

**A Biological Assessment of Impacts to
Threatened Anadromous Salmonids from the
Sudden Oak Death Management Program
in Redwood National and State Parks**

November, 2012

I. INTRODUCTION

The purpose of this biological assessment (BA) is to review the proposed Redwood National and State Parks (RNSP or “parks”) Sudden Oak Death Management Program. The aim of this document is to review, in sufficient detail, whether this program may affect any threatened or endangered species and/or their critical habitats. This biological assessment is prepared in accordance with legal requirements set forth under section 7 of the Endangered Species Act (19 U.S.C. 1536 (c), 50 CFR 402), and meets the criteria for an informal consultation. This document also meets the requirements of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et. seq) essential fishery habitat (EFH) consultation requirements (sec. 305 (b)(2) and 305 (b)(4)(B)) and ESA/EFH parallel consultation guidelines established by NOAA Fisheries (USDC 1999c, USDC 2001) for an informal consultation.

This consultation is meant to cover any actions taken as part of the RNSP SODMP over the next ten years (2012 – 2022). The action area is any watershed within RNSP. The Sudden Oak Death pathogen may become established anywhere at anytime but will most likely first become established in the Coyote Creek, Copper Creek and/or Devil’s Creek subwatersheds because those watersheds are closest to the existing SOD infection sites in Redwood Creek valley located outside RNSP. Other anadromous watersheds besides Redwood Creek within Redwood National and State Parks include the Klamath River and Smith River (Appendix I, Maps)

II. CONSULTATION TO DATE

RNSP currently has three species of anadromous fish that could be affected by the proposed action that are listed as threatened under the Endangered Species Act:

1. California Coastal (CC) Chinook Salmon (*Oncorhynchus tshawytscha*)
2. Northern California (NC) Steelhead (*Oncorhynchus mykiss*)
3. Southern Oregon/Northern California Coasts (SONCC) Coho Salmon (*Oncorhynchus kisutch*)

Critical habitat has been designated for all three.

The RNSP SODMP was first presented at an interagency consultation team meeting on 10 May 2011. The primary concerns brought up during that meeting was daylighting streams due to removal of riparian forest cover and streambank stability. A draft biological assessment was sent to NOAA Fisheries in June 2012 and a follow-up meeting occurred on 27 August 2012 to discuss comments.

Please note, two other anadromous fish species, green sturgeon (*Acipenser medirostris*) and southern eulachon (*Thaleichthys pacificus*) are also listed as threatened and potentially occurring in Redwood National and State Parks. Green sturgeon are only found in the marine portions of RNSP, outside the program area potentially affected by the RNSP SODMP. Southern eulachon historically occupied only the very lowest reaches of the Smith River which is well outside of Redwood National and State Parks, the very lowest reaches of the Klamath River where no

actions will occur, and the very lowest reaches of Redwood Creek during the winter and spring where/when the proposed program actions will have no effect because temperature sensitivity is not an issue. Neither of these species has any potential to be affected by the proposed program and so will not be mentioned further in this document.

III. CURRENT MANAGEMENT DIRECTION

Please refer to *Threatened, Endangered, Proposed, and Candidate Species in Redwood National and State Parks, Biological Assessment Reference Document* (RNSP 2011) for a detailed summary of laws and policies that influence management direction in RNSP.

Exotic Plant Disease Pathogen Management

No RNSP specific guidance exists concerning the management of the Sudden Oak Death plant pathogen. However, the Sudden Oak Death pathogen meets the criteria of an exotic pest and thus falls under general guidance policies. This plan was developed following NPS Management Policies 4.4 and 4.5 for exotic species management and integrated pest management (IPM) (NPS 2006) and guidelines for natural resource management exotic species and IPM procedures (USDI 1991). Both NPS guidelines and direction provided in the California Department of Parks and Recreation's Department Operations Manual (DOM), Natural Resources Chapter 0300 and Pest Control Chapter 0700, direct the management of populations of exotic species and pathogens wherever such species and pathogens threaten park resources, and where control is prudent and feasible. Park managers are to take action whenever exotic pathogens interfere with natural processes, the perpetuation of natural or cultural features, or the perpetuation of native species, especially those that are threatened, endangered, or otherwise unique. IPM procedures will be used to determine when to control exotic pathogens and the method of control.

RNSP Management Policy Memorandum No. 98-04 (July 31, 1998) directed parks personnel on the procedures for use of pesticides and herbicides within the parks. Additionally, RNSP Standard Operating Procedure #12.01, *Spill Response and Emergency Procedures* and the parks' *Spill Contingency Plan*, provide direction to staff relative to managing hazardous material spills, including pesticides. These guidelines identify federal and state laws and regulations governing herbicide use, protection of non-target species, worker safety, storage and disposal of hazardous materials, documentation, and reporting.

IV. DESCRIPTION OF THE PROPOSED PROGRAM

Background

Sudden Oak Death syndrome (SOD) is caused by *Phytophthora ramorum*, an invasive plant pathogen with suspected origins in Asia. Millions of oaks and tanoaks have been killed by this pathogen in forests and wildland-urban interfaces of coastal California covering an estimated 2 million acres since the disease became evident in the mid 1990's. Some watersheds have lost over 90 percent of their tanoak component. Extensive areas of mortality have led to concerns about changes in fire frequency and intensity, changes in species composition resulting in shifts

in ecosystem processes and function; loss of food resources and habitat for wildlife; and decreased water quality due to an increase in exposed soil surfaces. The disease has killed oaks and tanoaks over thousands of acres in southern Humboldt county to the south of Redwood National and State Parks and is found in small, isolated locations in Curry County, Oregon to the north of the parks. A wide variety of host plants can harbor *P. ramorum* but not die from the disease. Some of these host plants serve as primary vectors for the pathogen including California bay laurel, rhododendron, and huckleberry which are commonly found in the parks.

P. ramorum spreads from tree to tree as zoospores or sporangia in water including rain splash, drip and stem flow. Local spread is facilitated by transfer of sporangia dislodged from upper crown infections in clouds and wind driven rain. Most newly infected trees are found within about 300 to 600 feet of previously infected trees, a pattern consistent with wind and rain dispersal. However, new disease sites have been detected up to three miles from nearest known infested areas. This type of longer distance or landscape scale spread is believed to be facilitated by turbulent transfer of sporangia dislodged from upper crown infections in storm driven wind events. Extremely long distance spread of *P. ramorum* occurs when infected live plant stock is moved from place to place, such as nursery plants.

SOD has been positively identified on tanoak trees in the Redwood Creek drainage several miles upstream of the parks. Leaf baiting of Redwood Creek near Orick, approximately 15 miles downstream of the infestation site, has confirmed the presence of the SOD organism in the creek. Between the infection site and the bait station in Orick lies Redwood National Park, with high visitor use areas such as the Redwood Creek trail and Tall Trees Grove on or intersecting the waters of Redwood Creek. It can thus be assumed that SOD will become established in the parks soon. The most likely scenario, based on observed spread of the disease in southern Humboldt county and the rest of California, is that *P. ramorum* will have the highest likelihood of spreading into RNSP areas closest to the currently identified infection site in Redwood Creek valley (L. Arguello pers. comm.). The watersheds most likely to become infected first will be Coyote Creek, Copper Creek and Devil's Creek located in the southeastern end of RNSP (Appendix 1, Maps). The SOD pathogen, however, could occur in any watershed within Redwood National and State Parks within the next ten years.

Proposed Program

A successful SOD management program has been in existence in southwestern Oregon for the past five to seven years on US Forest Service and Bureau of Land Management lands (USFS - USDA 2006). The methods utilized in southwestern Oregon are largely replicated as part of this management program. The proposed RNSP program is intended to be enacted if and when SOD is found within RNSP boundaries. It is unknown when an infection may occur and so the program is proposed to be valid for the next ten years, or until 2022.

SOD can become established in any forested area within the parks and thus the exact location of any potential treatment area is unknown. A similar set of evaluation criteria and possible actions, however, are being proposed to determine the appropriate response and management to the discovery of an initial infestation. The proposed SOD management is thus programmatic and

not time or site specific. Any location within any watershed in all of RNSP containing host plant species could become infected, and thus the necessity for a programmatic approach. However, the most likely site for infection occurring first, as stated previously, are watersheds closest to the known infection site in Redwood Creek valley near the southeastern end of RNSP. The watersheds most likely to be infected first are Coyote Creek, Copper Creek and Devil's Creek (L. Arguello, pers. comm.) (Appendix I, Maps).

Monitoring for SOD will be conducted throughout the parks' forested areas. Upon discovery, the extent of the infestation will be mapped, and an inventory of the stand will be taken to determine the presence and cover of tanoaks, California bay laurel, rhododendron, and huckleberry in close proximity of the infection site. If tanoak and California bay laurel are absent within 300 feet of an infection, no action will be taken. If tanoak or bay laurel are present, the extent of the infestation will be mapped, and a 300 foot buffer will be extended around the infected site. All tanoaks, California bay laurel, rhododendron and huckleberry, greater than 1 foot tall, will be cut down with chainsaws by hand crews within the established 300 foot buffer zone. All attempts will be made to fall target tree/shrub species away from non-target tree species. Cut materials will be bucked to get them in contact with the ground and all materials will be left on site. The goal of the treatment will be to get infected trees and shrubs, and nearby potentially infected trees and shrubs, to the ground so that they cannot facilitate the release of *P. ramorum* spores into the air during rain and wind events – thus preventing the spread of the disease into adjacent stands. Both monitoring crews and treatment crews will disinfect all gear prior to leaving an infected site.

Tree and shrub cutting could occur at any time of the year, regardless of location. All attempts will be made, however, to avoid treating areas within suitable terrestrial candidate threatened or endangered species habitat during their respective noise restriction periods.

A single tree SOD infection will result in a 7 acre treatment area (a single point surrounded by a 300 foot buffer equals a circle with a 7 acre area). Multiple infected trees in one location with 300ft buffer areas overlapping will be joined together to form a single treatment area (polygon). The maximum single treatment area size will be dependent on the canopy cover of the tanoak and bay laurel trees in combination with conifer canopy cover as determined by spherical densiometer. The maximum cumulative total of all treatment areas for the lifespan of this consultation (2012 – 2022), will also be dependent on the canopy cover of tanoak and bay trees in combination. Finally, the linear feet limit of treated riparian area trees will also vary depending on the canopy cover of tanoak and bay trees in combination (Table 2). Please note that the riparian forest canopy along the entire length of the main stem of Redwood Creek and Mill Creek are conifer dominant and thus riparian shading would not decrease along these major RNSP streams due to SOD management activities (i.e. those streams' riparian canopies would always be characterized as having a greater than 75% existing canopy cover with virtually no tanoak or California bay canopy component).

Table 2. Maximum single treated area, cumulative treated area and maximum stream length treated within riparian area.

California Bay/Tanoak Relative Canopy Cover¹ at Sudden Oak Death Infection Site			
	0 to 25% of the canopy cover removed	26% to 50% of the canopy cover removed	51% to 75% of the canopy cover removed ²
Average existing stand canopy cover = 50% to 75%	50 acre total treatment polygon	25 acre total treatment polygon	13 acre total treatment polygon
	1,000 feet maximum length per stream	1,000 feet maximum length per stream	1,000 feet maximum length per stream
Average existing stand canopy cover = 76% to 100%	100 acre total treatment polygon	40 acre total treatment polygon	25 acre total treatment polygon
	Unlimited length per stream	2,000 feet maximum length per stream	1,000 feet maximum length per stream
Maximum Cumulative Treated Area 2012 - 2022	Unlimited	500 acres	100 acres

¹Canopy cover determined by spherical densitometer.

²Site will be planted after treatment with conifer/non host tree species.

No mechanical removal or burning of cut material is proposed on National Park Service (NPS) lands, unless those activities have been already approved as part of a separate management effort (e.g. second growth forest restoration, watershed restoration, fire management). Small pile burning may occur on California State Parks (CSP) lands. Pile burning will be restricted to small piles no more than six feet in diameter and 6 feet tall. All burn piles will be burned during the rainy season when fuel and soil moisture is high (typically mid October to mid May) in order to maintain burn control. All burn piles will be located more than 150 feet or beyond the break in slope, whichever is greater, from any riparian area.

No herbicide treatment will occur on CSP lands. On NPS lands only, ***stumps and cut stobs will be painted or injected directly*** with glyphosate based herbicide to prevent resprouting. ***No broadcast spraying will occur.*** Roundup™ will be used in upland areas or Aquamaster™ within 50 feet of springs and ephemeral, intermittent or perennial streams. All proposals for herbicide use in the NPS must go through a review and approval process that includes the park's IPM coordinator and regional IPM coordinator. All herbicide use would be conducted in compliance with NPS IPM guidelines (e.g., USDI 1991). Herbicides would be applied under the direction of personnel at RNSP that are Certified Pesticide Applicators or other qualified NPS personnel.

Glyphosate is a non-selective herbicide that kills plants by inhibiting the formation of amino acids tyrosine, tryptophan and phenylalanine, all of which are necessary for protein formation in susceptible plants. While animals need these amino acids, they obtain them by ingesting plants or other animals; this makes glyphosate relatively non-toxic to animals. Glyphosate binds tightly to soil particles and tends to remain within the top 6 inches of soil, making it unlikely to end up in surface or sub-surface runoff except by direct soil erosion. If it does run off it remains bound to soil particles and unavailable to fish and aquatic invertebrates.

Glyphosate is short lived in the environment. According to the EPA (Patterson 2004) under aerobic soil conditions glyphosate degrades to aminomethyl phosphoric acid (AMPA) with a half life of 1.85-2.06 days, which then degrades into carbon dioxide. The principal degradation mechanism is microbial metabolism, as glyphosate is stable in terms of hydrolysis and photo degradation.

Glyphosate has been well-studied relative to its toxicity to fish and other animals. As a result of the low-levels of toxicity detected in studies, the EPA has labeled it as "practically non-toxic" to fish and aquatic invertebrates. When used according to the manufacturer's label, it was determined "not likely to adversely affect" threatened and endangered salmon and steelhead by the EPA's Office of Pesticide Programs (Patterson 2004).

Inter-related and Interdependent Activities

Access

Vehicle access to SOD treatment sites would be via existing service roads; access would occur outside of the seasonal road closure on those roads that are closed during wet weather.

Hazardous Materials Treatment

In the event of a fuel, oil, or herbicide spill, a spill contingency plan would be in place. This plan is based on NPS and CSP existing spill plans, and was tailored to the type of hazardous spills that could be associated with SOD management activities. These plans are included in Appendix II.

Measures to Minimize Impacts on Listed Species

Herbicide use within 50 feet of riparian habitats, flow courses, or wet areas in watersheds with the potential to support listed steelhead, chinook, coho would be restricted to Aquamaster (stream safe formulation of glyphosate). ***This herbicide would either be injected directly into a plant or applied with a brush or target sprayer directly on a cut stump. No broadcast spraying will occur.*** With this herbicide application technique, no herbicide will come in contact with any soil and will be complete absorbed by the treated shrub or tree. The other herbicide considered for use in this document, Roundup, would not be used within 50 feet of riparian habitats and ***will not be broadcast sprayed but will also be either injected directly into a plant or applied with a brush or target sprayer directly on a cut stump.*** No herbicide will be used within 4 miles of the Redwood Creek or Klamath River estuaries as these areas contain no host plant species for the SOD pathogen.

Riparian shading canopy reduction due to the removal of tanoaks and bay laurels within riparian areas will be limited in extent as described in Table 2.

Tiering -

Specific SOD management projects would be tiered to this BA through use of the tiering form attached in Appendix III. Tiered projects would be reviewed by a RNP biologist or CSP Ecologist to ensure consistency with the project description in this BA.

V. STATUS AND DISTRIBUTION OF LISTED SPECIES

1. Southern Oregon/ Northern California Coast Coho Salmon (*Oncorhynchus kisutch*), Threatened

A. Species Account

Coho or “silver” salmon are found in streams and rivers throughout much of the Pacific Rim, from central California to Korea and northern Japan. North American coho spawn in tributaries from the San Lorenzo River in Monterey Bay, California to Point Hope, Alaska, and throughout the Aleutian Islands. They are most abundant in coastal areas from central Oregon to southeast Alaska.

Coho salmon (hereafter “coho”) have shown substantial decreases throughout their range (Konkel and McIntyre 1987). In the U.S. Pacific Northwest, they are now extinct in the eastern half of their former range, and badly depleted over most of the western half (Frissell 1993). At least 33 populations have been identified by agencies and conservation groups for being at moderate or high risk of extinction. Four of the seven west coast coho ESUs are listed as threatened (three) or endangered (one), and an additional one listed as a species of concern.

In California, current abundance, including hatchery stocks, could be less than 6% of estimates for the period 1940 to 1949. Brown and Moyle (1991) estimated that naturally-spawned adult

coho returning to California streams were < 1% of their abundance at mid-20th century, and indigenous, wild coho populations in California did not exceed 100 to 1,300 individuals. Further, they stated that 46% of California streams which historically supported coho populations, and for which recent data were available, no longer supported runs. Populations now are at least 70% lower than during the 1960s (CDFG 1994). The Southern Oregon/Northern California Coast Coho ESU, which occurs within RNSP, was designated as threatened in 1997 (Federal Register 1997), and re-designated as a threatened distinct population segment in 2005 (Federal Register 2005a).

Coho generally exhibit a relatively simple 3-year life cycle, with the majority of juvenile fish entering the ocean at 1 year of age and returning 2 years later to spawn. However, in Prairie Creek approximately one-quarter of smolts reside in streams for 2 years (Bell 2001). Most coho return and enter rivers between September and February. Coho river entry timing is influenced by many factors, one of which appears to be river flow. Many small California stream systems, including Redwood Creek in RNSP, have their mouths blocked by sandbars for most of the year except winter which prevents entry until sufficiently strong freshets open passages through the bars (Weitkamp *et al.* 1995). Timing of the opening of Redwood Creek depends on a combination of wave action on the sand berm which can increase the elevation of the berm, the water elevation in the estuary, and the flow of water in the stream. Coho spawn from November to January (Hassler 1987), and occasionally into February and March (Weitkamp *et al.* 1995), with peak runs in Redwood Creek in November (RNSP unpub. data).

Although each native stock appears to have a unique time and temperature for spawning that theoretically maximizes offspring survival, coho generally spawn at water temperatures within the range of 50-55° F (10-13° C) (Bell 1991). Bjornn and Reiser (1991) found that spawning occurs in a few third-order streams, but most spawning activity was found in fourth- and fifth-order streams. Nickelson *et al.* (1992) found that spawning occurs in tributary streams with a gradient of 3% or less and in clean gravel ranging in size from that of a pea to that of an orange. Spawning is concentrated in riffles or in gravel deposits at the downstream end of pools featuring suitable water depth and velocity (Weitkamp *et al.* 1995). In Redwood Creek spawning is restricted to approximately 12 mi (20 km) of the lower mainstem and the larger low-gradient tributaries including Prairie Creek (RNSP unpub. data).

The favorable thermal range for coho salmon egg incubation is 50-55° F (10-13° C) (Bell 1991). Coho eggs incubate for approximately 35-50 days, and fry start emerging from the gravel 2 to 3 weeks after hatching (Hassler 1987, Nickelson *et al.* 1992). Following emergence, fry move into shallow areas near the streambanks. The early diets of emerging fry include chironomid larvae and pupae (Mundie 1969). As coho fry grow, they disperse upstream and downstream to establish and defend territories (Hassler 1987).

Juvenile rearing usually occurs in tributary streams with gradients of 3% or less, although they may move into streams of 4 or 5% gradient. Juveniles have been found in streams as small as 3 to 6 ft (~1 to 2 m) wide, including non-natal juveniles in Strawberry Creek, a small tributary to lower Redwood Creek (RNSP 2009). At a length of 1.5-1.75 in (3.8-4.4 cm), the fry may migrate upstream a considerable distance to reach suitable rearing areas (Nickelson *et al.* 1992). Rearing requires temperatures of 68°F (20°C) or less, preferably 53-58° F (12-14° C) (Reiser and

Bjornn 1979, Reeves *et al.* 1987, Bell 1991). During spring, coho fry are most abundant in backwater pools featuring adequate cover such as LWD, undercut banks, and overhanging vegetation. During the summer, coho fry prefer deeper pools. Juvenile coho prefer to overwinter in large mainstem pools, backwater areas and secondary pools with LWD, and undercut bank areas (Hassler 1987, Heifetz *et al.* 1986). Juvenile coho are carnivorous opportunists that primarily eat aquatic and terrestrial insects. They do not appear to pick stationary items off the substratum (Mundie 1969, Sandercock 1991).

In preparation for their entry into the ocean, juvenile salmonids undergo physiological transformations known as smoltification that adapt them for their transition to saltwater (Hoar 1976). These transformations include different swimming behavior and proficiency, lower swimming stamina, and increased buoyancy that also make the fish more likely to be passively transported by currents (Folmar and Dickhoff 1980). The ideal channel for maximum coho smolt production has shallow depth (3-24 in; 8-24 cm), fairly swift mid-stream flows (2 ft/sec; 0.6 m/sec), numerous marginal back-eddies, narrow width, copious overhanging mixed vegetation (to lower water temperatures, provide leaf litter, and contribute terrestrial insects), and banks permitting hiding places. In general, smoltification is timed to be completed as fish are near the freshwater to saltwater transition. Too long a migration delay after the process begins is believed to cause the fish to miss the window of optimal physiological condition for the transition (Walters *et al.* 1978).

Little is known about residence time or habitat use in estuaries during seaward migration, although it is usually assumed that coho spend only a short time in the estuary before entering the ocean (Nickelson *et al.* 1992). Growth is very rapid once the smolts reach the estuary (Fisher *et al.* 1984). In Redwood Creek downstream migration to the ocean from upstream rearing areas occurs in early spring (March-April). Survey data from RNSP indicate that these young salmon are present in the Redwood Creek estuary in June and gone by July (Anderson 1995). Migration through the Redwood Creek estuary is dependent upon the mouth being open to the ocean.

While living in the ocean, coho remain closer to their river of origin than do other salmon (Weitkamp *et al.* 1995). Nevertheless, coho have been captured several hundred to several thousand kilometers away from their natal stream (Hassler 1987). After about 12 months at sea, coho gradually migrate south and along the coast. Coho typically spend two growing seasons in the ocean before returning to their natal streams to spawn as 3 year-olds. Some precocious males, called "jacks," return to spawn after only 6 months at sea.

The anadromous fish populations of Redwood Creek have experienced a substantial reduction, in part due to severe flood events that moved large amounts of sediment from highly eroded hillslopes to the stream channels of the Redwood Creek basin (Madej *et al.* 2006). News accounts and recollections of longtime residents of the Redwood Creek watershed suggest that both the size and numbers of salmonids have declined in recent decades (Van Kirk 1994). Within the last decade no juvenile coho have been observed in the main channel above river km 20 and juvenile coho were restricted to 9 side-pocket cold pool locations in the lower 20 km of the channel (Ozaki and Anderson 2005). Madej *et al.* (2006) stated that < 20% of the main Redwood Creek channel currently supports young coho during summer. In 2009, no 0+ or 1+ juvenile salmon were captured in the upper Redwood Creek down migration trap and both of these age classes' capture rates have showed steady declines between 2003 and 2009 with the 0+

age class exhibiting a particularly severe decline (Sparkman 2010). In 2010 at the lower Redwood Creek trap, only six 0+ and thirteen 1+ coho juveniles were captured (Sparkman 2011). The vast majority of coho juveniles are coming from the Prairie Creek subwatershed. In Prairie Creek Duffy (2011) estimated escapement of adult coho ranged from a high of 680 in 2002 to 28 in 2010.

B. Habitat Status

Currently occupied suitable coho habitat occurs in the lower 12 mi (20 km) of the mainstem of Redwood Creek and its low gradient tributaries, including the first 13 mi (21 km) of Prairie Creek. Suitable habitat in Redwood Creek also exists in the approximately 15 mi (25 km) upper most reach of Redwood Creek, however, coho no longer occur from here down to the lower reach below the Tall Trees Grove. Surface water and daily minimum temperatures in summer from Tall Trees to the O’Kane Bridge on Hwy 299 tend to be above the desired range for juvenile coho (i.e., < 18° C [64° F]) (Madej *et al.* 2006). These conditions are likely the result of intensive logging in the basin that began after 1950. Floods in the 1950s, 60s, and 70s, and in 1997 caused wide-spread road and stream-crossing failure that increased streambed aggradation and bank erosion. Also, the riparian vegetation changed from conifer-dominated to red alder-dominated, allowing for increased sunlight and an increase in stream temperatures (Madej *et al.* 2006). Non-natal coho habitat below Prairie Creek is restricted to the only two tributaries entering the estuary. Both, Sand Cache Creek and Strawberry Creek are low gradient but degraded due to land use activities and effects of the levee configuration; Sand Cache is generally isolated from the estuary embayment, but coho have been found in Strawberry Creek.

C. Critical Habitat

Critical habitat is defined in Section 3(5)A of the Endangered Species Act as “...the specific areas within the geographical area occupied by the species... on which are found those physical or biological features (a) essential to the conservation of the species and (b) which may require special management considerations or protection”. Essential features may include, but are not limited to, spawning sites, food resources, water quality and quantity, and riparian vegetation. Structurally complex streams containing boulders, logs, brush, and aquatic macrophytes support larger numbers of rearing coho juveniles (Scrivener and Andersen 1982) than do streams that lack these structural features.

In southern Oregon and northern California, designated critical habitat for this ESU is between Cape Blanco, Oregon and Punta Gorda, California. The critical habitat unit is all stream and estuarine reaches accessible to the species and includes water, substrate, and the adjacent riparian zone. Accessible reaches are those within the historical range of the ESU that can still be occupied by any life stage of coho. The adjacent riparian zone is the area that provides shade, sediment transport, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter. Habitat quality in this zone is related to the quality of riparian areas, upland areas, and inaccessible or headwater or intermittent streams that provide key habitat elements, such as large woody debris and gravel, that are crucial for coho in downstream reaches (Federal Register 1999a). Thus, the width of the riparian zone included as critical habitat is variable depending upon consideration of these factors.

Critical habitat is of variable quantity and quality depending on the condition of a watershed/sub watershed within RNSP. The condition of a watershed relative to critical habitat is primarily a function of past land use practices. That is, the level of logging and number of old or abandoned logging roads within a watershed or subwatershed influence the habitat in terms of fine sediment quantity, amount of instream LWD, amount of streamside shading, pool number and depth, and water temperature.

2. Northern California Steelhead (*Oncorhynchus mykiss*), Threatened

A. Species Account

Steelhead were historically distributed throughout the North Pacific Ocean from the Kamchatka Peninsula in Asia to the northern Baja California peninsula. Presently, the distribution extends from the Kamchatka Peninsula, east and south along the Pacific Coast of North America, to at least Malibu Creek in southern California. Steelhead likely inhabited most coastal streams in Washington, Oregon and California as well as many inland streams in these states and Idaho.

During this century, over 23 naturally reproducing stocks of steelhead are believed to have been extirpated, and many more are thought to be in decline in numerous coastal and inland streams in Washington, Oregon, California, and Idaho. Forty-three stocks have been identified as being at moderate or high risk of extinction. For these reasons, Northern California (NC) steelhead were federally listed as endangered in one environmentally significant unit (ESUs), threatened in 10 ESUs, and as a species of special concern in one ESU. The Northern California ESU, from Redwood Creek south, falls within the boundaries of RNSP; it was listed as threatened on June 7, 2000 and relisted as a distinct population segment (DPS) in 2006 (Fed. Reg 2006).

Biologically, steelhead can be divided into two basic run-types based on the state of sexual maturity at the time of river entry and duration of spawning migration (Burgner *et al.* 1992). The stream-maturing type, or summer steelhead, enters freshwater in a sexually immature condition and requires several months in freshwater to mature before spawning. The ocean-maturing type, or winter steelhead, enters freshwater with well-developed gonads and spawns shortly after river entry (Barnhart 1986). Variations in migration timing exist between populations. Some river basins have both summer and winter steelhead, while others only have one run-type. South of Cape Blanco, Oregon, summer steelhead are known to occur in the Rogue, Smith, Klamath, Trinity, Mad, and Eel Rivers, and in Redwood Creek (Busby *et al.* 1996), in addition to the winter runs present in these basins.

Summer steelhead enter freshwater between May and October in the Pacific Northwest (Busby *et al.* 1996, Nickelson *et al.* 1992). They require cool, deep holding pools during summer and fall, prior to spawning (Nickelson *et al.* 1992). As cited by Moyle *et al.* (1995), summer steelhead on the northcoast return to freshwater streams from April through June. They migrate up coastal streams and rivers during and soon after the final high flows of April, and migration continues through June. It may extend into July but declines presumably due to lower flows and warmer water temperatures. The gonads of the migrating fish are immature and do not mature until the fish have spent 8-10 months in freshwater (Roelofs 1983). Spawning occurs from late December through April.

Winter steelhead enter freshwater between November and April in the Pacific Northwest (Nickelson *et al.* 1992, Busby *et al.* 1996), migrate to spawning areas, and spawn generally in April and May (Barnhart 1986). Some adults, however, do not enter some coastal streams until spring, just before spawning (Meehan and Bjornn 1991). On the northcoast, steelhead generally spawn earlier than those in areas to the north; both summer and winter steelhead in California generally begin spawning in December,

There is a high degree of overlap in spawn timing between populations within a DPS regardless of run type (Busby *et al.* 1996). Difficult field conditions during winter months and the remoteness of spawning grounds contribute to the relative lack of specific information on steelhead spawning. Unlike Pacific salmon which die after spawning, steelhead are iteroparous, or capable of spawning more than one year before death (Busby *et al.* 1996). However, it is rare for steelhead to spawn more than twice before dying; most that do so are females (Nickelson *et al.* 1992). Iteroparity is more common among southern steelhead populations than northern populations (Busby *et al.* 1996).

Steelhead spawn in cool, clear streams featuring suitable gravel size, depth, and current velocity. Intermittent streams may be used for spawning (Everest 1973, Barnhart 1986). Steelhead enter streams and arrive at spawning grounds weeks or even months before they spawn and are vulnerable to disturbance and predation. Cover, in the form of overhanging vegetation, undercut banks, submerged vegetation, submerged objects such as logs and rocks, floating debris, deep water, turbulence, and turbidity are required to reduce disturbance and predation of spawning steelhead (Giger 1973). It appears that summer steelhead occur where habitat is not fully utilized by winter steelhead, with summer steelhead usually spawning farther upstream than winter steelhead (Behnke 1992).

Steelhead require a minimum depth of 7 in (18 cm) and a maximum velocity of 8 ft/sec (2.5 m/sec) for active upstream migration (Smith 1973). Spawning and initial rearing of juvenile steelhead generally take place in small, moderate-gradient (generally 3-5 %) tributary streams (Nickelson *et al.* 1992). A minimum depth of 7 in (18 cm), water velocity of 1-3 ft/sec (0.3-0.9 m/sec), and clean substrate 0.25-4 in (0.6-10 cm) (Hunter 1973, Nickelson *et al.* 1992) are required for spawning. Steelhead spawn in 39-49° F (3.9- 9.4° C) water (Bell 1991). Depending on water temperature, steelhead eggs may incubate for 1.5-4 months before hatching, generally between February and June (Bell 1991). Nickelson *et al.* (1992) stated that eggs hatch in 35-50 days, depending upon water temperature.

After 2 to 3 weeks, in late spring, and following yolk sac absorption, alevins emerge from the gravel and begin actively feeding. After emerging from the gravel, fry usually inhabit shallow water along banks of perennial streams (Nickelson *et al.* 1992). Older fry establish and defend territories.

Summer rearing takes place primarily in the faster parts of pools, although young-of-the-year are abundant in glides and riffles. Winter rearing occurs more uniformly at lower densities across a wide range of fast and slow habitat types. Productive steelhead habitat is characterized by complexity, primarily in the form of large and small in-stream wood. Some older juveniles move downstream to rear in larger tributaries and mainstem rivers (Nickelson *et al.* 1992).

Juvenile steelhead migrate little during their first summer and occupy a range of habitats featuring moderate to high water velocity and variable depths (Bisson *et al.* 1988). Rearing juveniles prefer water temperatures ranging from 54-59° F (12.2- 15.0° C) (Reeves *et al.* 1987). Juvenile steelhead feed on a wide variety of aquatic and terrestrial insects (Chapman and Bjornn 1969), and older juveniles sometimes prey on emerging fry. Steelhead hold territories close to the substratum where flows are lower and sometimes counter to the main stream. From these, they can make forays up into surface currents to take drifting food (Kalleberg 1958). Juveniles rear in freshwater from 1 to 4 years (usually 2 years in the California DPSs), then smolt and migrate to the ocean in March and April (Barnhart 1986). Winter steelhead generally smolt after 2 years in freshwater (Busby *et al.* 1996). The majority of juvenile steelhead in Redwood Creek spend their second year of life in the estuary and mainstem Redwood Creek (Anderson 1988). Steelhead smolts are usually 6-8 in (15-20 cm) total length and migrate to the ocean in the spring (Meehan and Bjornn 1991). Based on incidental purse seine catches, juvenile steelhead tend to migrate directly offshore during their first summer from whatever point they enter the ocean, rather than migrating along the coastal belt as salmon do. During the fall and winter, juveniles move southward and eastward (Hartt and Dell 1986).

Steelhead typically reside in marine waters for 2 or 3 years prior to returning to their natal stream to spawn as 4- or 5-year olds. Populations in Oregon and California have higher frequencies of returning age-1 ocean steelhead, (aka half-pounders) than populations to the north, but age-2 ocean steelhead generally remain dominant (Busby *et al.* 1996).

Steelhead are found in most small order, high and low gradient tributaries to Redwood Creek. They are able to leap above barriers that might impede coho salmon (D. Anderson pers. comm.). Whether logjams are barriers to fish movement depends upon stream dynamics such as the logjam size and height, pool depth immediately below, and the stream discharge as well as the timing and duration of the steelhead migration. These events change from year to year.

Redwood Creek summer steelhead snorkel surveys began in 1981 between Lacks Creek and Tom McDonald Creek, a 25.7 km (16 mi) index reach, and were expanded to 38.6 km (24 mi) in 1992. Survey data indicate a steady decline since that time, although numbers were low to begin with when the surveys began. In recent years the numbers have leveled off at approximately 10-20 adult fish observed annually (D. Anderson pers. comm.). Forty-four was the highest total number of adult fish observed (in 1984 and 1985); zero fish were observed in 1989 and 2001. In other years the count ranged from 1 to 19 (1991 through 2010). Including surveys upstream of the 38.6 km reach conducted from 1993 to 1998, covering between 53 and 85 river km (33 and 53 river mi) of the 109 km (67.7 mi) long Redwood Creek, the highest numbers of adult summer steelhead observed were 36 in 1994 and 37 in 1997.

No park tributaries in the Redwood Creek basin have been snorkel surveyed for summer steelhead; the smaller streams do not have large enough pools to support fish during the warm summer months. In addition, adult summer steelhead have not been encountered in these streams during other survey and monitoring activities.

In Redwood Creek winter-run steelhead numbers are higher than summer steelhead numbers. Juvenile winter-run steelhead are the most common and widely distributed fish in the Redwood Creek basin. During sampling efforts in the summers of 1980 and 1981, steelhead occurred in 57 of the 111 Redwood Creek tributaries surveyed (Anderson 1988, Brown 1988). Sparkman's (2010) upper basin down migrant rotary trap catches for the 9 years between 2000-2008 averaged 81,179 0+ steelhead, 9,212 1+ steelhead, and 866 2+ steelhead. There were declines in all of these age classes in 2009, and significant declines in 0+ and 2+ age classes for reasons not easily explained. Results for the lower Redwood Creek trap show a similar negative decline for 1+ and 2+ juvenile steelhead; the decline was significant for 2+ age class (Sparkman 2011). Sparkman (2010) hypothesized that over-summer conditions (e.g., lethally high water temperatures) could be limiting the production of older (2+) age classes in upper Redwood Creek. He goes on to cite numerous studies from other areas that indicate a positive linear relationship between out-migrating 2+ smolts and returning adult steelhead (percent returning in the cited studies were between 84 and 98%), and that this age class is the best class for assessing steelhead status, trends, and abundance when information on adult steelhead is not available. In addition, he states "[t]he 2+ steelhead trout are also an excellent indicator of watershed and stream conditions because they spend the longest amount of time in freshwater habitat."

Duffy (2011) estimated escapement in Prairie Creek between 1999 and 2010 to be 4-142 adults; the wide range was influenced by uncertainty in run timing in the earlier years and precipitation in all years. Beginning in 2005 a weir was installed in Prairie Creek that revealed a migration of steelhead beginning in late February through mid-April. Numbers of estimated adults in 2005 through 2008 were 70-142 fish (Duffy 2011). Downstream migrant traps in Prairie Creek caught between 505 (2001) and 8 (2004) juvenile steelhead (Duffy 2011). When unidentified 0+ and 1+ trout (which could include juvenile coastal cutthroat trout) are added, the numbers ranged between 201 in 2008 and 4,745 in 2003.

All ages of juvenile steelhead rear in the Redwood Creek estuary during the summer and fall. Population estimates show a seasonal decline in numbers, to a mean of 3,300 (range 540 to 9,350) in the fall (1997 through 2007) before the estuary opens to the ocean. The numbers indicate a lowered carrying capacity of the estuary in the fall.

B. Habitat Status

The Redwood Creek watershed is listed as impaired for high water temperatures and sediment under Section 303(d) of the Clean Water Act. As an example, data from a temperature logger (Tidbit) located on mainstem Redwood Creek upstream of Tom McDonald Creek/Tall Trees Grove for July and August 2009 had maximum and minimum water temperatures of 22.6° C (72.7° F) and 16.2° C (61.2° F), respectively. Maximum diurnal range was 4.9° C (40.8° F). The average water temperature was 19.4° C (66.9° F). Maximum weekly average temperature (MWAT) was 20.6° C (69.0° F). Hours of temperature of 18° C (64.4° F) and above were 1,193 hrs (RNPS unpub. data).

Lower Redwood Creek, closer to the ocean, has lower temperatures relative to upstream, but it is still warm. 2009 data for a logger located in lower Redwood Creek upstream of the Redwood Creek trailhead for July and August 2009 had maximum and minimum water temperatures of

22.1° C (71.8° F) and 15.1° C (59.2° F), respectively. Maximum diurnal range was 6.7° C (44.1° F). The average water temperature was 17.7° C (63.9° F). MWAT was 18.3° C (64.9° F). Hours of temperature of 18° C (64.4° F) and above were 492 hrs (RNSP unpub. data).

What these recent data indicate is that water temperatures in mainstem Redwood Creek are high for salmonid fish, above the preferred temperature range for steelhead of 7.3° C (45.1° F) to 14.6° C (58.3° F), reported by Reiser and Bjornn (1979).

Tributaries to Redwood Creek have lower water temperature. Water temperatures of 63 east and westside tributaries entering Redwood Creek measured during a late July/early August summer steelhead survey in 2005 ranged from 12° C (53.6° F) to 17° C (62.6° F) (Anderson 2005). Water temperatures of all tributaries were cooler than the corresponding temperature of mainstem Redwood Creek measured at the same time. Westside tributaries were generally cooler than eastside tributaries. The mean water temperature of westside tributaries was 14.3° C (57.7° F) (n = 43) and the mean water temperature of eastside tributaries was 15.3° C (59.5° F) (n = 20). The 2005 year tributary water temperatures are similar to temperatures and patterns that have been recorded in past summer steelhead surveys. Where these tributaries enter Redwood Creek there may be deeper, colder pools that may sustain steelhead, although these pools are relatively few (D. Anderson pers. comm.).

C. Critical Habitat

Designated critical habitat for NC steelhead was defined by NMFS (Federal Register 2005b) to include the stream channels within the stream reaches and a lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined pursuant to the lateral extent, it is defined by the bankfull elevation. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge which generally has a recurrence level of 1 to 2 years on the annual flood series. Critical habitat in estuaries is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater.

In designating critical habitat, NMFS focuses on the known primary constituent elements (PCEs) essential for the conservation of the species. These PCEs are those sites and habitat components that support one or more life stages, including: (1) freshwater spawning, (2) freshwater rearing, (3) freshwater migration, (4) estuarine areas, (5) nearshore marine areas, and (6) offshore marine areas. Within the PCEs, essential elements of NC steelhead critical habitat include adequate (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, (10) safe passage conditions, and (11) salinity conditions.

Critical habitat is of variable quantity and quality depending on the condition of a watershed/sub watershed within RNSP. The condition of a watershed relative to critical habitat is primarily a function of past land use practices. That is, the level of logging and number of old or abandoned logging roads within a watershed or subwatershed influence the habitat in terms of fine sediment quantity, amount of instream LWD, amount of streamside shading, pool number and depth, and water temperature.

3. California Coastal Chinook Salmon (*Oncorhynchus tshawytscha*), Threatened

A. Species Account

Chinook salmon populations have declined along the Pacific coast to the degree that certain evolutionarily significant units (ESUs) were listed as threatened by the National Marine Fisheries Service (NMFS) under the Endangered Species Act (Federal Register 1999). In 2005 the California Coastal (CC) Chinook salmon was “re-listed” (i.e. reaffirmed) as threatened after a status review in response to a court order directing the Service to consider the contribution of hatchery fish to species viability (Federal Register 2005). Chinook historically ranged as far south as the Ventura River, California, and north as far as the Russian Far East (Federal Register 1999). The California Coastal ESU falls within the southern boundaries of Redwood National and State Parks and stretches from Redwood Creek south through the Russian River.

Of the Pacific salmon, Chinook exhibit the most diverse and complex life history strategies. Two generalized freshwater life-history types were described by Healey (1991): “stream-type” Chinook that reside in freshwater for a year or more following emergence, and “ocean-type” Chinook that migrate to the ocean within their first year.

Chinook mature in the ocean between 2 and 6+ years of age (Myers *et al.* 1998). Freshwater entry and spawning timing are generally thought to be related to local water temperature and flow regimes (Miller and Brannon 1982). Distinct runs differ in the degree of maturation at the time of river entry, thermal regime and flow characteristics of their spawning site, and actual time of spawning (Myers *et al.* 1998).

Run timing for spring-run Chinook in the CC Chinook ESU typically begins in March and continues through July, with peak migration occurring in May and June. Spawning begins in late August and can continue through October, with a peak in September. Historically, spring-run Chinook spawning areas were located in the river headwaters (generally above 1,300 feet). Run timing for fall-run Chinook varies depending on the size of the river.

Post-emergent fry seek out river/stream shallow areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects and aquatic crustaceans. As they grow to 2 to 3 in (5 to 7.6 cm) in length, the juvenile salmon move out into deeper, swifter water, but continue to use available cover to minimize the risk of predation and reduce energy expenditure. The optimum water temperature range for rearing Chinook fry is 50-55° F (10–12.8° C) (Seymour 1956, Rich 1997) and for fingerlings is 55-61° F (12.8-16° C) (Rich 1997). Data from the Mad River (Sparkman 2002) and Redwood Creek (Sparkman 2004) indicate that emergent Chinook fry develop rapidly following emergence. Over a 15-week period in the spring of 2001, Chinook fry increased in average length from 1.6 to 2.6 in (4.0 to 6.6 cm) with the bulk of this riverine growth occurring during a 10-week period in May and June (Sparkman 2002).

The majority of Chinook juveniles emigrate to the ocean as sub-yearlings, although yearling smolts can constitute up to approximately one-fifth of out-migrants from the Klamath River Basin. The proportion of fish which smolt as sub-yearling vs. yearling varies from year to year (Busby and Barnhart 1995). This fluctuation in age at smoltification is more characteristic of an

ocean-type life history. Furthermore, the low flows, high temperatures, and barrier bars that develop in smaller coastal rivers (such as Redwood Creek) during the summer months would favor an ocean-type (sub yearling smolt) life history (Kostow 1995).

Ocean-type juveniles enter saltwater during one of three distinct phases. Immediate fry migrate to the ocean soon after yolk resorption at 1.2-1.8 in (3.0-4.6 cm) in length (Lister *et al.* 1971, Healey 1991). In most river systems, however, fry migrants, that migrate at 50-150 days post-hatching, and fingerling migrants, that migrate in the late summer or autumn of their first year, represent the majority of ocean-type emigrants. In upper Redwood Creek the months of May and June accounted for 91.5% of the total captures of migrating young-of-the-year Chinook in 2001 (Sparkman 2002). Stream-type Chinook migrate during their second or, more rarely, their third spring (Healey 1991). Under natural conditions, stream-type Chinook appear to be unable to smolt as sub-yearlings (Healey 1991).

Winter-run Chinook constitute the main Chinook run in RNSP streams. Adult fish return to spawn after 3 to 6 or more years in the ocean, although 2 year old male spawners (“jacks”) are commonly observed (Myers *et al.* 1998). These fish begin their upstream migration into the park around November, if access through the Redwood Creek estuary is possible. Entry into Redwood Creek is dependent on the mouth being open to the ocean. The sand bar that blocks the mouth usually breaks open as a result of winter rain events increasing stream flow that fills the estuary and breaches the sand bar. Chinook have spawned and died by the end of January. Spring-run Chinook are not typically considered to use the Redwood Creek watershed. Adult spring-run Chinook have been observed in mainstem Redwood Creek once (6 in the summer of 1988) in the 31 years since 1981 when the park began summer steelhead (*O. mykiss*) snorkel surveys (RNSP unpub.data).

In upper Redwood Creek, almost all of the juvenile Chinook migrants are 0+ fry or fingerlings; only 0.01% (92 fish) of the juveniles captured in 10 years of downstream migration study consisted of 1+ juveniles (Sparkman 2010). The estimated population of 0+ juveniles has varied over 10 years of trapping (Sparkman 2010); production was greater than 350,000 individuals in the first 3 years, less than 1,000 in the fourth year (cohort failure) and in the fifth year there was a peak of 630,000 juvenile fish. The 9-year average (2000-2008) for the study was 244,894. A 10-year trend in population abundance over time (2000-2009) showed a significant negative decline (Sparkman 2010). This decline could have been the result of flood flows; studies cited in Sparkman (2010) indicated that scour of redds by high stream flows or floods can cause severe decreases in the production of juvenile salmonids. One study indicated a mortality estimate of 90% due to redd scour. Greene et al. (2005; cited in Sparkman 2010) showed that flood recurrence interval during Chinook intergravel development was the second most important variable in their models used to predict the return rate of adult Chinook. Three of 10 years of study in upper Redwood Creek documented flows capable of scouring spawning redds, which was deemed a likely explanation for the poor production of cohorts in each of the following spring seasons. High, potentially damaging stream flows in upper Redwood Creek are not uncommon, estimated to occur on average every 3.1 years (Redwood National Park unpub. data).

Salmonid surveys in Redwood Creek and its tributaries (e.g., Prairie Creek) show juvenile Chinook do not spend time rearing in upstream areas (Anderson and Brown 1982), but instead,

utilize the Redwood Creek estuary. In spring, Chinook fry migrate downstream to rear in the estuary before and after the mouth closes. After the mouth closes, Chinook entry into the ocean is in the fall when the mouth opens. Thus, the Redwood Creek estuary is important as the sole rearing habitat for these 'ocean-type' juveniles. Research shows that if given the opportunity the juveniles will spend an extended period (to late summer) in the estuary before entering the ocean. Based on scales of returning adult Chinook spawners it was determined that there may be a survival advantage favorable to the fish that remain in the estuary and grow to a larger size before entering the ocean (Reimers 1973). Redwood Creek estuary Chinook juvenile population estimates for 1997 through 2007 show a seasonal decline in numbers. The September mean estimate was 2,260 Chinook, the minimum and maximum numbers 50 and 6,660, respectively (RNSP unpub. data). The limited carrying capacity of the estuary cannot accommodate the Chinook juvenile production occurring in the watershed. However, this extended estuary rearing affords size increases to 100 mm forklength of those fish surviving in the Redwood Creek estuary in the fall.

In Prairie Creek, the escapement of adult Chinook ranged from a high of 710 in 2002 to a low of 38 in 2008 for 1999 through 2011. Escapement of Chinook has been relatively low in this tributary since 2005. Juvenile fish abundance in the downstream migrant trap varied considerably among years. Chinook fry were very abundant during 1999-2004 but decreased after that (Duffy 2011).

The low numbers of returning adult Chinook are probably related in part to the conditions in the Redwood Creek estuary (D. Anderson pers. comm.). Chinook spawning in the RNSP tributaries may be impeded by stream barriers, but they may be able to surmount some barriers depending on flow conditions when the fish are present.

B. Habitat Status

Chinook estuary rearing habitat was degraded when flood control levees that bisected and altered the historical configuration of the Redwood Creek estuary were constructed in 1968. The levees altered the physical and biological functions of the estuary and adjacent wetlands and confined the lower 3.4 mi (5.5 km) of Redwood Creek stream channel to a width of 300 ft (91 m). The flood control project reduced the amount of riparian vegetation and tree cover, reduced adjacent wetlands, altered valley drainage patterns, decreased the amount of instream woody debris, and caused decreased pool depths along lower Redwood Creek. The levees bypassed and isolated the last downstream meander of Redwood Creek (now called the South Slough), reduced circulation into the North and South Sloughs, and contributed to 50% of the lower estuary between 0 and 4 ft Mean Sea Level filling with sediment or becoming isolated from the embayment (Ricks 1983). Adjacent land uses, e.g., cattle grazing on the flood plain and uncontrolled breaching of the sand berm (which forms a seasonal barrier to the ocean across the mouth), also have contributed to habitat degradation of the estuary.

The Redwood Creek watershed is listed as impaired for high water temperatures and sediment under Section 303(d) of the Clean Water Act. An example of Chinook rearing temperatures, July/August 2009 data from a temperature logger (Tidbit) located at the ends of the levees in the embayment of the Redwood Creek estuary, show the average temperature as 15.1° C (59.2° F) and minimum and maximum temperatures as 21.3° C (70.3° F) and 11.5° C (52.7° F),

respectively. Maximum weekly average temperature (MWAT) was 20.2° C (68.4° F). Hours of temperature of 18° C (64.4° F) and above were 227 hrs. Some periods in the estuary are above the optimum rearing temperatures for Chinook.

C. Critical Habitat

Critical habitat for California Coastal Chinook salmon was designated in 2005 (Fed. Reg 2005a). Designated critical habitat for California Coastal Chinook salmon includes the stream channels within the stream reaches and includes a lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent is defined by the bankfull elevation. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge which generally has a recurrence level of 1 to 2 years on the annual flood series. Critical habitat in estuaries is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater.

In designating critical habitat, NMFS focuses on the known primary constituent elements (PCEs) essential for the conservation of the species. These PCEs are those sites and habitat components that support one or more life stages, including: (1) freshwater spawning, (2) freshwater rearing, (3) freshwater migration, (4) estuarine areas, (5) nearshore marine areas, and (6) offshore marine areas. Within the PCEs, essential elements of CC Chinook salmon critical habitat include adequate (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, (10) safe passage conditions, and (11) salinity conditions.

Critical habitat is of variable quantity and quality depending on the condition of a watershed/sub watershed within RNSP. The condition of a watershed relative to critical habitat is primarily a function of past land use practices. That is, the level of logging and number of old or abandoned logging roads within a watershed or subwatershed influence the habitat in terms of fine sediment quantity, amount of instream LWD, amount of streamside shading, pool number and depth, and water temperature.

VI. IMPACTS TO THREATENED AND ENDANGERED SPECIES

Chinook Salmon, Coho Salmon, and Steelhead

Most of the SODMP activities described would not impact the three species of listed salmonids. The majority of SOD treatment areas will likely be in upland locations away from streams. Short distance “natural” spread, the most common infection spread type, is generally less than 250m (approximately 275 yds). Longer distance “natural spread” of hundreds or a few thousand meters (yards) tends to be upslope from infected areas because of uphill aerial transportation of *P. ramorum* spores by spring rainstorm winds. Long distance spread over many kilometers or miles is always due to the physical movement of infected plant hosts by humans. However, there will most likely be a limited number of SOD infected areas which will be within riparian areas (Meentemeyer et al. 2011, Swiecki and Bernhardt 2002). Given these spread patterns, the most likely first watersheds to be affected will be the Coyote Creek, Copper Creek and Devil’s

Creek watersheds (Appendix I, Maps). Special analytical emphasis will be given to these watersheds in the following discussion.

Upland Area Effects

In upland areas, tanoaks and California bay laurel trees, and rhododendron shrubs will be cut by hand crews. No heavy equipment will be used unless the infected area is within an existing, previously consulted upon, currently active, mechanical forest treatment project area (i.e. forest restoration, fire management). All felled trees and shrubs will be bucked and left on site. No soil disturbance will occur. In upland areas, the use of directly injected or target sprayed chemical herbicides directly onto cut stumps will not cause adverse impacts to listed fish. In upland areas, the proposed glyphosate type herbicide for upland treatment areas, Roundup, will be directly absorbed into the plants tissue and thus will not be available to be transported to any streams.

Riparian Area Effects

In riparian areas, the felling of tanoaks, bay laurel trees and rhododendron shrubs will not mobilize any measurable amount of sediment into creeks and wet areas. The trees and shrubs will be cut and bucked only by hand crews and left on site, causing no soil disturbance. The cut trees and shrubs will provide ground cover for any soil exposed to rain splash due to the removal of the canopy. The rapid growth of the surrounding and remaining non target trees, shrubs and herbaceous vegetation will fill in the removed canopy and provide stream bank stability when cut tree root wads and slash eventually rot.

The use of chemical herbicides has the potential to impact riparian habitats should a chemical make its way into ground water in a riparian area. This will be prevented by applying the herbicide glyphosate either via directly injected into cut stumps or target sprayed/painted directly onto cut stumps. These methods will allow the chemical to be directly absorbed into the plants' tissues, thereby preventing the herbicide from coming in contact with the soil. As an added precaution, however, the chemical used in riparian habitats will be restricted to Aquamaster (glyphosate formulation for riparian use) in order to further minimize the potential for adverse impacts. Glyphosate in this formulation is a plant-specific compound that targets enzymes found only in plants, not animals. Glyphosate in this formulation lacks surfactants and has been approved for use by the EPA in aquatic environments, and has been determined by an EPA assessment to not likely to adversely affect salmon and steelhead when used according to the manufacturer's instructions. With chemical use there is always the slight possibility of the substance entering the environment should a spill occur. Spill plans and best management practices for managing chemical products should minimize the probability of runoff of hazardous materials in the unlikely event of a spill associated with SOD treatment activities (see Appendix II). A spill, in the unlikely event of an occurrence, would be low in volume, readily contained, and would be unlikely to have an adverse impact on Chinook and/or coho salmon and/or steelhead.

Felling riparian canopy trees along the main stems of Redwood Creek, Mill Creek and the Smith River will not impact stream shading function and food input into streams will be insignificant. The main stems of Redwood Creek, Mill Creek and the Smith River within RNSP are fully shaded by riparian forest canopies dominated by large conifers or non-target hardwoods (RNSP unpub. data) that will continue to provide shading and food input. Tanoaks and California bay laurels do not reach into the upper canopy along the main stems of these streams in significant amounts (i.e. only a few individual, isolated tanoaks or bay laurels reach the upper canopy and thus do not constitute the majority component of the canopy). The removal of subcanopy tanoaks and bay laurels and isolated individual canopy level tanoaks and laurels along the main stems will not alter stream temperatures and will result in minimal food input loss.

Felling riparian canopy trees located along tributaries to the main stems of Redwood Creek, Mill Creek and the Smith River will minimally increase stream temperatures from a loss of riparian cover along perennial streams that would be flowing during the summertime. Most riparian SOD treatment areas will leave more than 75% of the canopy intact due to the generally spotty distribution of host tree species (RNSP unpub. data), effectively leaving all shading functions intact. However, in those few areas where tanoak and bay laurel make up a significant proportion of the riparian canopy along perennial reaches of tributary streams (primarily in Copper Creek and Rock Creek drainages) (RNSP unpub. data) (Appendix I, Maps), increased stream temperatures will be insignificant because of the restrictive spatial limitations placed on streamside SOD treatments described in the proposed program (Table 2). In almost all cases, treatment areas with portions of the riparian canopy to be removed will be along streams with relatively high gradients, which results in generally cooler water temperatures and more resiliency to increased temperatures due to solar radiation (Lewis et al. 2000). Also, almost all tributaries to the main stems of Redwood Creek, Mill Creek and the Smith River within RNSP are within what is considered the coastal fog zone or zone of coastal influence, where ambient air temperatures and direct solar radiation stay significantly lower than inland areas. Stream temperature reviews of northern California streams within the fog zone, or zone of coastal influence, have demonstrated lower increases in temperature when partially day lit after riparian forest thinning (or even total removal) (Lewis et al. 2000, CBOF-TAC 2007). Exceptions to this rule include Rock Creek (a tributary to the Smith) and Coyote Creek (a tributary to Redwood Creek) that are located more inland and have a higher oak component and less conifer cover. The conservation measures described Table 2, however, will prevent stream temperature rise in those creeks. Linear riparian canopy opening limitations described in Table 2 are reasonable for minimizing stream temperature increases as shown in a local experimental riparian clearcut treatment done along multiple streams in the Smith River and Klamath River basins at or farther inland (i.e. exposed to as much or more solar radiation and higher ambient air temperatures) than any comparable streams within RNSP (Wilzbach et al. 2005). In that study, riparian forests were completely clearcut (a much more severe riparian removal than expected along any reach within a SOD treatment area) along multiple 300 foot long riparian stretches. In none of the treatments did stream temperature raise more 1 degree Celsius. Therefore, the minimal riparian tree removal within SOD treatment areas along smaller, low volume tributary streams to Redwood Creek, Mill Creek and the Smith River is not expected to cause adverse increases in stream temperature over the short and medium term either within the tributaries themselves or in the main stems of Redwood Creek, Mill Creek and the Smith River.

In addition, felled riparian trees will result in a minimal reduction in food inputs into salmonid occupied streams. The loss of food input will be minimal because, as stated previously, only scattered individual trees along the mainstems of Redwood Creek, Mill Creek or the Smith River or very limited stream lengths of tanoaks and bay laurels (Table 2) will be removed on any given tributary to Redwood Creek, Mill Creek or the Smith River. The many miles of remaining untreated areas and remaining untreated conifers and non-host hardwoods within treated riparian areas will continue to provide ample food inputs.

Critical Habitat

The SOD management activities described in this document would minimally impact critical habitat for the three species of listed salmonids for the reasons described above.

Essential Fish Habitat

Essential fish habitat would not be impacted, or would be impacted only minimally by the activities described in this document, for the same reasons provided above relative to impacts on Chinook and coho salmon and/or steelhead and their critical habitats.

Cumulative Effects

Cumulative effects are defined as all those state, tribal, local, and private actions that are reasonably certain to occur in the future that have the potential to impact listed species in the park. SOD management activities are likely to occur on adjacent private timber lands including, but not limited to, chemical herbicide use, may cause additional impacts to the species considered in this document, as well as salmonid critical habitat, especially if such activities occur in the vicinity of tributaries to Redwood Creek.

VII. DETERMINATION

Based on the nature and timing of the proposed program, it is the National Park Service's and California Department of Parks and Recreation's determination that the Sudden Oak Death Management Program in RNSP:

may affect, but is not likely to adversely affect Chinook salmon, coho salmon, or steelhead, nor is it likely to result in destruction or adverse modification of designated critical habitat for these species;

VIII. MANAGEMENT (CONSERVATION) RECOMMENDATIONS

There are no management recommendations.

VIX. CONTRIBUTORS

Prepared by: Keith Bensen, Fish and Wildlife Biologist, Redwood National Park

LITERATURE CITED

- Anderson, D.G. 1988. Juvenile salmon habitat of the Redwood Creek basin in Humboldt County, California. M.S. Thesis. Humboldt State University, Arcata, CA. 99 pp.
- Anderson, D.G. 1995. Biological supplement to Redwood National and State Parks US Army Corps of Engineers application: coho salmon utilization of Redwood Creek estuary. Unpub. Rep. on file at Redwood National and State Parks, Orick, CA. 13 pp.
- Anderson, D.G. 2005. 2005 Redwood Creek summer steelhead survey. Unpub. Rept on file at South Operations Center, Orick, CA. 19 pp.
- Anderson, D.G. 2009. Strawberry Creek Fish and Water Quality Sampling, Humboldt County, California: August 2006 to February 2009. Redwood National and State Parks, Orick, California. 14pp.
- Barnhart, R.A. 1986. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest)--steelhead. U.S. Fish and Wildl. Serv. Biol. Rep. 82(11.60). 21 pp.
- Behnke, R J. 1992. Native trout of western North America. American Fisheries Soc. Monog. 6. Am. Fish. Soc., Bethesda, MD. 275 pp.
- Bell, E. 2001. Survival, growth and movement of juvenile coho salmon (*Oncorhynchus kisutch*) over-wintering in alcoves, backwaters, and main channel pools in Prairie Creek, California. M.S. thesis, Humboldt State University, Arcata, Calif.
- Bell, M.C. 1991. Fisheries handbook of engineering requirements and biological criteria. Third edition. U.S. Army Corps of Engineers, Office of the Chief of Engineers, Fish Passage Development and Evaluation Program, North Pacific Division, Portland, OR.
- Bisson, P.A., K. Sullivan, and J.L. Nielsen. 1988. Channel hydraulics, habitat use, and body form of juvenile coho salmon, steelhead and cutthroat trout in streams. Trans. Am. Fish. Soc. 117:262-273.
- Bjornn, T. C. and D. W. Reiser. 1991. Habitat requirements of salmonids in streams. In W. R. Meehan (ed.), Influences of forest and rangeland management on salmonid fishes and their habitats, pp. 83-138. Am. Fish. Soc. Spec. Pub. 19. Bethesda, MD. 751 pp.
- Brown, R.A. 1988. Physical rearing habitat for anadromous salmonids in the Redwood Creek basin, Humboldt County, California. M.S. Humboldt State University, Arcata, CA. 132 pp.
- Brown, L.R. and P.B. Moyle. 1991. Status of coho salmon in California. Report to the National Marine Fisheries Service. Dept. of Wildlife and Fisheries Biology, Univ. of Calif. Davis. 89 pp.

- Burgner, R.L., J.T. Light, L.Margolis, T.Okazaki, A.Tautz, and S.Ito. 1992. Distribution and origins of steelhead trout (*Oncorhynchus mykiss*) in offshore waters of the North Pacific Ocean. Int. North Pac. Fish Comm. Bull. 51. 92 pp.
- Busby and Barnhart. 1995. Potential food sources and feeding ecology of juvenile fall chinook salmon in California's Mattole River lagoon. Calif. Fish and Game 81(4):133-146.
- Busby, P.J., T.C. Wainwright, G.J. Bryant, L.J. Lierheimer, R.S. Waples, F.W. Waknitz, and I. V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-NWFSC-27. 261 pp.
- [CDFG] California Department of Fish and Game. 1994. Petition to the California Board of Forestry to list coho salmon (*Oncorhynchus kisutch*) as a sensitive species. Calif. Dep. Fish Game Rep. 35 pp plus appendices. (Available from Board of Forestry, 1416 Ninth, Sacramento, CA 95814).
- [CDFG] California Department of Fish and Game. 1998. A report to the Fish and Game Commission: A status review of the spring-run Chinook salmon (*Oncorhynchus tshawytscha*) in the Sacramento River drainage. Candidate Species Status Report 98-01. June.
- Chapman, D.W., and T.C. Bjornn. 1969. Distribution of salmonids in streams, with special reference to food and feeding. Pages 153-176. in: T.G. Northcote, editor. Symposium on Salmon and Trout in Streams. H.R. Macmillan Lectures in Fisheries. Institute of Fisheries, University of British Columbia, Vancouver, British Columbia.
- Cramer, F.K. and D.F. Hammack. 1952. Salmon research at Deer Creek, California. U.S. Fish and Wildlife Service, Spec. Sci. Report 67. 16 pages.
- Duffy, W.G. 2011. Prairie Creek life cycle monitoring project. Final Proj. Rept. to Calif. Dept. of Fish and Game Fisheries Restoration Grants Program. HSU Sponsored Programs Foundation Agmt No. P0810315. 12 pp.
- Everest, F. H. 1973. Ecology and management of summer steelhead in the Rogue River. Oregon State Game Comm. Fish. Res. Rep. No. 7. Corvallis, OR. 48 pp.
- Federal Register. 1997. Department of Interior, USFWS, 50 CFR Part 17. Endangered and threatened wildlife and plants; threatened status for southern Oregon/ northern California coast evolutionarily significant unit of coho salmon. Final Rule Vol. 62 (17): 33038-33029.
- Federal Register, 1999a. Department of Commerce. Designated critical habitat; central California coast and southern Oregon/northern California coast coho salmon; final rule and correction. Vol. 64 (86): 24049-24062.
- Federal Register. 1999b. Department of Commerce. Endangered and threatened species; threatened status for two chinook salmon evolutionarily significant units (ESUs) in California. Final Rule, Vol. 64 (179): 50394-50415.

- Federal Register. 2005a. Department of Commerce, NOAA, 50 CFR Parts 223 and 224. Endangered and threatened species: final listing determinations for 16 evolutionarily significant units of West Coast salmon and final 4(d) protective regulations for threatened salmonid evolutionarily significant units. Final Rule, Vol. 70 (123): 37159-37204.
- Federal Register. 2005b. Department of Commerce, NOAA, 50 CFR Parts 223 and 224. Endangered and threatened species: designation of critical habitat for seven evolutionarily significant units of Pacific salmon and steelhead in California. Final Rule, Vol. 70 (170): 52488-52536.
- Federal Register. 2005c. Department of Commerce, NOAA, 50 CFR Part 226. Endangered and threatened species; designation of critical habitat for seven evolutionarily significant units of Pacific salmon and steelhead in California. Final Rule, Vol. 70 (170): 52488-52626.
- Federal Register. 2006. Department of Commerce, NOAA, 50 CFR Parts 223 and 224. Endangered and threatened species: final listing determinations for 10 distinct population segments of west coast steelhead. Final Rule Vol. 71 (3): 833-862.
- Federal Register. 2009. Department of Commerce, NOAA 50 CFR Parts 223 and 224. Endangered and threatened wildlife and plants: proposed threatened status for Southern Distinct Population Segment of Eulachon. Proposed Rule Vol. 74 (48): 10857- 10876.
- Federal Register. 2010. Department of Commerce, NOAA 50 CFR Parts 223 and 224. Endangered and threatened wildlife and plants: threatened status for Southern Distinct Population Segment of Eulachon. Final Rule Vol. 75 (52): 13012-13024.
- Fisher, J. P., W. G. Percy, and A. W. Chung. 1984. Studies of juvenile salmonids off the Oregon and Washington coast, 1983. *Oreg. State Univ. Coll. Oceanogr. Cruise Rep.* 84-2; *Oreg. State Univ. Sea Grant Coll. Program.* ORESU-T-85-004:29 pp.
- Folmar, L.C. and W.W. Dickhoff. 1980. The parr-Smolt transformation (smolitification) and seawater adaptation in salmonids: a review of selected literature. *Aquaculture* Vol 1, Issue 1, pp. 1-37.
- Frissell, C.A. 1993. Topology of extinction and decline of native fishes in the Pacific Northwest and California. *Conserv. Biol.* 7:342-354.
- Giger, R. D. 1973. Streamflow requirements of salmonids. Oregon Wildl. Commission. Job Final Report, Project AFS-62-1. Portland, OR.
- Hart, J.L. and J.L. McHugh. 1944. The smelts (Osemeridae) of British Columbia. *Fisheries Research Board of Canada* 64. 27 p.
- Hartt, A.C. and M.B. Dell. 1986. Early oceanic migrations and growth of juvenile Pacific salmon and steelhead trout. *International North Pacific Fisheries Commission Bulletin* 46:1-105. In Nickelson *et al.* (1992).
- Hartzler, B. 2006. Aminopyralid- new herbicide for pastures, roadsides, etc. http://www.weds.iastate.edu/mgmt/2006_aminopyralid.shtml Dept. of Agronomy, Iowa State University.
- Hassler, T. J. 1987. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest)--coho salmon. U.S. Fish and Wildl. Serv. Biol. Rep. 82(11.70). 19 pp.

- Hay, D. E. and McCarter, P. B. 2000. Status of the eulachon *Thaleichthys pacificus* in Canada. Department of Fisheries and Oceans Canada, Canadian Stock Assessment Secretariat, Research Document 2000-145. Ottawa. 92 pp.
- Healey, M. C. 1991. The life history of Chinook salmon (*Oncorhynchus tshawytscha*). Pages 213-393 In: C. Groot and L. Margolis (eds.), Life history of Pacific salmon. Univ. B.C. Press, Vancouver, B.C.
- Heifetz, J., M. L. Murphy, and K.V. Koski. 1986. Effects of logging on winter habitat of juvenile salmonids in Alaska streams. N. Am. J. Fish. Manage. 6:52-58.
- Hoar, W. S. 1976. Smolt transformation: Evolution, behavior and physiology. J. Fish. Res. Bd. Can. 33:1233-1252.
- Hunter, J. W. 1973. A discussion of game fish in the State of Washington as related to water requirements. Report by the Washington State Department of Game, Fishery Management Division, to the Washington State Department of Ecology, Olympia. In Bjornn and Reiser (1991).
- Kalleberg, H. 1958. Observations in a stream tak of territoriality and competition in juvenile salmon and trout (*Salmo salar* L. and *S. trutta* L.). Institute of Freshwater Research, Drottningholm, Sweden. Report No. 39:55-98.
- Konkel, G.W. and J. D. McIntyre. 1987. Trends in spawning populations of Pacific anadromous salmonids. USDI Fish and Wildlife Service Wildl. Tech. Rep. 9, Washington DC. 25 pp.
- Kostow K (1995) Biennial Report on the status of wild fish in Oregon. ODFW, Clackamas OR, 213 pp.
- Larson, Z. S. and M. R. Belchik. 1998. A preliminary status review of eulachon and Pacific lamprey in the Klamath River Basin. Yurok Tribal Fisheries Program. Klamath CA. 24 pp.
- Leidy, R. A. and G. R. Leidy. 1984. Life stage periodicities of anadromous salmonids in the Klamath River Basin, Northwest California. U.S. Fish and Wildlife Service, Division of Ecological Services, Sacramento, CA. 21 pp.
- Lewis, A. F. J., M. D. McGurk, and M.G. Galesloot. 2002. Alcan's Kemano River eulachon (*Thaleichthys pacificus*) monitoring program 1988-1998. Consultant's report prepared by Ecofish Research Ltd. for Alcan Primary Metal Ltd., Kitimat, B.C.
- Lister, D. B., C.E. Walker, and M.A. Giles. 1971. Cowichan River Chinook escapements and juvenile production 1965-1967. Can. Fish. Serv. 1971-3, 8 p. In Myers *et al.* (1998).
- Madej, M. A., C. Currens, V. Ozaki, J. Yee, and D.G. Anderson. 2006. Assessing possible thermal rearing restrictions for juvenile coho salmon (*Oncorhynchus kisutch*) through thermal infrared imaging and in-stream monitoring, Redwood Creek, California. Can. J. Fish. Aquat. Sci. 63: 1384-1396.

- Meehan, W. R. and T. C. Bjornn. 1991. Salmonid distributions and life histories. *In* W.R. Meehan (ed.), Influences of forest and rangeland management on salmonid fishes and their habitats, pp. 47-82. Am. Fish. Soc. Spec. Pub. 19. Bethesda, MD. 751 pp.
- Meentemeyer, R. K., N. J. Cunniffe, A. R. Cook, J. A. N. Filipe, R. D. Hunter, D. M. Rizzo, and C. A. Gilligan. 2011. Epidemiological modeling of invasion in heterogeneous landscapes: spread of sudden oak death in California (1990–2030). *Ecosphere* 2(2):art17. doi:10.1890/ES10-00192.1
- Miller, R. J. and E. L. Brannon. 1982. The origin and development of life-history patterns in Pacific Salmon. Pages 296-309 *In* E.L. Brannon and E.O. Salo (eds.). Proceedings of the Salmon and Trout Migratory Behavior Symposium. Univ. Wash. Press, Seattle, WA.
- Moyle, P. B., R. Yoshiyama, J. E. Williams, and E. D. Wikramanayake. 1995. Fish Species of Special Concern in California. Second Edition. UC Davis. Prepared for Department of Fish and Game, Inland Fisheries Division. Final Report for Contract No. 2128IF. 272pp.
- Mundie, J. H. 1969. Ecological implications of the diet of juvenile coho in streams. *In* T.G. Northcote (ed.), Symposium on salmon and trout in streams, pp. 135-152. H.R. MacMillan Lectures in Fisheries, Univ. British Columbia, Institute of Fisheries, Vancouver, B.C. 388 pp.
- Myers, J. M, R. G. Kope, G. J. Bryant, D. Teel, L. J. Lierheimer, T. C. Wainwright, W. S. Grant, F. W. Waknitz, K. Neely, S. T. Lindley, and R. S. Waples. 1998. Status review of Chinook salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Of Commer., NOAA Tech. Memo. NMFS-NWFSC-35. 443 pp.
- [NPS] National Park Service. 2006. Management Policies – The Guide to Managing the National Park System. National Park Service, U.S. Department of the Interior. 288 pp.
- National Marine Fisheries Service. 2010. Endangered Species Act section 7 consultation. Biological opinion. Issuance of a protected species conservation and recovery grant to the Yurok Tribe (Award File NAWNMF4720374) to conduct research on eulachon smelt in northern California. 17 pp.
- Nickelson, T. E., J. W. Nicholas, A. M. McGie, R. B. Lindsay, D. L. Bottom, R. J. Kaiser, and S. E. Jacobs. 1992. Status of anadromous salmonids in Oregon coastal basins. Unpublished manuscript. Oregon Dept. Fish Wildl., Research and Development Section, Corvallis, and Ocean Salmon Management, Newport, OR. 83 pp.
- Odemar, M. 1964. Southern range extension of the eulachon, *Thaleichthys pacificus*. Marine Resources Operations, California Department of Fish & Game.
- Ozaki, V., and D. Anderson. 2005. Evaluation of stream temperature regimes for juvenile coho salmon in Redwood Creek using thermal infrared. National Park Service, Water Resources Division, Ft. Collins. Co., Tech. Rep. NPS/NRWRD/NRTR-2005/331.

- Patterson, M. 2004. Glyphosate analysis of risks to endangered and threatened salmon and steelhead. Environmental Field Branch, Office of Pesticide Programs. U.S. Environmental Protection Agency. 117 pp.
- [RNSP] Redwood National and State Parks. 2009. Strawberry Creek fish and water quality sampling, Humboldt County, California, August 2006 to February 2009. 14 pp.
- [RNSP] Redwood National and State Parks. 2011. Threatened, endangered, proposed, and candidate species in Redwood National and State Parks, biological assessment reference document. 93 pp.
- Reeves, G. H., F. H. Everest, and J. D. Hall. 1987. Interactions between the redbside shiner (*Richardsonius balteatus*) and the steelhead trout (*Salmo gairdneri*) in western Oregon: the influence of water temperature. *Can. J. Fish. Aquat. Sci.* 44:1603-1613.
- Reeves, G. H., F. H. Everest, and T. E. Nickelson. 1989. Identification of physical habitats limiting the production of coho salmon in Western Oregon and Washington, United States Forest Service. USFS General Technical Report PNW-GTR-245.
- Rich, A. A. 1997. Testimony of Alice A. Rich, Ph.D., regarding water rights applications for the Delta Wetlands Project, proposed by Delta Wetlands Properties for Water Storage on Webb Tract, Bacon Island, Bouldin Island, and Holland Tract in Contra Costa and San Joaquin Counties. July. Calif. Dept. of Fish and Game Exhibit DFG-7. Submitted to State Water Resources Control Board.
- Ricks, C. 1983. Flood history and sedimentation at the mouth of Redwood Creek, Humboldt County, California. MS Thesis. Oregon State University, Corvallis, Oregon. 166 pp.
- Reimers, P. E. 1973. The length of residency of juvenile fall Chinook salmon in Sixes River, Oregon. *Res. Rep. of Fish Comm. of Oregon* 4(2).
- Reiser, D. W. and T. C. Bjornn. 1979. Influence of forest and rangeland management on anadromous fish habitat in western North America. *Gen. Tech. Rept. PNW-GTR-096*. U.S. Dept. of Agriculture, Forest Service, Pacific Northwest Research Station: 1-54.
- Roelofs, T. D. 1983. Current status of California summer steelhead (*Salmo gairdneri*) stocks and habitat, and recommendations for their management. Report to USDA Forest Service Region 5. 77 pp.
- Sandercock, F. K. 1991. Life history of coho salmon. In C. Groot and L. Margolis (eds.), *Pacific salmon life histories*, pp. 397-445. Univ. British Columbia Press, Vancouver, B.C. 564 pp.
- Saunders, R.L. 1965. Adjustment of buoyancy in young Atlantic salmon and brook trout by changes in swim bladder volume. *J. Fish. Res. Bd. Can.* 22:335-352.
- Scrivener, J. C. and B. C. Andersen. 1982. Logging impacts and some mechanisms which determine the size of spring and summer populations of coho salmon fry in Carnation Creek. In: *Proceedings of the Carnation Creek Workshop: a ten year review*. G.F. Hartman, ed. Pacific Biological Station, Nanaimo, BC, Canada.
- Seymour, A. H. 1956. Effects of temperature on young Chinook salmon. Ph.D. thesis. University of Washington, Seattle, WA.

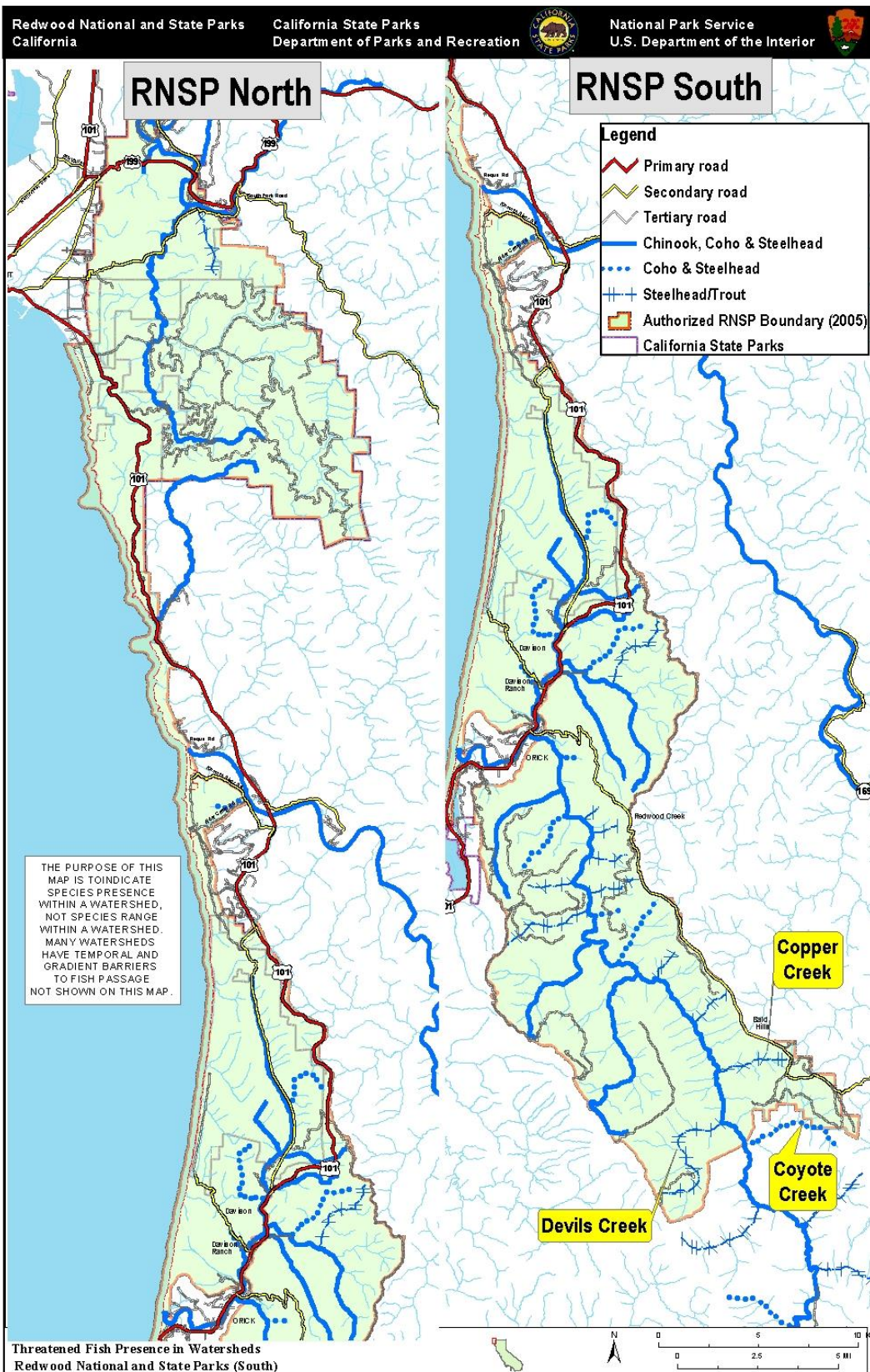
- Smith, A. K. 1973. Development and application of spawning velocity and depth criteria for Oregon salmonids. *Trans. Am. Fish. Soc.* 102:312-316.
- Smith, L. S. 1982. Decreasing swimming performance as a necessary component of the smolt migration in salmon in the Columbia River. *Aquaculture* 28:153-161.
- Sparkman, M. D. 2002. Juvenile Steelhead Downstream Migration Study in the Mad River, Humboldt County, California – Spring 2001. Project 2a3. 2000-2001 Annual Report. California Department of Fish and Game. Steelhead Research and Monitoring Program. 52 pp.
- Sparkman, M. D. 2003. Upper Redwood Creek juvenile salmonid downstream migration study, 2000-2002. California Department of Fish and Game. Steelhead Research and Monitoring Program. Annual Report 2a5. 62 pp.
- Sparkman, M. D. 2010. Upper Redwood Creek juvenile salmonid (smolt) downstream migration study, study year 2009. CDFG AFRAMP, 2009 Annual Report 2a5: 125 pp.
- Sparkman, M. D. 2011. Lower Redwood Creek juvenile salmonid (smolt) abundance project, study year 2010: a report to the Fisheries Restoration Grants Program (Project No. P0810509). CDFG AFRAMP, study 2a7: 79 pp.
- Sweetnam D. A., R. D. Baxter, and P. B. Moyle. 2001. True smelts. In: Leet WS, Dewees CM, Klingbeil R, Larson EJ (eds) *California's living marine resources: a status report*. Dept of Fish and Game, University of California Press, Oakland, pp 477–478.
- Swiecki, T. and E. Bernhardt. 2002. Evaluation of stem water potential and other tree and stand variables as risk factors for *Phytophthora ramorum* canker development in coast live oak, Proceedings of the Fifth Symposium on Oak Woodlands: Oaks in California's Changing Landscape, 23-25 October 2001, San Diego, California. USDA – Forest Service, General Technical Report PSW – GTR – 184, Pacific Southwest Forest and Range Experiment Station, Berkeley, California. 787 – 798 pp.
- Trihey and Associates. 1996. Instream flow requirements for tribal trust species in the Klamath River. Report prepared for the Yurok Tribe. 43 pp.
- Tu, M., C. Hurd, R. Robison, and J. M. Randall. 2001. Triclopyr. In *Weeds control methods handbook: tools and techniques for use in natural areas*. (M. Tu, C. Hurd, and J.M. Randall, eds.), Wildland Invasive Species Team, The Nature Conservancy, Davis, CA
- [USFS - USDA] United States Forest Service – Department of Agriculture. 2006. Decision Memo – Section 13 *Phytophthora ramorum* Treatment, Chetco Ranger District, Rogue River-Siskiyou National Forest. 28 pp.
- [USDI] U.S. Department of the Interior. 1991. Natural resources management guideline (NPS-77). National Park Service. Washington DC
- [USDI/NPS] U.S. Department of the Interior and National Park Service. 1994. Exotic plant management plan and environmental assessment. 104 pp.
- Van Kirk, S. 1994. Historical information on Redwood Creek. Unpub. Rep. on file at Redwood National and State Parks, Arcata, CA.

- Velson, F. P. 1987. Temperature and incubation in Pacific salmon and rainbow trout, a compilation of data on median hatching time, mortality, and embryonic staging. Canadian Data Rept. of Fisheries and Aquatic Sciences. No. 626.
- Vincik, R. F. and R. G. Titus. 2007. Occurrence of a Eulachon, *Thaleichthys Pacificus*, in the Lower Sacramento River, California. Calif. Fish and Game Scientific Journal. Vol. 93, No. 3.
- Walters, C. J., R. Hilborn, R. M. Peterman, and M. J. Staley. 1978. Model for examining early ocean limitation of Pacific salmon production. Journal of the Fisheries Research Board of Canada 35:1303-1315.
- Weitkamp, L. A., T. C. Wainwright, G. J. Bryant, G. B. Milner, D. J. Teel, R. G. Kope, and R. S. Waples. 1995. Status review of coho salmon from Washington, Oregon, and California. U.S. Dep. Commer., NOAA Tech Memo. NMFS-NWFSC-24, Northwest Fisheries Science Center, Seattle, WA. 258 pp.
- Wilzbach, M.A., B.C. Harvey, J.L. White, R. J. Nakamoto. 2005. Effects of riparian canopy opening and salmon carcass addition on the abundance and growth of resident salamonids. Can. J. Fish Aquat. Sci. 62: 58-67.

PERSONAL COMMUNICATIONS

Anderson, David. Fishery Biologist. Redwood National and State Parks, Orick, CA

Appendix I – Maps



Appendix II – Spill Control Plans

HAZARDOUS SUBSTANCE CONTINGENCY PLAN- PETROLEUM

1. Precautions or preventative measures to be taken:

Lubricating Oils

All lubricating oils and hydraulic fluids will be stored in proper, approved containers. All containers will be securely capped or sealed when in storage, and protected from the rain. Because of the presence of residuals, all empty hydrocarbon containers, oily rags, etc. are to be disposed of in accordance with existing hazardous material regulations.

Fuel

All fuel containers will be located in stable, secure locations that are chosen to minimize the potential for a spill and the impact to resources should a spill occur. Valves, caps, hoses, etc. will be routinely inspected. Any identified problems (or potential problems) will be promptly fixed.

Streams and Waterways

No maintenance or fueling activities shall be permitted within 200 ft of a stream.

Fueling and Servicing

Absorbent materials will be placed on the ground beneath the equipment to catch any fuel or lubricants that may leak during fueling.

2. If a spill occurs:

A spill kit will be readily available (on hand) in the event of a spill, and appropriate materials provided in the kit will be used to contain and absorb the spill. These materials will continue to be used until such time as the hazardous material is completely removed or a HAZMAT specialist takes over the spill treatment. Spills in the sand will be quickly contained by shoveling contaminated sand into large buckets. Once the spill is treated, all material used during cleanup will be removed from the site and disposed of in accordance to proper handling guidelines for hazardous material.

In the event of equipment breakage which results in a spill, repairs will be carried out in such a way as to prevent further spillage. Containers and absorbent materials will be used to capture fluids during hose removal and replacement, filter replacement, routine maintenance, etc.

If equipment breaks proximal to or within a watercourse, the equipment is to be removed, if possible, from its proximity to the waterway before initiating repairs. If equipment cannot be removed, devices for total containment of potential spills associated with repairs will be in place to insure the protection of the watercourse. All captured material will be properly contained and disposed of.

Notification Requirements

The following authorities (as appropriate) shall be immediately notified of the release of hazardous substances into the environment. Notifications will normally be made by a Chief Ranger or project manager.

Redwood National & State Parks (707) 464-6101

Park Personnel Notification List (707)-

NPS Superintendent	465-7301
CSP Superintendent	465-7332
Chief Ranger	465-7302

Supervisory Ranger 465-7750
Chief of Maintenance 465-7303
Chief of Resources 465-7700
HAZMAT Coordinator 465-7375

County Agencies

Del Norte Sheriff, Crescent City, CA **911** or 707-464-4191
Humboldt Sheriff, Eureka, CA **911** or 707-445-7251
Del Norte County Health Dept. 707-464-7227
Humboldt County Health Dept. 707-445-6200

Fire Departments

Del Norte and Humboldt Fire Departments are dispatched by dialing **911**
Eureka FD (only public HAZMAT unit on North Coast) 707-441-4044

State Agencies:

California Highway Patrol (Arcata Dispatch) 707-822-5981
California Dept. of Fish and Game (M-F, 8-5) (Eureka) 707-445-6493
CDF&G OSPR Dispatch (Office of Spill Prevention and Response) 916-445-0045
CALTRANS (Crescent City) 707-464-1751
DPR Northern Communications Center (NORCOM) 916-988-9830
Regional Water Quality Control Board 707-576-2220
California Office of Emergency Service 800-852-7550

Federal Agencies:

1. National Response Center 800-424-8802
2. Pacific Great Basin Support Office Environmental Management Program Coord. (EMPC) 510-817-1376
3. Support Office Facilities Manager 510-817-1384
4. DOI- Office of Environmental Policy and Compliance 510-817-1476
5. Deputy Regional Director 510-817-1305
6. U.S. Coast Guard 707-464-2172 (day) 707-455-2055 (night)

Notification Information

To the extent possible, the following information should be obtained and provided to assisting agencies:

- 1) Date and time the incident occurred or was discovered.
- 2) Specific location of the spill.
- 3) Name (or placard number) of material spilled or released.
- 4) Source of the spilled material.
- 5) Cause of the release.
- 6) Total quantity released.
- 7) Whether the material was released to the air, ground, water or subsurface.
- 8) Amount spilled into water, if applicable.
- 9) Water conditions.
- 10) Weather conditions.
- 11) Name, address, and telephone number of reporting party.
- 12) Name of party and or individual responsible for the incident.
- 13) Mailing address of the responsible party.
- 14) Telephone number of the responsible party.
- 15) Identifying numbers of responsible vehicle, and vehicle information including the driver's name and address.
- 16) Name of carrier.
- 17) Number and type of injuries or fatalities, and expected exposure.
- 18) Whether evacuations have occurred or should occur.
- 19) Estimated dollar amount of property damage, and extent of damage.
- 20) Description of cleanup action taken and future plans.

21) Other agencies that have been notified or will be notified.

CONTAINMENT PROCEDURES FOR HERBICIDE USE

PRINCIPLE STEP	HAZARDS	CONTROL STEP
Best Management Practices for Handling Herbicides in Redwood National and State Parks.	Mixing Solutions and Filling Tanks, “Paint Buckets” and Injection Tools	- Assure that containers are securely situated on the ground and will not tip and spill during filling. - Use accurately measured amounts by using proper measuring devices. - Protect against spills and splashes by slowly mixing / filling all components.
	Leaky Tanks	- Ensure that the lid is tightly secured and that the o-ring is in place and not broken or cracked. - Test the lid by vigorously shaking the full sprayer prior to wearing backpack sprayer.
	Painting / Wicking Application	- Do not use food/drink containers for herbicide “paint bucket” – use a properly labeled container. - Take extra caution when walking around with an open “herbicide paint bucket.” - Do not leave open “herbicide paint buckets” unattended. - Use a properly labeled, closed, non-food/drink container for temporary storage of herbicide “painting” solutions.
	Clean Up and Storage	Store all herbicide chemicals in properly labeled and secured locations, within properly labeled and closed containers. Absolutely no unlabeled or open containers are to be stored, even temporarily.
	Herbicide Spill	- Keep herbicide spill kit at hand and know how to use it. - Keep others away from the spill, unless help is needed.

Appendix III – Tiering Form

Redwood National and State Parks Sudden Oak Death Management Program Project Tiering Form

Today's Date:

Project Name:

Project Location and Treatment Area(s) Size in Acres:

Proposed Implementation Date(s):

Preliminary Dates for Site Visit with RNSP Biologist:

Brief Description of Methods and Associated Activities:

Project Leader (name and phone extension):



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

AUG 23 2013

In response refer to:
2011/675

Mr. Stephen Prokop
Superintendent
Redwood National and State Parks
1111 Second Street
Crescent City, California 95531

Dear Mr. Prokop:

On November 15, 2012, NOAA's National Marine Fisheries Service (NMFS) received your November 8, 2012, letter requesting informal consultation pursuant to section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. § 1531 *et seq.*) and its implementing regulations (50 C.F.R. Part 402). Your request concerns the effects of the Sudden Oak Death Management Program (program) on threatened salmonid species and Pacific eulachon, and their habitats in Redwood National and State Parks (RNSP). We have also included consultation on the effects of the program on essential fish habitat (EFH) for species managed under the Pacific Coast Salmon Fishery Management Plan, pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSA), 16 U.S.C. § 1855 (b).

The purpose of the program is to control the spread of Sudden Oak Death syndrome (SOD) by removing infected trees and shrubs, and host trees and shrubs surrounding the infection site, to control the spread of this invasive forest disease. The RNSP proposes to apply the program throughout Redwood National Park, Jedediah Smith State Park and Prairie Creek State Park, over the next ten years (2013 – 2023).

This letter concludes informal consultation for the following threatened species (Evolutionarily Significant Units (ESUs) and Distinct Population Segments (DPSs)) and their critical habitats: (1) Southern Oregon/Northern California Coast (SONCC) coho salmon ESU (*Oncorhynchus kisutch*; 70 FR 37160, June 28, 2005) (2) California Coastal (CC) Chinook salmon ESU (*O. tshawytscha*; 70 FR 37160, June 28, 2005), (3) Northern California (NC) steelhead DPS (*O. mykiss*; 71 FR 834, January 5, 2006), (4) Southern DPS of Pacific eulachon (*Thaleichthys pacificus*; 75 FR 13012, March 18, 2010), (5) SONCC coho salmon ESU critical habitat (64 FR 24049, May 5, 1999), (6) CC Chinook salmon ESU critical habitat (70 FR 52488, September 2, 2005), (7) NC steelhead DPS critical habitat (70 FR 52488, September 2, 2005), and (8) Southern DPS of Pacific eulachon critical habitat (76 FR 65324, October 20, 2011). In addition, this letter completes EFH consultation.



ACTION AREA

Treatment of SOD would occur in small areas throughout RNSP lands. Within RNSP, new locations could be discovered and treated each year. Currently, SOD is found in the middle portion of the Redwood Creek watershed (on private land), and as described in the November 2012, Biological Assessment (BA) (RNSP 2012), the SOD pathogen may become established anywhere, but will most likely first become established in the Coyote Creek, Copper Creek and/or Devil's Creek sub-watersheds of the Redwood Creek watershed because those sub-watersheds are closest to the existing SOD infection sites. Other anadromous watersheds besides Redwood Creek (including Prairie Creek) within RNSP include portions of the Klamath River basin and portions of the Smith River basin (see Appendix I of the 2012 BA)

DESCRIPTION OF THE PROPOSED ACTION

Background

SOD is caused by *Phytophthora ramorum*, an invasive plant pathogen with suspected origins in Asia. Millions of oaks and tanoaks have been killed by this pathogen in forests and wildland-urban interfaces of coastal California since the disease became evident in the mid-1990s. Extensive areas of oak and tanoak mortality have led to concerns about changes in fire frequency and intensity, changes in species composition resulting in shifts in ecosystem processes and function, loss of food resources and habitat for wildlife, and decreased water quality due to an increase in exposed soil surfaces. The disease has killed oaks and tanoaks over thousands of acres in southern Humboldt County, to the south of RNSP, and is found in small, isolated locations in Curry County, Oregon, to the north of RNSP. A wide variety of host plants can harbor *P. ramorum*, but not die from the disease. Some of these host plants serve as primary vectors for the pathogen, including California bay laurel, rhododendron, and huckleberry which are commonly found in RNSP.

P. ramorum spreads from tree to tree as zoospores or sporangia in water including rain splash, drip and stem flow. Local spread is facilitated by transfer of sporangia dislodged from upper tree crown infections in clouds and wind driven rain. Most newly infected trees are found within about 300 to 600 feet of previously infected trees, a pattern consistent with wind and rain dispersal. However, new disease sites have been detected up to three miles from the nearest known infested areas. This type of longer distance, or landscape scale, spread is believed to be facilitated by turbulent transfer of sporangia dislodged from upper crown infections in storm driven wind events. Extremely long distance spread of *P. ramorum* occurs when infected live plant stock is moved from place to place, such as nursery plants.

SOD has been positively identified on tanoak trees in the Redwood Creek drainage several miles upstream of RNSP. Leaf baiting in Redwood Creek near Orick, approximately 15 miles downstream of the infestation site, has confirmed the presence of the SOD organism in the creek. Between the infection site and the bait station in Orick is RNSP land. Based on the known

location of SOD and the type of pathogen spread, it is likely that SOD will become established in RNSP in the near future. The most likely scenario, based on the observed spread of the disease in southern Humboldt County and the rest of California, is that *P. ramorum* will have the highest likelihood of spreading into RNSP areas closest to the currently identified infection site in Redwood Creek valley (RNSP 2012). The watersheds most likely to become infected first will be Coyote Creek, Copper Creek and Devil's Creek located in the southeastern end of RNSP (see Appendix I of the BA). The SOD pathogen, however, could occur in any sub-watershed within RNSP within the next ten years.

Proposed Program

The proposed program is intended to be enacted if, and when, SOD is found within RNSP boundaries. The program is proposed to be in effect until December 31, 2023. A successful SOD management program has been in existence in southwestern Oregon for the past five to seven years on US Forest Service and Bureau of Land Management lands (USFS - USDA 2006). RNSP's management program is based, in large part, on the methods used in southwestern Oregon.

RNSP proposes a set of evaluation criteria to determine the appropriate response to and management of a SOD infestation. Monitoring for SOD will be conducted throughout RNSP forested areas. Upon discovery, the extent of the infestation will be mapped, and an inventory of the stand will be taken to determine the presence and cover of tanoaks, California bay laurel, rhododendron, and huckleberry in close proximity to the infection site. If tanoak and California bay laurel are absent within 300 feet of an infection, no action will be taken. If tanoak or bay laurel are present, a 300 foot buffer will be extended around the infected site. All tanoaks, California bay laurel, rhododendron and huckleberry, greater than 1 foot tall, will be cut down with chainsaws by hand crews within the established 300 foot buffer zone. Conifers will not be cut. All attempts will be made to fall target tree/shrub species away from non-target tree species. Vegetation proposed for treatment will be cut and left on the ground. The goal of the treatment will be to get infected trees and shrubs, and nearby potentially infected trees and shrubs, to the ground so that they cannot facilitate the release of *P. ramorum* spores into the air during rain and wind events, thus preventing the spread of the disease into adjacent stands. Both monitoring crews and treatment crews will disinfect all gear prior to leaving an infected site. Tree and shrub cutting could occur at any time of the year.

A single tree SOD infection will result in a 7 acre treatment area (i.e., a single point surrounded by a 300 foot buffer equals a circle with a 7 acre area). Multiple infected trees in one location with 300 foot buffer areas overlapping will be joined together to form a single treatment area (polygon). The maximum single treatment area size will be dependent on the canopy cover of the tanoak and bay laurel trees in combination with conifer canopy cover as determined by spherical densiometer. The maximum cumulative total of all treatment areas for the lifespan of this consultation will also be dependent on the canopy cover of tanoak and bay trees in combination. In order to prevent surface water from being exposed or minimize the amount of surface water that could be exposed to increased solar radiation and possible increases in summer

water temperatures, RNSP proposes to limit the maximum length of treatment areas within the riparian zone, based on the existing bay laurel and tan oak canopy cover (Table 1), and proposed bay laurel and tan oak removal. Thus, as shown in Table 1, reductions in the bay laurel/tan oak portion of the canopy cover will be dependent on the percentage of the canopy that these tree species occupy, and the greater the potential reductions in canopy cover, the greater the limit on stream length that could be exposed to possible increased solar radiation. RNSP also notes that bay laurel and tan oak are not typically found within riparian areas within RNSP, but are more typical hill slope tree species.

Table 1. SOD Management Program, maximum single treated area, cumulative treated area, and maximum stream length treated within riparian area.

California Bay/Tanoak Relative Canopy Cover¹ at Sudden Oak Death Infection Site			
	0 to 25% of the canopy cover removed	26% to 50% of the canopy cover removed	51% to 75% of the canopy cover removed ²
Average existing stand canopy cover = 50% to 75%	50 acre total treatment polygon	25 acre total treatment polygon	13 acre total treatment polygon
	1,000 feet maximum length per stream	1,000 feet maximum length per stream	1,000 feet maximum length per stream
Average existing stand canopy cover = 76% to 100%	100 acre total treatment polygon	40 acre total treatment polygon	25 acre total treatment polygon
	Unlimited length per stream	2,000 feet maximum length per stream	1,000 feet maximum length per stream
Maximum Cumulative Treated Area 2012 - 2022	Unlimited	500 acres	100 acres

¹Canopy cover determined by spherical densitometer.

²Site will be planted after treatment with conifer/non host tree species for areas with 51 to 75 percent of tan oak and bay tree canopy cover.

No mechanical removal or burning of cut material is proposed on National Park Service (NPS) lands, unless those activities have been already approved as part of a separate management effort (e.g., second growth forest restoration, watershed restoration, fire management). Small pile burning may occur on California State Parks (CSP) lands. Pile burning will be restricted to small piles no more than six feet in diameter and 6 feet tall. All piles will be burned during the rainy season when fuel and soil moisture is high (typically mid-October to mid-May) in order to maintain burn control. All burn piles will be located more than 150 feet, or beyond the break in slope, whichever is greater, from any riparian area.

No herbicide treatment will occur on CSP lands. On NPS lands, stumps and cut branches will be painted or injected directly with glyphosate based herbicide to prevent re-sprouting. Roundup™ will be used in upland areas, and Aquamaster™ will be used within 50 feet of riparian habitats, springs, and ephemeral, intermittent or perennial streams. "Aquamaster" is Monsanto's trade name for the glyphosate compound that has been approved by the EPA for use in aquatic environments. The spot application method (painting and injection) is proposed for riparian areas so that the herbicide does not come in contact with soil. Aquamaster™ would either be injected directly into a plant or applied with a brush or target sprayer directly on a cut stump. No broadcast spraying will occur. With this herbicide application technique, no herbicide will come in contact with any soil and will be completely absorbed by the treated shrub or tree. The other herbicide proposed for use in this program, Roundup™, would not be used within 50 feet of riparian habitats and would not be broadcast sprayed, but would also be either injected directly into a plant or applied with a brush or target sprayer directly on a cut stump in upland locations. No herbicide would be used within 4 miles of the Redwood Creek, Klamath River or Smith River estuaries as these areas do not contain host plant species for the SOD pathogen.

All proposals for herbicide use in the NPS must go through a review and approval process that includes the park's Integrated Pest Management (IPM) coordinator and the NPS regional IPM coordinator. All herbicide use would be conducted in compliance with NPS IPM guidelines as described in the BA (RNSP 2012). Herbicides would be applied under the direction of personnel at RNSP that are certified pesticide applicators or under the direction of other qualified NPS personnel. Herbicides would be stored and handled in accordance with containment procedures that are based on NPS Best Management Practices (BMPs) and on spill contingency plans that are based on NPS standards (RNSP 2012).

Other important elements of the proposed program include: 1) vehicle access would be restricted to existing service roads, 2) access would occur outside of the seasonal road closure on those roads that are closed during wet weather, and 3) in the event of a fuel, oil, or herbicide spill, a spill contingency plan would be in place. The spill contingency plan is based on NPS and CSP existing spill plans, and is tailored to the type of hazardous spills that could be associated with SOD management activities. Spill contingency plans are included in Appendix II of the BA (RNSP 2012). In addition, specific SOD management projects would be reviewed by a NPS

biologist or CSP ecologist to ensure consistency with the project description found in the BA (RNSP 2012).

ESA CONSULTATION

Redwood Creek

Coho salmon, Chinook salmon, steelhead, and Pacific eulachon are ESA-listed as threatened in the Redwood Creek watershed. Coho salmon are currently distributed within the lower and middle sections of Redwood Creek, but are mostly found in the Prairie Creek sub-watershed and the lower sections of tributaries to lower/middle Redwood Creek. Chinook salmon are distributed throughout the mainstem of Redwood Creek and Prairie Creek. Steelhead are distributed throughout the Redwood Creek basin, including many tributaries; however many tributaries to mainstem Redwood Creek often contain steep channel gradients which limit steelhead distribution to the lower sections of most tributaries. Pacific eulachon have not been observed in Redwood Creek since the 1970s. However, if they were to re-colonize Redwood Creek, we would expect Pacific eulachon to be distributed within the estuary and the lower section of mainstem Redwood Creek. The Redwood Creek watershed contains migratory, rearing and spawning habitat for coho salmon, Chinook salmon and steelhead, and migratory and spawning habitat for Pacific eulachon.

Smith River

Coho salmon are the only ESA listed salmonid in the Smith River basin. Park lands are located on the mainstem of the Smith River and its lower tributaries near Hiouchi, California, and in the Mill Creek sub-watershed of the Smith River (see Appendix I of the BA). Coho salmon are distributed throughout the mainstem river and lower tributary locations of park lands within this basin. Park lands in the Smith River basin, including Mill Creek, contain migratory, spawning and rearing habitat for coho salmon. Park lands in the Smith River are upstream of Pacific eulachon distribution.

Klamath River

Coho salmon are the only ESA listed salmonid in the Klamath River basin. Park lands are located in the most downstream section of the lower Klamath River, near Klamath, California (see Appendix I of the BA). Coho salmon are distributed throughout the lower mainstem river and its tributaries, and these streams contain spawning, migratory and rearing habitat for coho salmon. Pacific eulachon are distributed throughout the lower mainstem Klamath River, which contains migratory and spawning habitat for Pacific eulachon.

Effects of the Action on Listed Species

The SOD management program has the potential to result in: 1) sediment delivery to the stream channel network through felling of trees in the riparian area and use of existing access roads, 2)

the delivery of petroleum products and/or herbicides to the stream network through the use of hand power tools and Aquamaster within riparian zones, 3) increases in water temperature through removal of trees and brush in the riparian area, and 4) decreases in the food resources from felling trees and shrubs in the riparian area. However, the program incorporates numerous BMPs, and regional and local standards and guidelines. The program has been designed to prevent or minimize increases in water temperature and sediment, and designed to prevent herbicide and petroleum product delivery to the stream network. In addition, RNSP has implemented a similar program, the exotic plant management program, since 2002, and implementation monitoring indicates that RNSP has successfully implemented BMPs, standards, guidelines and specific program design features aimed at preventing or minimizing the risk of sediment, herbicide and petroleum products from entering the stream network.

Sediment

RNSP proposes to cut only tanoaks, bay laurel trees, rhododendron and huckleberry shrubs in riparian areas if control of SOD is needed. Trees and shrubs will be cut by hand, using chain saws, and will be further cut into smaller pieces (i.e., bucked) and left on site, and soil will be very minimally exposed from manual tree and brush removal activities. The cut trees and shrubs will provide ground cover for any soil exposed to rain splash due to the removal of trees in the canopy. The rapid growth of the surrounding and remaining non-target trees, shrubs and herbaceous vegetation will fill in the removed canopy, and provide stream bank stability when cut tree root wads and slash eventually rot.

In addition, we do not expect that related activities, such as road use, will mobilize sediment into the stream network. Much of the program work will occur in upland locations, and seasonal road closures will prevent native surface road use during the wet weather season. The likelihood of sediment being delivered to the stream network from manual tree and shrub removal activities and related road use is low and the potential amount of sediment mobilized would be very small. Thus, the potential for exposing salmonids of all species and life stages, and adult, egg or larval Pacific eulachon to sediment mobilized from program activities is negligible, and the expected response of salmonids and Pacific eulachon to this negligible potential exposure to increase in sediment is insignificant.

Petroleum Products and Herbicide Use

With power tool use in the riparian area, there is the possibility that petroleum products may enter the stream network through either spills or leaks. Spill plans and best management practices for managing petroleum products should prevent or minimize the probability of runoff of hazardous materials in the unlikely event of a spill or leak associated with power tool use. Therefore, the potential for exposing salmonids (all species and life stages), and adult, egg or larval Pacific eulachon to petroleum pollutants is negligible, and the expected response of salmonids and Pacific eulachon to this negligible potential exposure to petroleum products is insignificant.

Chemical herbicides are proposed for use in this program and have the potential to enter the aquatic environment if a chemical makes its way into surface water or ground water. It is very unlikely that herbicides will enter ground water since glyphosate will be directly injected into cut stumps or target sprayed/painted directly onto cut stumps. These methods will allow the chemical to be absorbed into the plants' tissues, thereby preventing the herbicide from coming in contact with the soil or groundwater. In addition, glyphosate in the Aquamaster formulation is a plant-specific compound that targets enzymes found only in plants, not animals. Glyphosate in this formulation lacks surfactants and has been approved for use by the EPA in aquatic environments. With any chemical use there is always the slight possibility of the substance entering the aquatic environment should a spill occur. Spill plans and best management practices for managing chemical products should minimize the probability of runoff of hazardous materials in the unlikely event of a spill associated with SOD management activities. A spill, in the unlikely event of an occurrence, would be low in volume and readily contained. Thus, based on: 1) the use of Aquamaster in riparian areas, 2) the methods of glyphosate application, and 3) the use of best management practices for handling chemicals and spill plans, the potential for salmonids or Pacific eulachon to be exposed to herbicides from program activities is negligible and the expected response of salmonids and Pacific eulachon to this negligible potential exposure to herbicides is insignificant.

Water Temperature

Redwood Creek, Mill Creek, the Smith River and the Klamath River within RNSP are shaded by riparian forest canopies dominated by large conifers or non-target hardwoods (RNSP 2012) that will continue to provide shading even if tan oaks, bay laurels and rhododendrons are removed for SOD management. In addition, tanoaks and bay laurels do not reach into the upper canopy along the main stems of these streams in significant amounts (i.e. only a few individual, isolated tanoaks or bay laurels reach the upper canopy and thus do not constitute the majority of the canopy), and these species provide minimal shading function in these areas. Since the riparian forest canopy along the entire length of these creeks and rivers are conifer or non-target species dominant, those streams' riparian canopies would be characterized as having a greater than 75 percent existing canopy cover with virtually no tanoak or bay laurel canopy component. Based on the proposed action as shown in Table 1, the canopy cover would not decrease. Thus, the removal of sub-canopy tanoaks and bay laurels and isolated individual canopy level tanoaks and bay laurels along the creeks and rivers will not alter canopy cover enough to increase stream temperatures.

Felling riparian canopy trees located along tributaries within RNSP could minimally increase summer stream temperatures from a reduction in riparian cover. Most riparian SOD treatment areas will leave more than 75 percent of the canopy intact due to the generally spotty distribution of SOD host tree species (RNSP 2012) in riparian areas. Thus, based on the linear limits and canopy retention targets that RNSP proposes (see Table 1) and the distribution of target and non-target tree species, the shading functions of the tributary riparian area will be largely intact after removal of target trees and shrubs.

However, in those few areas where tanoak and bay laurel make up a larger proportion of the riparian canopy along perennial reaches of tributary streams (primarily in Copper Creek and Rock Creek drainages) (see maps in Appendix I of the BA; RNSP 2012), a small and temporary increase in tributary stream temperatures may occur. Based on the pattern of SOD spread and the vegetation patterns within RNSP, most tributary treatment areas that would experience reductions in riparian canopy cover will be upstream of anadromous habitat (RNSP 2012) along upper reaches of tributaries with relatively high channel gradients. These tributaries have generally cooler water temperatures (RNSP 2012) and more resiliency to increases in water temperatures (CBOF-TAC 2007). Also, almost all tributaries within RNSP are within the coastal fog zone or zone of coastal influence, where ambient air temperatures and direct solar radiation stay significantly lower than inland areas (CBOF-TAC 2007). RNSP also proposes to limit the length of stream exposed to canopy thinning. Thus, we expect that small and temporary increases to tributary water temperatures may occur.

Exceptions to this pattern include Rock Creek (a tributary to the Smith River) and Coyote Creek (a tributary to Redwood Creek) that are located farther inland, and have a higher tan oak component and less conifer cover. However, RNSP proposes measures (see Table 1) that will minimize stream temperature rise in those creeks by limiting the length of stream that is exposed to increased solar radiation, and specifying canopy retention standards. Wilzbach et al. (2005) found that riparian clear cut treatments done along multiple tributary streams in the Smith River and Klamath River basins at or farther inland (i.e., exposed to as much or more solar radiation and higher ambient air temperatures) than any comparable streams within RNSP, minimally increased stream temperatures. In that study, riparian forests were completely removed along multiple 300 foot long riparian stretches, and in none of the treatment areas did stream temperature raise more than 1 degree Celsius. Based on the proposed linear and canopy cover limits on treatments within riparian areas, and the pattern of tan oaks and bay laurels within riparian areas in RNSP (i.e., riparian areas contain mostly conifers and non-target tree species), we expect much less rise in water temperature in potential SOD treatment areas in inland areas such as Rock Creek and Coyote Creek than that found by Wilzbach et al. (2005).

Therefore, removal of tan oaks and bay laurel within SOD riparian treatment areas along smaller, low volume tributary streams to Redwood Creek, Mill Creek, the Klamath River and the Smith River is expected to have an insignificant increase in water temperatures. The riparian forest canopy along the entire length of the mainstem of Redwood Creek, Mill Creek and the Smith River are conifer dominant and thus riparian shading would not decrease along these major RNSP streams due to SOD management activities (i.e. those riparian canopies would always be characterized as having a greater than 75 percent existing canopy cover with virtually no tanoak or California bay canopy component). Based on their life history and distribution (i.e., Pacific eulachon are present in lower river systems during the spring for a short time to spawn when water temperatures are low), Pacific eulachon will not be exposed to potentially small increases in water temperature. In addition, based on the low likelihood of stream temperature increase, the potential for exposing salmonids of any species and life stages to elevated stream temperatures due to program activities is very low, and the expected response of salmonids to this negligible potential exposure to increase in water temperature is insignificant.

Food Resources

The proposed SOD management program also has the potential to result in a minimal reduction in food resources for salmonids due to thinning of target tree species in riparian areas. The potential reduction of food resources will be low because, as described previously, only scattered individual trees along the creeks and rivers will be thinned. Additionally, in most cases, limited stream lengths of tributaries will be thinned, and tan oak, bay laurel and rhododendron are not dominant species within riparian areas of tributaries to Redwood Creek, Mill Creek, the Klamath River or the Smith River. The many miles of remaining untreated areas and remaining untreated conifers and non-host hardwoods within treated riparian areas will continue to provide food inputs for salmonids. Thus, the potential for exposing salmonids of any species and life stages to reduced food resources caused by program activities is negligible, and the expected response of salmonids to this negligible potential of decrease in food resources is insignificant.

Effects of the Action on Critical Habitat

The program will have limited effects to critical habitat from activities causing: 1) a negligible increase in sediment mobilized from program activities, 2) a negligible increase in water temperatures, 3) a negligible decrease in food resources, and 4) from the low possibility of petroleum products or herbicides entering the stream network and decreasing water quality. However, the likelihood of increased water temperatures and reduced food resources is low, and any increase in water temperatures or decrease in food resources would be very small. In addition, the likelihood of very small amounts of petroleum products or herbicides entering the stream network is also low. As described previously, the response of water temperature and food resources to the removal of small quantities of tan oaks, bay laurels and rhododendrons is expected to be insignificant. In addition, for the same reasons described previously that we concluded that listed species are expected to have an insignificant response to a negligible increase in sediment mobilized from program activities and the low possibility of petroleum products or herbicides entering the stream network and decreasing water quality from program activities, NMFS concludes that any change in water quality from these limited effects is expected to be insignificant. Therefore, the effects to critical habitat from the program are expected to be insignificant.

ESA Conclusion

Based on our review of the documents provided by RNSP and based on our review of site conditions within the action area, NMFS concurs with RNSP's determination that the SOD management program is not likely to adversely affect threatened SONCC coho salmon, CC Chinook salmon, NC steelhead, Pacific eulachon or their designated critical habitats.

This concludes informal consultation for the program. Reinitiation of consultation may be necessary where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: 1) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered, 2) the action is subsequently modified in a manner that causes an effect to the listed species or

critical habitat not considered, or 3) a new species is listed or critical habitat designated that may be affected by the action.

EFH CONSULTATION

The project area is located within an area identified as EFH for Pacific salmon (coho salmon and Chinook salmon) managed under the Pacific Coast Salmon Fishery Management Plan under the MSA.

NMFS has evaluated the proposed program for potential adverse effects to EFH pursuant to Section 305(b) of the MSA. Under the EFH implementing regulations [50 C.F.R. 600.810(a)], the term "adverse effect" is defined as any impact that reduces quality and/or quantity of EFH and may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce quantity and/or quality of EFH.

The potential adverse effects to EFH from the program would be from riparian area thinning causing a small and temporary increase in stream temperatures, and from the risk of petroleum products and herbicides entering the stream network. Therefore, NMFS has determined that the proposed program would adversely affect EFH for Pacific salmon. However, the proposed program contains adequate measures to avoid, minimize, mitigate, or otherwise offset the adverse effects to EFH. NMFS has no additional EFH conservation recommendations to provide at this time. This concludes EFH consultation for the proposed program. Pursuant to 50 CFR 600.920(l), RNSP must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH.

Please contact Ms. Leslie Wolff at (707) 825-5172, or via email at Leslie.Wolff@noaa.gov, if you have any questions regarding these consultations.

Sincerely,

For 
William W. Stelle
Acting Regional Administrator

cc: Administrative File: 151422SWR2011AR00046

REFERENCES CITED

- California Board of Forestry and Fire Protection Technical Advisory Committee (CBOF-TAC). 2007. Primer on Biotic and Nutrient Riparian Exchanges Related to Forest Management in Western U.S., Version 1.0. Sacramento, CA.
- Redwood National and State Parks (RNSP). 2012. Biological assessment of impacts to threatened anadromous salmonids from the Sudden Oak Death Management Program in Redwood National and State Parks. November.
- United States Forest Service – Department of Agriculture (USFS – USDA). 2006. Decision Memo – Section 13 *Phytophthora ramorum* Treatment, Chetco Ranger District, Rogue River-Siskiyou National Forest. 28 pp.
- Wilzbach, M.A., B.C. Harvey, J.L. White, R. J. Nakamoto. 2005. Effects of riparian canopy opening and salmon carcass addition on the abundance and growth of resident salmonids. Can. J. Fish Aquat. Sci. 62: 58-67.