Brad Shepard's presentation, below):

- Scale matters
 - In both space and time
 - Science linked to management
- Manage uncertainty
 - Portfolio approach
 - Information based
 - Learn from management
- Different strategies for bull versus cutthroat
- Commitment and collaboration
- Prioritize
- Information based process



Broad Observations

1. Scale matters
 - Space, time, taxonomic/ecological
 - Science and management
2. Manage uncertainty
 - Portfolio (diversity) (Figge, Schindler, Haak and Williams)
 - Information-based process
 - Learn from management
3. Different strategies for bull versus cutthroat
4. Commitment and collaboration
5. Prioritize



Accuracy Standards

TAKING ACTION ON CLIMATE CHANGE ADAPTATION for NATIVE TROUT

Cherry Creek Project:

- Restored WSCT
- Started in planning in 1995

- Implemented in 2003 currently in evaluation
- You are going to make mistakes; things are going to go wrong.
- Takes commitment and monitoring, write things down. The best time to develop written agreements is when you are all getting along the best: creates frameworks for changes, e.g. different people will be at the table in the future, etc.
- Montana Conservation Agreement
- True resilience is harvestable surplus. Sport fishing is allowed.
- Very successful project; anglers catch 60 fish **per hour** here now (!).

Philosophies:

- Conserve genetic diversity and integrity across the range.
- Do true adaptive management.
- Think about creating a decision tree (see PowerPoint slides posted to website for example of decision tree)
- Think about what you are going to do about nonnative species.

2. *Panel #2: Adaptation Strategies and Tactics: Options and Examples - Introduction by Regan Nelson, Crown of the Continent Conservation Initiative; Moderated by Brad Shepard, Wildlife Conservation Society*

Regan Nelson welcomed the panel and provided an overview of her summary work to compile adaptation strategies and tactics into a usable format for participants. She noted this resource was included in the Participant Workshop Package along with Vulnerability Assessments for both species. Regan indicated panel speakers would each address a strategy or tactic they are currently using in their jurisdiction. *(For more information on presentations and maps shared by speakers please see the CMP website: <http://crownmanagers.org/adaptative-management/>).*

Brad Shepard initiated the panel discussion noting the following:

- Climate change is not gloom and doom.
- Fish have been here since post glaciation.
- Humans are now on the landscape at a much higher level than before
- In cool times, valley bottoms were likely sources, and higher elevation tributaries were probably sinks. Now in warmer climates and with human impacts, valley bottoms have become the sinks and tributaries are the source populations for native salmonids.
- Lakes probably buffer climate effects.
- Three approaches for managers: Isolate, replicate, remove
 1. Strategy: Isolation (waterfalls and barriers)
Nonnative Fish Threats: competition, predation and hybridization. All will have slightly different impacts, long-term vs. short-term effects
 2. Strategy: Replication: Intervention
Introduction Strategies: Hatcheries or wild. Favorable to put embryos and juveniles into the river (recognize that not everyone agrees about this, but I

have found that this words very well as it allows them the maximum amount of time to adapt to their habitat).

3. Strategy: No nonnative fish

- Secure, (management designation, barrier construction)
- Connect
- Expand (up and downstream)

Bruce Rieman, Clearwater Resource Council

- Management tends to be opportunistic and piecemeal. We need a Landscape Context to recognize Conservation Tradeoffs and be effective
- Vulnerability analysis and other new science tools are important but only one piece of the challenge. Priority= vulnerability x conservation value x feasibility
- Conservation values need to be clear they are at least three fold: evolutionary legacy; ecological function (role of species, ecological processes, evolutionary potential); and socioeconomic. Concern over hybridization is only one element
- Feasibility: What will it take to actually have an effect at the level of a complete population? (Can enough be done to be successful; can we afford it; can we focus in a few key populations rather than spreading our effort out; is it sustainable)
- Sustainability? Are natural processes being restored, are we creating populations that will be resilient or will we be committed to maintaining them into the future.
- Feasibility and Resilience have important tradeoffs with intentional isolation:
 - Do we increase productivity or reduce it?
 - Do we maintain spatial structure or reduce it?
 - Do we maintain or re-create life history diversity or reduce it?
 - Do we expand population sizes or reduce them?
- Ultimately it will require a mix of strategies because we have a mix of values and important uncertainty. A key uncertainty with climate change is whether hybridization will take over all populations or will thermal resistance will limit it). Need different strategies in different places (*see below slide*). We need to learn.

It will be a “Mix of “Strategies” and “Experiments”

*We can't save every population or value
where do we focus?*

*Important Uncertainty
hybridization
thermal resistance*

*We need different strategies
in different places*

We need to learn



Strategies for Conserving Native Salmonid Populations at Risk From Nonnative Fish Invasions: Tradeoffs in Using Barriers to Upstream Movement

David C. Fausch, Steve A. Rieman, Michael P. Young, Jason B. Dunham

Using a Comprehensive Landscape Approach for More Effective Conservation and Restoration

Richard B. Smith, Michael P. Young, Steve A. Rieman, David C. Fausch

ES&B 2011-1 | September 10, 2011

TAKING ACTION ON CLIMATE CHANGE ADAPTATION for NATIVE TROUT

Connie Simmons, Oldman Watershed Council

- Community engagement, bringing collaborative partnerships together.
- Get an understanding and acceptance about what has to be done in the headwaters.
- Public engagement is a critically important part of these projects.
- Maintain current and native fish populations, increase their range, etc.
- Conflicts with the recreational community. Using Dutch Creek as an educational project to prototype solutions to these challenges (*see below slide*).
- Collaborative action on the ground. User group education.
- Access management on the ground.
- Public and user understanding is number one priority.

Oldman Headwaters Action Plan –Dutch Creek Pilot Project
‘Adopt-A-Watershed’ – community action for headwaters health and resilience



Headwaters Action Plan –
2 years of science, stakeholder
and public engagement



OLDMAN INTEGRATED WATERSHED MANAGEMENT PLAN
HEADWATERS ACTION PLAN 2013-14
SHORT SUMMARY OF TARGETS, ACTIONS AND RECOMMENDATIONS

TARGETS

INDICATOR 1: Presence and abundance of fish, especially native populations

TARGET 1: Maintain current native and naturalised fish population integrity within the headwaters and explore opportunities to increase native fish populations in their current range.

TARGET 2: Restore native fish in selected streams* in the headwaters.

INDICATOR 2: Density of Linear Features

TARGET 1: In urban centres and major transportation corridors, no linear thresholds will be set; however, mitigation of the impact of linear features will be actively pursued.

TARGET 2: Maintain negligible and low linear features density where it currently exists; ensure no net increase of linear features in each sub-watershed.

TARGET 3: Decrease density of linear features where there is moderate to high risk rating¹ in the headwaters.

TAKING ACTION ON CLIMATE CHANGE ADAPTATION for NATIVE TROUT

Shane Hendrickson, US Forest Service, Seeley Lake Ranger District

- Center Horse Landscape Restoration: one project of Southwestern Crown Collaborative CFLR project (part of CFLR program described above)
- Midscale planning effort: 60,000 acres.
- Forest Service owns a lot of the headwater areas, so needs to collaborate.
- Cottonwood does not have a stable population of bull trout
- Landowners have done a lot of restoration efforts below the forest boundary.
- Keyhole into the work that is already going on in the watersheds.
- In middle of a National Environmental Policy Act (NEPA) process. Writing effects.
- Project goals include: improve and restore forest composition; improve restore fire adapted ecosystems; improve water quality, restore or enhance fish and wildlife habitat; decommission 170 miles of roads, upgrade culverts; reintroduce fire, road closures, thinning of forest (*see below slide*).
- Embedded in the landscape are important lands/salmonid habitat acquired by the Nature Conservancy through the Montana Legacy Project.



Center Horse Landscape Restoration

Anticipated Outcomes -

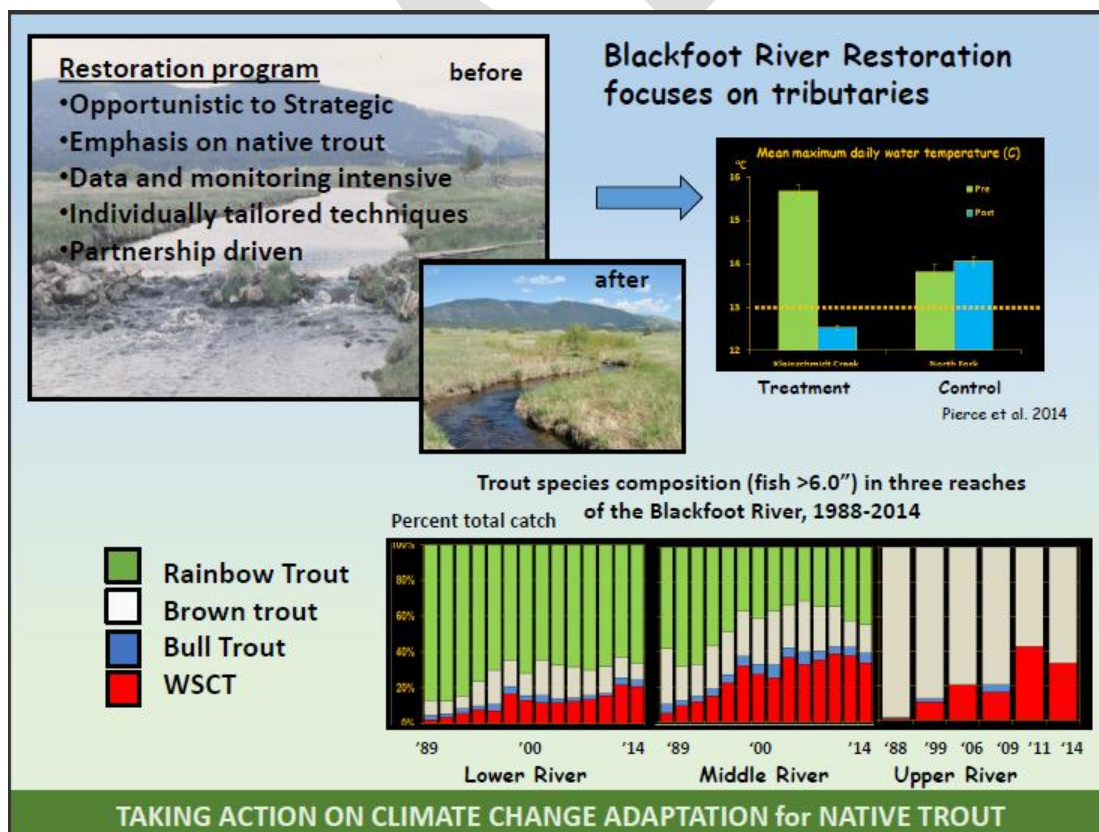
- Removes 13 and replaces 10 culverts in fish bearing streams
 - Restoring access to 28 of the 32 miles of stream w/in the project area
- Reroutes 5 road segments
 - Improving riparian and stream conditions
- Removes approximately 170 miles of road from the landscape
 - Improving overall long-term watershed conditions
- Utilizes approx. 3,600 acres of prescribed fire
 - Brings fire back on to the landscape that has been precluded for ~100yrs.
- ~5,500 of vegetated acres treated with a variety of commercial and noncommercial treatments
 - Moving vegetative stand conditions to a more resilient state.

This work coupled with the past and current downstream restoration effects is an attempt to move entire watersheds into a more resilient direction.

TAKING ACTION ON CLIMATE CHANGE ADAPTATION for NATIVE TROUT

Ron Pierce, Montana Fish, Wildlife and Parks

- Blackfoot River Basin
- Many partnerships in the basin with a long history of work
- Plum Creek Timber Company is no longer in the Blackfoot due to Montana Legacy Project
- Initiated basin scale project in 1988 for the Blackfoot River.
- Restoration program
 - Focused on native salmonids
 - Many surveys, data and intensive monitoring
 - Need data to enable the project
 - Partnership driven
- Reconstructed a spring creek using groundwater influence; resulted in significant decreases in stream temperatures.
- Stream restoration and regulation at the same time.
- WSC increased habitat occupancy in this area from 1% to 30-40% (see below slide)
- Upstream of private land, many hybrid forms of WSC
- Number 2 migratory stream for bull trout but ends at the waterfall barrier. There is great habitat upstream of the barrier.



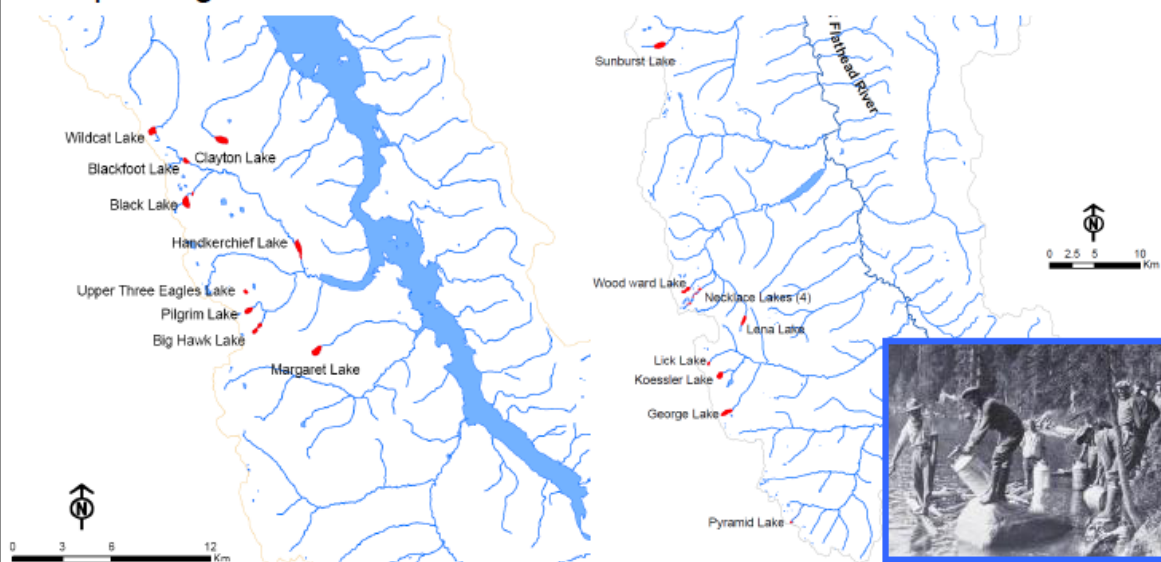
Matt Boyer, Montana Fish, Wildlife and Parks

- WSCT Conservation in the Upper Flathead is an extremely high ecological priority
- Substantial portion of the watershed lies within designated wilderness area
- Funding opportunity through Bonneville Power Administration.
- Good working relationships with partners.
- Upstream expansion of rainbow trout hybridization with WSCT, and subsequent loss of WSCT (i.e. genomic extinction). Tactic taken is mechanical removal of spawning adults and relocation to a closed-basin fishing pond.
- 60% decline in CPUE, decrease in the rate of rainbow trout expansion, promoted population resiliency by maintaining watershed connectivity (keep migratory life history forms and allow for habitat re-colonization)
- South Fork Flathead: downstream expansion of hybridization from historically fishless lakes. Tactic is to eradicate headwater sources of invasives (*see below slide*).
- Outcomes: Secure native WSCT population in headwater refugia, used multiple and genetically divergent source populations for restoration.
- Habitat is extremely important. Adaptation strategies need to keep an eye toward genetic conservation to promote adaptive capacity

South Fork Flathead

Problem: downstream expansion of hybridization from historically fishless lakes planted with nonnative trout (1920-1960)

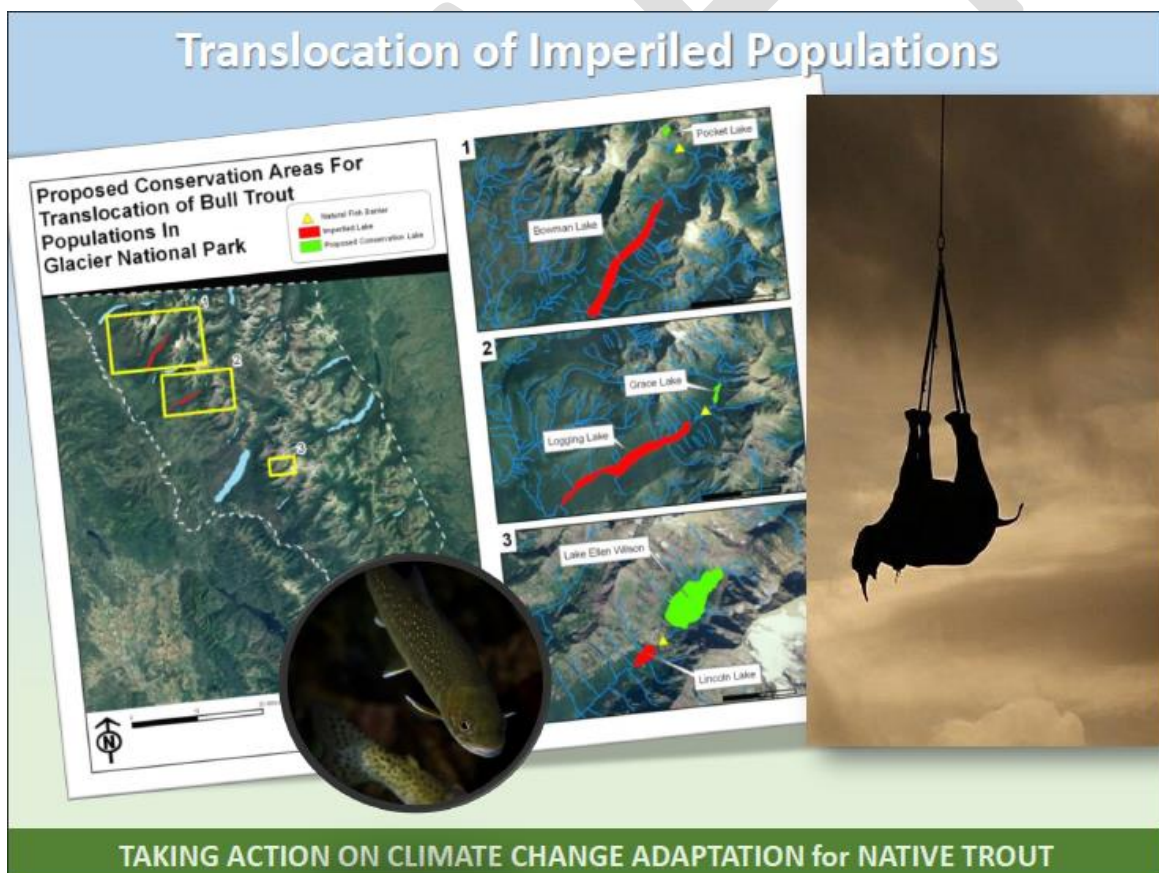
Tactic: eradicate headwater sources of introgression and conserve intraspecific genetic variation in WCT



TAKING ACTION ON CLIMATE CHANGE ADAPTATION for NATIVE TROUT

Chris Downs, Glacier National Park

- Lake Trout in Glacier National Park
- 9 of 12 bull trout lakes in the Park have been invaded; 5 are secure.
- Lake trout are trumping climate change impacts in Glacier NP
- Looking to create areas of refuge for bull trout. Rapid switch in the last 30 years,
- Successful lake trout suppression efforts in Quartz Lake. Has been done in Lake Pend Oreille.
- Need to realize costs of efforts. Getting better and putting more effort into catching lake trout. Harder to catch adult lake trout.
- Deep, cold systems with no place for the fish to hide. Need to hit from the juvenile and adult stages.
- Results: declining catch rates for lake trout overall, declining size structure of adult lake trout, and a record bull trout red count in 2014
- Want to prevent any additional lake trout adult from entering the system.
- Translocation of imperiled populations.
- Currently translocating juvenile bull trout in to Grace Lake. Suitable habitat for bull trout. This is a salvage operation (*see below slide*).



Lorne Fitch, Alberta Cows and Fish

- Beaver reintroductions as tool for restoring stream habitat.
- Linkages to reduce vulnerability and increase resilience to climate impacts
- Beavers increase soil water interface and groundwater storage, enhance downstream flow, dampen flooding effects, alleviate downstream water temperature issues (*see below slide*).
- Regional and local beaver populations are low.
- Have a critical role as a keystone species of biological diversity.
- Move from a landowner perceived problem to where communities see beavers as an advantage. Where can they be successfully re-located?
- Important to explore habitat suitability for reintroduction efforts
- Impediments to re-establishment of beaver on the landscapes.
 - Population resistance
 - Landscape resistance – streams are incised, no woody vegetation, recurring drought or flooding, blockages, excessive stream gradients
 - Mortality resistance – high predation, road crossing mortality, predation and harassment from pets
 - Social resistance- removal of dams and lodges, lack of tolerance, concerns over effects on fish. Beavers are often viewed as a nuisance. Perform a makeover of their image.
 - Policy resistance- lack of policy on beaver relocation,
 - Beaver reestablishment must be part of a viable long-term strategy.



Beavers in our landscape: Dam? or Damn!

- 1.Modify channel geomorphology and hydrology
- 2.Increase retention of sediment and organic material
- 3.Create and maintain wetlands
- 4.Modify nutrient cycling
- 5.Modify and increase riparian zone
- 6.Influence water quality downstream
- 7.Modify habitat

Cows and Fish

Questions:

Q. Bull trout conservation strategy and recovery plan. How have you shown that the management actions taken are related to the strategy and plan?

Each year there is a requirement to report back on each of the actions taken. It is collaborative process. Recovery plan is fairly new, still in draft mode. Strategy has been around for a few years, useful tool to present upward on actions taken in a certain watershed. State recovery plan has been used as strategy in prioritization and funding. Consistency and good index reaches; big picture comes down to redd counts.

In Canada bull trout have just been listed.

Q. For Brian: The Wilderness Society is trying to understand how management interventions are evolving or may evolve in Wilderness areas as the climate continues to change. In your example of using piscicides to eliminate non-native fish populations in the Bob Marshall Wilderness before re-establishing native salmonid populations, what process did you follow as you developed and implanted the project?

- Big areas, national disturbance regimes.
- Mountain lakes project had a number of issues, motorized use, invasives
- Need to pick the low hanging fruit
- Areas outside the wilderness, demonstrated successes
- Reaching out to potential critics, etc. beforehand

Q. Contentious and competing issues. Have you thought about habitat rather than species?
Contentious topic: 200+ fish lakes in the Wilderness. Purpose of the project leaving the lakes fishless was a problem. Popular recreational sources. Restocking headwater lakes allows fish to move downstream to eradicate unwanted species.

Q. Flathead introduction of non-native species and its pitfalls. Are there any key points so there are no hang-ups, is the action worthwhile? Do we really know what we are doing?

- Hands-off management is where we have been.
- Exploring opportunities to try and do something because we can see what happens when we do nothing.

Q. Different examples of actions are actions that we should be taken now. Do we think any adjustments need to make to these actions to be sufficient in the terms of climate change? Where? Or how much? Is there an argument for even more in the terms of climate, or a sense of urgency?

- Need more skilled practitioners out there doing the work. These people will need a suite of social skills. Good science skills. Identifying opportunities and pursue those.
- Game has change dramatically. Tools we have now were only dreamt about in past. Can anticipate where change is going to happen.
- Key is a policy that is informed by science, not driven by economic considerations. Policy changes need to happen now.

The morning session concluded.

3. Breakout Session #1 - Working Together to Identify Coarse-Scale Strategies in the CCE

Following lunch participants self-selected the groups they wished to join. In these five small groups, participants worked through a series of questions individually and then shared their perspectives with other members of their group. A series of Crown-wide maps on actual stream temperature changes to date, as well as projected stream temperature changes under two future scenarios, were provided by Clint Muhlfeld and Leslie Jones for participants to use and draw on during this session.

The questions each group addressed were as follows:

1. From your perspective, what are the geographic priorities on the East side and West side of the divide for WSCT and bull trout?
2. Within the broad geographic areas identified in Question #1, where do you feel the greatest need for action exists?
3. What are the general adaptation strategies (opportunities for action) that you feel would make the most sense within the geographic areas of need that you identified?

The results from each small group are summarized below:

Group 1 – Erin Sexton

1. Broad Geographic Priorities

WSCT General

Suitable habitats both today and in the future higher elevation/ northern areas future (blue areas in northwest and southwest portions of temperature change projection maps)

WSCT (West)

North Fork of Blackfoot
North Fork of Flathead
Elk River (selenium issue)
Kootenai River

WSCT (East)

Porcupine Hills (AB) - Genetically pure populations

Bull Trout General

Focus on genetically pure populations - Focus on best 10% in each watershed

BT (West)

North Fork Flathead
Elk River
Kootenai River

BT (East)

St. Mary's Drainage

Old Man Watershed and upper tributaries (Alberta)

Badger-Two Medicine

2. Detailed Geographic Priorities/ Greatest Need

- Varies by watershed - Focus on best 10% in each watershed for both BT and WSCT (hang on to what is good now and where the thermal regime is going to remain good).
- Hybridization is an issue all the way up the East side of the CCE especially in SW Alberta.
- Fulfill the fisheries commitments under the Transboundary MOU.
- Complete linear footprint and recreation management plans on east slopes in Alberta.
- Swan and Stillwater – need to deal with invasives - most urgent.

3. General Strategies/Tactics

Across the Crown:

- Look at what is left (i.e. the best remaining habitat) and prioritize protecting that.
- Prevent, remove invasives.
- Introduction of BT and WSCT into 100 miles of headwaters tributaries - expansion into refugia (re-introduction)
- Introduce a soil loss threshold (2 tonnes/ha per year) next to water bodies; 4 tonnes/ha per year on upper lands and require all developers to have erosion and sediment control measures to ensure threshold is not exceeded.
- Use dams to our advantage by releasing the water that we need at the rate we need; selective withdrawal.
- [Pair above with] Use beavers to help meet multiple environmental objectives.
- Common monitoring protocols across the Crown for sentinel populations
- Develop and deliver consistent messaging (using aquatic invasive species control across the Crown as a model).
- Map the bounded alluvial floodplains – hyporrheic floodplain – areas of groundwater up-welling – identify those as priority conservation areas – keep what is good, restore and reintroduce where there is opportunity. Identify priorities for conservation / restoration across these sites.

Group 2 – Molly Cross

1. Broad Geographic Priorities

General – Anything at high elevation

WSCT (East)

Upper Oldman Watershed - high elevation areas

Upper Castle, Willow Creek

Ear Mountain Area (Gibson Reservoir South to blue)

Boulder Creek – Connection between lake to the east

BT

Same as for WSCT

Upper Oldman and Upper Castle even better for BT than WSCT

St. Mary's

Milk River

2. Detailed Geographic Priorities/ Greatest Need (not specified)

3. General Strategies/Tactics

- Decrease, manage linear features throughout watershed especially in Oldman Watershed, Upper Flathead, Whitefish range, Jocko and Lincoln Face.
- Reclamation of /roll back roads.
- Increase riparian health where possible especially in priority areas – habitat restoration and erosion control.
- ATV/OHV regulation.
- On Flathead Reservation – habitat restoration, replicate, supplement populations (might need to revisit questions about mixing Mission and McDonald populations – tradeoffs with maintaining genetically different populations).
- Erosion control - unregulated crossings (need to decrease sediment)
- Conservation of upwelling areas – how to protect upwelling (look at forestry impacts on upwelling).
- Beaver reintroduction.
- Getting science into policy and then into management.
- Community education and engagement to increase public buy-in (especially in non-wilderness areas).
- St. Mary's water diversion entrainment (fish get sucked down and over to "death zone")
- Barriers may be useful on Whitefish side for WSCT
- Reduce/ prevent nonnatives everywhere in range, barriers to decrease spread.
- Forest management to maintain high elevation snowpack – trees, such as Whitebark Pine, retain snow and provide cool water inputs to system. Manage forest to retain cool stream temperatures (riparian vegetation, mature timber to retain snow).
- Need strategy to influence politicians - we require political will.

Group 3 – Linh Hoang

1. Broad Geographic Priorities

WSCT (West)

Flathead

Elk

Swan

North Fork Blackfoot

WSCT (East)

Oldman Watershed
Porcupine (Trout, Sharples, Beaver)
MidVale (Two-Medicine)
North Fork Willow (Teton)

BT (West)

Flathead
North Fork Blackfoot
Swan Lake
Elk River

BT (East)

St. Mary's River
Oldman Watershed

2. Detailed Geographic Priorities/ Greatest Need**WSCT (West)**

Glacier National Park
North Fork Flathead (secure habitat)

WSCT (East)

Tributaries to Two-Medicine
Headwaters of Sun, Teton Rivers
Headwaters of Oldman Watershed and Bow (Sharples, Beaver, Trout)

BT (West)

Glacier National Park
Flathead Lake
Swan Lake
North Fork of the Blackfoot (Gold Creek, Deer Creek)
Elk River (selenium)

BT (East)

St. Mary's River

3. General Strategies/Tactics**BT (West)**

- Glacier National Park lakes – Non-native fish removal (translocation)
- Swan – Lake trout removal (cost effective, feasible)
- Flathead – Collaborative solution to shared management of lake?
- North Fork of the Blackfoot – Translocation
- Elk River – Mining impacts remediation

BT (East)

- St. Mary – Ditch passage up and downstream of entrainment
- Oldman Watershed – Lake trout effects and treatment

WSCT (West)

- North Fork of the Flathead – Rainbow trout elimination
- Glacier National Park – Isolate important populations

WSCT (East)

- Porcupine (Beaver, Sharpels, Trout) – remove nonnatives, reintroduce beavers
- Two-Medicine, Sun, Teton, Marias Rivers – translocate, replicate

Group 4 Steph Legault**1. Geographic Priorities (Combined Q1&2)****Hungry Horse - South Fork (BT & WSCT)**

- South Fork of the Flathead: one area with intact cold water habitats

Transboundary (BT & WSCT)

- North Fork Watershed - North of the Border, US Forest Service side, Glacier National Park

Upper Oldman Watershed (BT)**Blackfoot (BT)****2. Detailed Geographic Priorities/ Greatest Need (See Above)****3. General Strategies/Tactics****Hungry Horse - South Fork**

- Complete eradication of non-genetically pure WSCT populations
- Continue to create passage for both species across elevation
- Manage recreation impacts
- Keep aquatic invasive species out

North Fork – East and West sides

- Continue suppression/removal efforts in Glacier National Park (BT)
- Continue /maintain fish barriers
- Collaborate/coordinate with BC
- Keep aquatic invasive species out

Upper Oldman Watershed

- Managed recreation and motorized use
- Prioritize sub-basins for recovery, maintaining populations (BT)

Blackfoot – No additional information due to time constraints

Group 5 Regan Nelson

1. Geographic Priorities (Combined Q1&2)

Westside

- Blackfoot
- Swan
- North South Fork
- Flathead Lake
- Kootenay
- Elk
- Clearwater

Eastside

- Glacier National Park (WSCT)
- Hudson
- Gulf
- Sun
- Teton
- Marias
- Oldman Watershed and Bow headwaters

2. Detailed Geographic Priorities/ Greatest Need (Not clearly identified in Breakout Session #1)

3. General Strategies/Tactics

The group discussed a range of possible options and generated a number of questions (possible criteria) they might be able to use to determine appropriate strategies and tactics for the areas they identified. Examples are provided below.

- Where will it remain cold with good flows?
- How does groundwater play into this?
- Where do we have the best opportunity to reduce human stresses?
- Easier to keep strong populations strong, then to triage.
- Resilience or genetic purity?
- If rarity is prioritized, then Kootenai is high priority.
- What makes residency a viable lifeform for bull trout?
- Invasives appear to be a bigger deal – let's look at how climate change will affect invasives and don't work in places that are likely to get overwhelmed by invasives.
- Need to protect the landscape first so we maintain our options.

Detailed information about geographic priorities for bull trout and WSCT across Alberta and British Columbia were provided by John Weaver subsequent to the

workshop, based on two of his recent publications that synthesized the latest information/data/maps from fisheries biologists working in these areas:

- (1) Weaver, J.L. 2013a. Safe Havens, Safe Passages for Vulnerable Fish and Wildlife: Critical Landscapes in the Southern Canadian Rockies, British Columbia and Montana. Wildlife Conservation Society Canada Conservation Report No. 6. Toronto, Ontario, Canada.
- (2) Weaver, J.L. 2013b. Protecting and Connecting Headwater Havens: Vital Landscapes for Vulnerable Fish and Wildlife, Southern Canadian Rockies of Alberta. Wildlife Conservation Society Canada Conservation Report No. 7. Toronto, Ontario, Canada.

ALBERTA

Bull Trout:

The Key areas include the **Castle River** (specifically the *West Castle, Castle, and Carbondale River*) and the **Oldman River** (specifically *South Racehorse Creek Livingston River, and upper Oldman River*).

- See Weaver 2013b, pp. 35-43, particularly 39-43. Tables 1 & 2, Fig. 8.

Westslope Cutthroat Trout:

The Key areas include the **Upper Castle River** (specifically the *West Castle, Castle, and Carbondale River*) and the **Upper Oldman River** (specifically *South Racehorse Creek, Livingston River, and upper Oldman River*). Research shows that the upper Castle and upper Oldman are connected in terms of WSCT movements and meta-populations.

- See Weaver 2013b, pp. 44-51, particularly 49-51. Table 3, Fig. 9. **Note similar areas as for bull trout.**

BRITISH COLUMBIA

Bull Trout:

The Key areas include the **transboundary Flathead River (North Fork)**, but also -- **critically** -- the Wigwam River which flows into Koocanusa Reservoir which is the biggest stronghold for bull trout in the Rocky Mountains and perhaps western North America. The other key system missing from the report is the **Upper White River** (specifically the *Middle White River and Blackfoot Creek*).

- See Weaver 2013a, pp. 34-43, particularly 40-43. Table 1, Fig. 7.

Westslope Cutthroat Trout:

In B.C. (unlike AB), different streams are important for westslope cutthroat trout. In addition to **transboundary Flathead River (North Fork)**, other key systems include **Upper Elk river** and **all of the Bull River**.

- See Weaver 2013a, pp. 44-51, particularly 49-51. Table 2, Fig. 8.

MONTANA – EAST OF THE CONTINENTAL DIVIDE

Westslope Cutthroat Trout:

The **Two Medicine River (South Fork)** and **Badger Creek** and their tributaries represent the last cluster of pure and/or nearly pure WSCT along the Rocky Mountain Front.

4. Large Group Report Back

Following the small group discussions, participants reconvened as a large group and shared highlights from these conversations. Commonalities, cautions and comments raised by the group during the report back are captured below.

Commonalities

- Representation
- Focusing on areas that have the best opportunities for success
- Invasives, primarily fish species
- Oldman Watershed/River
- Entire Flathead system
- Focus on the "Best of the Best" in terms of numbers, purity and water temperature

Cautions/Red Flags:

- Crown wide focus, no need to reinvent the wheel, be methodical
- South Fork of the Flathead – What is the priority for action?
- Flathead Lake - There is not agreement on the degree of effort
- Potential volume of work.
- For invasives: we are not just talking fish (e.g. zebra mussels, etc. too).
- Absence of work in Milk River South on the east side – Opportunity for restoration. There is currently not much there.
- Need a comprehensive Crown-wide genetic status map for WCST (could act also as mechanism to build awareness)

5. Breakout Session #2 Working Together to Identify Fine Scale Strategies in the CCE

In the same small groups, participants then considered the following questions and used the same temperature maps to focus and inform their discussions:

1. Where could an existing project be scaled up?
2. Where could we implement a new tactic as a prototype project?
3. What could we work on in a coordinated way at the scale of the Crown?

Ideas generated for these three questions are listed below:

SCALE UP

Group 1 – Erin Sexton

- Scale up inventory, monitoring protocols, trend analyses
- Scale up piscicide use to control invasives (in Glacier National Park and in British Columbia/Alberta)
- Common indicators to track populations/habitat
 - fish sustainability index (Alberta?)
 - riparian health indicators
 - soil loss indicator
- Scale up harvesting program that is working

Group 2 – Molly Cross

- **Replicate, refund, translocate populations to cold water refugia**
 - East of the Divide, especially in Canada; North Fork of Blackfoot, Flathead Reservation, Blackfeet Reservation
 - Replication, redundancy of different, east-side populations
 - Cold water refugia in Canada especially for BT
- Scale up restoration on Flathead Reservation streams
 - Provides representation and some redundancy
 - Opportunity - cultural links, motivation, better link between natural resource and social system
- Expand/ ram up rainbow suppression in Glacier National Park
 - Most important for protection of the core
 - Known to be successful

Group 3 – Linh Hoang

- **Bull trout translocation North Fork Blackfoot**
- **Upper Blackfoot - Scale up adaptive management approach in Crown**
- Riparian grazing management - Porcupine Hills, Eastern US
- Capacity – need more biologists
- Long term funding opportunities (Swan Lake translocation)
- North Fork Flathead rainbow trout suppression, move into Glacier National Park
- Scale up Flathead projects
 - Lake trout reduction
 - Rainbow trout reduction

Group 4 – Steph Legault

- Extending monitoring protocols in more areas/sites/geographic regions and share the learnings (re: intentional isolation and connection)
- **Using the RIBS project as large scale planning and prioritization process**
- **Learning from the monitoring of intentional isolation or connecting via thermal resistance**
- **Community engagement / citizen science of monitoring projects and buy-in for invasive eradication**

Group 5 – Regan Nelson

- Monitoring efforts
- Geographic scope of successful restoration - expand and build
- Coordinate lake trout suppression efforts, techniques, programs
- Help those with projects, interest that need resources
- Increase scope of suitable habitats
- Mechanistic understanding of relationships of salmonids and climate change

NEW TACTIC

Group 1 – Erin Sexton

- Piscicides (Lincoln Lake Glacier)
- Make a commercial fishery to harvest invasives (e.g. lake trout)
- Collaborative engagement to raise awareness (public not aware of issue)
- Use of intentional (maybe temporary) barriers (e.g. electronic barriers)

Group 2 – Molly Cross

- **Suppression of nonnatives**
 - North and Middle Forks of Flathead (esp. Glacier National Park)
 - The places we are doing replication, re-founding and translocation (e.g. cold water refugia)
 - Climate link - focus on core area and cold water refugia. All bets are off if we don't do this
- Reintroduce beavers where there is social tolerance
- Forest management in groundwater areas
- Engage stakeholders
- Mixing across sub-populations
- Reforestation at high elevation to help retain snow pack as much as possible

Group 3 – Linh Hoang

- Lake trout - Using e-fishing to kill embryos
- St. Mary's - Cross jurisdictional work
- Large-scale adaptive management experiment - monitor
- Isolate - kill - open - where WSCT extant and nonnatives present

Group 4 – Steph Legault

- Implement introduction of beavers - depending of level of public acceptance (need for education efforts)
- Oldman Watershed headwaters (Bob Creek)
- North Fork of Placid Creek
- Find opportunities to protect landscape/watersheds

Group 5 – Regan Nelson

- Pacfish Infish Biological Observation (PIBO) Monitoring - scale up - combine and standardize data and baseline data
- Predictive models for invasive species threats
- Innovative remote sensing (e.g. aerial surveys), imagery
- Identify new areas to extrapolate successes
- Identify and apply techniques in new refugia - increase beaver distribution and abundance
- Include anglers more in suppression efforts
- Development of effective mysis shrimp suppression agent

COORDINATE AT SCALE OF THE CROWN

Group 1 – Erin Sexton

- Engagement to raise awareness (e.g. agency workshop challenge)
- Mapping across Crown of:
 - riparian areas (use of LIDAR); include/focus on alluvial aquifers
 - erosion risk
 - status of fish populations (including genetics) using common index
- Common monitoring protocols
- Assessment protocol in sub-watershed - road / trail condition assessment - e.g. Dutch Creek Prototype in Oldman Watershed

Group 2 – Molly Cross

- Genetic survey
- **Coordinated monitoring across the Crown to feed into adaptive management**
 - fish populations
 - fish habitat
 - abundance
- More upstream-downstream consideration
- Agreeing on a management goal outcome - what does success look like?

Group 3 – Linh Hoang

- **Fish screening - exclusion from diversion (St. Mary's, Belly, etc.)**
- **Prevention of AIS**
- **Long-term money for selected actions**
- Identify conservation population priorities
- Commitment to not stock with nonnatives
- Harvesting of hybrids, nonnatives

Group 4 – Steph Legault (No data to report)

Group 5 – Regan Nelson

- Comprehensive, coordinated mapping (e.g. genetics etc.)
- Monitoring protocols, techniques, products
- Map and secure upwelling / groundwater recharge areas
- Apply consistent control protocols to identify invasive threats and address introductions
- Support major initiatives / projects of partners in "Crown" (technical, political, financial)

6. Breakout Session #3 Exploring Criteria and Opportunities to Identify Priority Projects

For the final Breakout Session of the day, each group was asked to consider the criteria used in the Yellowstone cutthroat example (provided by Brad Shepard) and discuss possible criteria that might be applicable and/or helpful to consider for BT and WSCT in the context of the CCE. Then, using these criteria, each group was challenged to shorten/rank their list of priority projects.

In the large group report back, criteria cited by the groups in their discussions included the following:

- Commitment - money, legislative mandate etc.
- Benefits gained (substantial) vs. effort (resource pragmatism).
- Level of public support (after outreach).
- Success of technique (proven technique).
- Eminent threat (addresses the biggest threats).
- Connection to climate change and risks associated with climate change.
- Opportunity, resilience, redundancy, replication.
- Socio-economic factors (feasibility - economically, social aspects, cost).
- Collaborative and includes key stakeholders.
- Effective monitoring of success - re: balance \$ and change observed.
- Results can be maintained over time.
- Directly addresses issue.
- Immediate response [possible].
- Finite, not open ended. (e.g. install, but maintain indefinitely).

Each group highlighted their top ideas and these are captured in bold font in each of the group lists (see pages 27-30).

7. Day 2 - Closing Exercise

To close, participants were asked to reflect on the ideas generated throughout the day and identify two ideas they personally had an interest in further discussing and/or advancing. These ideas were collected and responses sorted into themes. This information was used as the starting point for Day 3 discussions.

Workshop - Day 2 Concluded

Workshop Day 3 - November 20, 2014

8. Reflections from Day 2

To begin the day, participants were asked to share any reflections or thoughts that occurred to them after the conclusion of the second day. Comments included the following:

- Dichotomy of addressing nonnative fish species or with habitat. Some people may be using the information for non-productive purposes. The presence of nonnative fish means development or harvesting (timber).
- One participant sees two objectives - Cross boundary projects or places with high priority which may not be cross boundary.
- Yellowstone cutthroat trout- Nucleus of ideas, CMP could play a similar role by providing a consistent focus, people will coalesce around good data.
- Nonnative fish publically are not a problem. Need to support people that are trying to combat the nonnative fish problem.
- Expand the aquatic invasive species programs across Crown to include nonnative fish.
- Committed to collaborating across borders with the MOU. Developing an Aquatics Adaptation Strategy for the Elk Valley/Flathead. This could be expanded across the CCE. The plan will be out there this winter. There is also an Alberta/Montana MOU. The fish plan is in British Columbia/Montana and this could be expanded to the entire CCE.
- People want to see the CMP organize a plan similar to the Multi-State Interagency Yellowstone Cutthroat Trout Conservation Work Group and others just want to get action on the ground. Need to do both, get some stuff done as well as doing a prioritization of watersheds for salmonids. Include a process of learning (adaptive management).
- People are going to continue with priority projects; random acts of management are not random; how are these acts moving these objectives forward?
- Working on a map that will show efforts across the CCE towards native salmonids.
- Need to get watershed health into mainstream curriculum.
- Need to be deliberate about who does what.

9. Themes and Top Ideas from Day 2

To prepare for the final breakout session of the workshop, participants reviewed the themes and individual ideas they wrote on cards at the conclusion of Day 2. These themes and ideas are listed below:

Theme: Identify & Secure Refugia

- Identify current/future strongholds for WSCT and bull trout on east slopes in northern CCE (i.e. Canada); identify habitat refugia in our changing climate (including fishless, i.e. suitable areas) as well as implementing protection and habitat restoration strategies to keep extant populations healthy.

- Identify and secure cold water refugia

Theme: Translocation:

- South Fork of the Flathead River
 - Continued genetic restoration
 - Monitoring
 - Summarizing techniques and successes for restoration to share Crown-wide
 - Sharing social aspects and work in wilderness – use of piscicides and effects on insects and amphibians.
- Relocation/translocation replication to cold water habitats
- North Fork of the Flathead – Help Park Service with lake trout suppression, monitoring, barrier work, rainbow hybrid suppression.
- North Fork of the Blackfoot project
- North Fork of the Blackfoot river trout projects
- Translocation projects in Glacier National Park
- Translocate WSCT to fishless streams in the Swan

Theme: Road/Culverts:

- Road/culverts/stream projects to reduce sedimentation and re-establish connectivity across altitudinal gradients

Theme: Community Conservation Efforts:

- Identify and support community based conservation efforts in our area (citizen science, school, curriculum based)
- Support Oldman river conservation
- Reintroduction of beavers where appropriate/ feasible
- Citizen involvement/citizen science – engage and develop interest/support/understanding
- Beaver awareness leading to enhanced tolerance and expanded beaver populations and range of native trout species
- Public education, community outreach and engagement, collaboration and sharing of ideas
- Working through the needs related to the community engagement and education related to native fish conservation – this would include integration of initiatives and as citizen science/public education and drawing together collaborative endeavors to accomplish key objectives

Theme: Suppression/eradication of nonnatives:

- Where possible and reasonable (WSCT present, nonnatives nearby or present)
- Scale up harvesting program (increase angling hours, catch and keep, commercial harvesting)
- Nonnative fish reduction in the Flathead
- Expand suppression of rainbow/hybrid trout sources in connected stream systems
- Prevent/eliminate and/or suppress nonnative fish
- Assist with large scale nonnative eradication project

- Collaborate on lake trout suppression in Swan Lake

Theme: Monitoring/Protocols:

- Come up with common, robust monitoring protocols for the Crown (fish populations, riparian areas, erosion)
- Data collection coordination and standardization
- Coordinated monitoring efforts across Crown
- Establish common methods/protocols for monitoring bull trout and WSCT trout populations, habitat quality, stream temperature, etc. throughout CCE
- Hydroelectric protocol to address water temperature issues

Theme: Map conservation populations and priorities:

- Multi-stakeholder Yellowstone Cutthroat Trout prioritization process could be iterated in the Crown – forming basin/sub-basin or geographic units working groups
- Prioritize conservation populations across the crown
- Research into the rate of >90% pure WSCT in ecological terms
- Expand work that took place in transboundary Flathead to the Elk/Koocanusa to resolve mining issue
- The Crown Managers could provide the foundation for a WSCT/ bull trout conservation collaborative very similar to the Yellowstone cutthroat trout work. Brad suggested there was no governance structure, but there really was/is in the group of fisheries biologists providing the vision for this project. Some “serving” of the relevant vulnerability analyses (all of them) would be huge

Theme: Map and secure groundwater upwelling areas:

- Groundwater mapping
- Identify/map/secure groundwater upwelling areas
- Identify and secure alluvial upwelling areas
- Mapping of groundwater upwelling/adfluvial unbounded areas
- Map/identify the groundwater upwelling areas/hyporheic areas/bounded alluvial aquifers at the scale of the Crown and use to prioritize areas for bull trout and WSCT. Based on the mapped riparian areas and upwelling zones, prioritize these for prescription of existing populations and restoration

The group discussed the themes and decided to amalgamate “Translocation” with “Suppression of Nonnatives” and “Map Groundwater” with “Map Conservation Populations and Priorities”.

10. Open Space – Developing Plans to Advance Project Ideas

Applying an “Open Space” approach, participants then self-selected the theme they wished to discuss. Each group had 45 minutes to discuss the theme and the actions / next steps they felt should occur to advance the idea. The results from each group are listed below:

THEME: COMMUNITY BASED CONSERVATION

Curriculum connections and doing field science/ monitoring with students

- Crown of the Continent Ecosystem Education Consortium
- Key science messages identification as outcome of workshops
 - broader focus that specific nonnative species (e.g. rainbow trout)
- Need to talk about broader issues, importance of fully functional aquatic systems
- Use of volunteers for aquatic invasive species program
 - learning resource kits (core curriculum links) – important to have your own people doing the outreach.
- Different models
 - short time (1-2 hrs)
 - more intense time / experience - longer is better
- Start young, multiple grade levels
- Importance / opportunity to tie into "big science", big landscape, health/well-being and economics

Community Engagement

- Connection works best when it connects to personal interests
 - anglers and guides
 - recreational water users
 - private property owners
 - faith-based groups
 - government agencies
 - politicians
 - NGOS

Role of Community Conservation

- Go beyond education, and get things done on the ground, e.g. citizen science, weed pulls, restoration, hydro-dam operators, stakeholder engagement (stewardship actions).

Steps to Advance Ideas

- Key messages from scientists
- Identify key audiences
- Audit / scope out approaches and tools already in use
- Incorporate into existing agency programs, goals (seeking linkages)
- Incorporate external communication as part of workshop planning
- Consider order (From beginning and follow through, at all levels, identify common values, threats and decision points)
- Engaging Tribes and First Nations –Engagement takes time and there is a lot to learn from these relationships.

THEME: ELIMINATE/ SUPPRESSION OF NONNATIVES / TRANSLOCATION

Process/Ideas

- Think about processes that need to happen and specific projects

- Clean out Harrison Lake and restore with entirely native community
- Translocate WSCT to north end of Waterton
- Leave some areas fishless
- Cross border and cross-agency adaptive management
- Identify different tactics for management practices and evaluate

Locations

1. Transboundary Flathead – How can we bring what we learn from that process to rest of the CCE?
2. Transboundary Oldman
3. North Fork of the Blackfoot

Conversations to Have

Note: Conversations are useful as long as you do not spend too much time [just] talking

To Start

- Waterton National Park
- Parks Canada
- Identify current projects and the partners involved and start those conversations

Conversations to Continue (already happening)

- Multiagency work crews

Resource Needs

- Identify leaders
- Identify who has jurisdiction/ bring in jurisdictions and key stakeholders
- Increase capacity agency level or through collaborations
- Have clear objectives for NGOS and other partners to get involved - funding
 - e.g. Identify key areas for nonnative [removal] work

Questions / Potential Barriers / How to Overcome

- Funding (Barrier)
- Interagency / partnership - there needs to be agreement between objectives and goals, need to scale back and see commonalities in order to meet the objectives and goals of partners to, so everyone benefits.

Project Specific Recommendations

- St. Mary's diversion and replicate
- Re-found, re-create new areas of refugia in the transboundary / Oldman (east of the divide)
- Suppression of rainbow trout on the west side in transboundary Flathead

Education Key Messages (share with Community Engagement group)

- Rainbow trout are a problem and suppression is working,
- Best of the best – stress its importance! West of the Divide

- Opportunity to come together in collaborative manner to address problem on both sides of the border

Question – Why didn't Harrison make the project list?

Answer; wanted to focus on transboundary projects.

THEME: IDENTIFY AND SECURE REFUGIA

Process

1. **Identify metrics and classify potential quality as refugia (High, Medium, Low)** - based on parameters (intrinsic, extrinsic)
 - e.g. thermal suitability, stream temperature, land cover, roads, roadless, role of geo-spatial data, high resolution imagery (LIDAR), Crown wide coverage, valley-bottom confinement algorithm, Netmap, where are the upwelling zones, bull trout spawning data and FWP redd data
2. **Consider climate vulnerability** (as parameters - could include invasives, flows, temperatures)
3. **Identify [current] projects / objectives** and link to parameters and climate vulnerability
4. **Identify Actions / Tactics of [current] projects** (track / map success of tactics in meeting objectives)
5. **Use to prioritize / strategy for where work is needed to fill gaps** on where certain needs are not met
6. **Identify where/what else to take action** (using list from workshop)
7. **Identify community outreach, education pieces** and where are they and coordinate

Next Steps

1. "We" assemble the data for a comprehensive first pass at spatially identifying the refugia
2. Some type of "ground- truthing" / gathering or process (release meta data)
3. Identify existing know refugia
 - E.g. Harrison Lake, Glacier National Park
 - rescue operation
 - eradication
 - re-introduction

THEME: ROAD / CULVERT STREAM PROJECTS

Roads

- Access to streams and riparian areas from roads and mechanical disturbance
- Access ties into everyone's work groups

Access (legal and illegal)

- Increasing stress on watersheds
- Allows translocation
- Increasing off road use (legal or illegal)

- Sanitation issues (humans gravitate towards water)
- Public access - illegal entrance
- Dispersed use - increase riparian
- Address over exploitation - poaching, increase officers

Mechanical Disturbances (mostly related to road location within the watershed)

- Reduced woody debris due to riparian harvest (logging, wood cutting) and instream wood removal from floaters and fishermen
- Riparian canopy removal results in increased stream temperatures

Road Locations

- Road/stream crossings often result in partial or total barriers to upstream fish passage
- Roads can result in increased sedimentation, reduced wood to streams, and be a delivery agent of road-borne chemicals
- Watershed resiliency decreases with increased roads

Survey / Mapping

- Knowledge of location and density of roads
- GIS, Netmap, Geomorphic Roads Analysis Integrated Program (GRAIP), LIDAR
- Identification of fish barriers (need definition), partial barriers
- Crossing Inventory - Barriers (+/-), sediment, stream geography
- Need classification system for roads – (Natural, Recovery value, Natural Range of Variation)
- Need support for treatments (are you going to keep the road or not?). If you keep the road you need to determine impacts. If you don't need the road you can abandon, or completely recover.
- Integrate with wildlife, identify terrestrial corridors

Treatments

Keep road- Mitigate site specific issues (e.g. add wood to streams); Relocate (Best Management Practices, narrow, E&C)

OR

- **Store road** - Pull culverts, seed and stabilize

OR

- **Don't keep road**- Closure level - [Abandon, reclaim]?

Monitoring

Objective-based: determine the objectives (social, engineering, aquatic) for each road/road segment and allow a diverse team to monitor the implementation and effectiveness of changes over time.

Following the small group report back, the participants offered the following concluding comments:

- It would be great to have an annual report back from all players in each jurisdiction. This would keep people informed about what is going on in each agency and allow an opportunity to give an update about what is going on across the CCE.

The group discussed how it will decide what projects get going on the ground. The following ideas were suggested:

- Need to determine where the geographical priorities are.
- The project needs to have a role in the greater good of the CCE.
- Potential criteria and project areas, marry these together.
- Need to line up the science and the criteria.
- Need to make sure that whatever we start has some potential for success to give momentum.
- Need to determine who “we” is. The Wilderness Society, Crown of the Continent Conservation Initiative and Crown Managers Partnership. Each is accountable to their organizations. The other “we” are the people attending. Need to measure and figure out who the “we” is more specifically when moving a project forward.
- Important to take back information and use in your own projects. Need to provide support for each other’s projects.
- Need to provide support and incentive for people that have contributed to this process. Follow up gets lost, difficult to do.
- Put together a tentative list; draw potential projects on a map.
- Include the experts, scientists in making the plan. Have the information distilled first and then have the scientists review and input and then go back to the group.
- Use the information collected from the workshop to guide a native salmonids adaptation strategy or plan for the CCE. But also identify 3-5 things that could be worked on as pilots.
- Note: The Confederated Salish and Kootenai Tribes have developed a Strategic Climate Adaptation Plan for the Flathead Reservation (available on their website), and is working to implement this plan through a Climate Change Oversight Committee (CCOC) that meets monthly. The CCOC recently created a guide for incorporating Traditional Ecological Knowledge into this plan, which is intended to be an informational resource in understanding traditional ecological knowledge in the face of climate change. Also available through their website, or contact Mike Durglo (Chair of CCOC).

11. Final List of Prioritized Native Salmonid Projects

The individual priorities identified by each breakout group (noted in bold font on pages 27-30) are listed below.

- Given that several of these projects could have been classified under more than one workshop goal, we have chosen to list the three workshop goals at the top of the list as a reminder of our collective focus, and then provided the entire list of priority projects developed at the workshop below these goals;

- We have divided the list into: (1) those projects that meet key informational/policy needs, versus (2) those that are more boots-on-the-ground projects; and
- Lastly, we have removed "support community-based conservation efforts" from the list because of the critical importance of this component in any Crown-wide project on native salmonids moving forward.

- 1. Identify 1-2 on-the-ground projects that could be scaled up and applied more broadly across the Crown of the Continent Ecosystem;**
- 2. Identify one new tactic that could be implemented as a prototype project (with strong scientific basis used to identify appropriate geospatial location for that strategy/tactic); and**
- 3. Coordinate across jurisdictions on one Crown-wide project.**

PROPOSED PROJECTS

PROJECT #1: Establish coordinated monitoring efforts across the CCE, including standard protocols, frameworks, and objectives, as well as a common data repository, for both fish populations and habitats.

OUTCOME: A consistent and coordinated monitoring approach will assist in the identification of highest priority native salmonid conservation and restoration projects and habitat, as well as provide real-time information feedback loops to managers to facilitate adaptive management at a Crown-wide scale.

PROJECT #2: Complete prioritization and mapping of conservation populations and key watersheds most critical to sustain native salmonids across the CCE given both existing stressors and climate change, and simultaneously work to identify and secure groundwater upwelling areas and potential coldwater refugia at fine scales; additionally, identifying important coldwater tributary entrances (where adult salmonids tend to gather) into warmer river systems falls under this category as well. For bull trout, this exercise has been completed in the Montana portion of the Crown by the US Fish & Wildlife Service in 2011 (please see Appendix I of final maps courtesy of Wade Fredenberg, USFWS).

OUTCOME: A Crown-wide prioritization of the populations and sub-watersheds most critical to conserve and restore will ensure all partners in the Crown are focused on the highest impact places and projects. At the same time, we can get started right away securing groundwater upwelling area where they already support native salmonid populations, as these have the potential to offer coldwater refugia into the future.

PROJECT #3: Develop a set of consistent strategies for suppressing non-native fish species across Crown (e.g. prevention, monitoring, response, and enforcement) that is based on lessons learned about critical uncertainties and ecological function from ongoing projects; prioritize testing of these strategies in core areas and known cold water refugia.

OUTCOME: Existing efforts by the Crown Managers Partnership focused on preventing the introduction of aquatic invasive species has demonstrated the efficiency and strength of coordinated strategies. Applying this successful model to the management of invasive

trout species would help to conserve the genetic integrity and fitness of the Crown's native salmonids.

PROJECT #4: Secure the placement of fish screens on existing water diversions, including those on Saint Mary's River, and the Belly River.

OUTCOME: Existing water diversions on the Saint Mary and Belly Rivers currently entrain thousands of fish per year; this is a particular concern in light of the recent decline in bull trout population numbers in these rivers (particularly in the Alberta portion of the watershed).

PROJECT #5: Replicate, restore and/or translocate native salmonid populations to cold water refugia in priority transboundary watersheds East of the Divide (including the Oldman Watershed).

OUTCOME: A strong, transboundary, community-based effort focused on replicating, restoring, and perhaps translocating native salmonid populations could help ensure that these species persist in these watersheds.

PROJECT #6: Implement strategic and coordinated suppression of invasive rainbow trout in the transboundary Flathead watershed, combined with exportation of best management practices to other locales;

OUTCOME: The transboundary Flathead watershed remains the "best of the best" in terms of native salmonid population distribution and abundance. A strategic and coordinated non-native suppression effort would address the largest threat to these populations.

PROJECT #7: Improve and restore native salmonid habitat in headwaters by whatever suite of interventions are appropriate locally (e.g. use of monitoring tools to identify significant point sources of sediment from roads, stream channel restoration to lower stream temperatures; replace/upgrade culverts to restore connectivity with higher elevation cooler stream segments; control water temperatures through selective cold water release from dams to offset climate change impacts; etc.);

OUTCOME: Native salmonids require clean, cold, complex, and connected habitat. Focusing habitat restoration efforts on headwater streams will help ensure the delivery of cold, clean water lower in the watershed, and increase access to cold water refugia at higher elevations into the future.

PROJECT #8: Re-establish beavers across the landscape: launch a pilot project that incorporates efforts to (a) reduce trapping of existing beaver populations (i.e. to facilitate successful dispersal events by existing populations), (b) identify policy avenues that can incentivize expansion of beaver populations in key watersheds, and (c) identify educational outreach opportunities for private landowners, agency staff, and fisheries managers (Stillwater, Montana, and Alberta);

OUTCOME: Beavers play a major role in creating complex habitats that native salmonids need to thrive, but their contribution to the landscape has diminished as a result of intensive trapping and eradication efforts. The goal here is to develop pilot projects that would foster natural or augmented expansion of beaver populations through increased tolerance and reduced trapping efforts.

PROJECT #9: Export successful bull trout translocation efforts piloted in the North Fork of the Blackfoot to other landscapes.

OUTCOME: Efforts to translocate bull trout into historic or novel habitats have seen great success in the North Fork Blackfoot watershed; exporting this successful translocation model to other landscapes (and expanding it to include westslope cutthroat trout) can help to sustain native salmonid populations in their historic (and future) range.

The Workshop Organizing Committee thanked everyone for their participation and wisdom. Materials from the presentations, a workshop Summary Report and correspondence regarding next steps will be sent to participants as soon as completed.

WORKSHOP CONCLUSION