Enclosure 5

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

January 25, 2012

In response reply to:
F/SWR/2006/04022

Ms. Jane Hicks
Chief, Regulatory Division
U.S. Army Corps of Engineers
San Francisco District
1455 Market Street

San Francisco, California 94103-4573

Dear Ms. Hicks:

This letter transmits NOAA's National Marine Fisheries Service's (NMFS) final biological opinion (Enclosure 1) and Essential Fish Habitat (EFH) consultation (Enclosure 2) pertaining to the U.S. Army Corps of Engineers' (Corps) proposed issuance of a section 404 Clean Water Act permit to the Humboldt County Resource Conservation District (HRCD) for the Salt River and Riverside Ranch Restoration Project (project).

The biological opinion is based on NMFS' review of information provided within the Corps' January 31, 2011, request for formal consultation, the project biological assessment (BA), and numerous meetings and emails culminating in the proposed action as approved by the HRCD on October 14, 2011.

Our biological opinion addresses potential adverse effects on the following listed species Evolutionarily Significant Unit (ESU) or Distinct Population Segment (DPS) and their designated critical habitat in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531§ et *seq.*):

Southern Oregon/Northern California Coast (SONCC) coho salmon ESU
(*Oncorhynchus kisutch*)
Threatened (June 28, 2005, 70 FR 37160)
Designated critical habitat (May 5, 1999, 64 FR 24049)

California Coastal (CC) Chinook Salmon ESU
(*O. tsawytscha*)
Threatened (June 28, 2005, 70 FR 37160)
Designated critical habitat (September 2, 2005, 70 FR 52488)

Northern California (NC) steelhead DPS
(*O. mykiss*)
Threatened (January 5, 2006, 71 FR 834)
Designated critical habitat (September 2, 2005, 70 FR 52488)
Southern DPS of North American green sturgeon
(*Acipenser medirostris*)
Threatened (April 6, 2006, 71 FR 67)
Designated critical habitat (September 9, 2009, 74 FR 52300)

Southern Resident Killer Whale
(*Orcinus orca*)
Endangered (November 18, 2005, 70FR66903)

Based on the best scientific and commercial information available, NMFS concluded that the action is not likely to adversely affect the Southern DPS of green sturgeon because they will not be present in the action area during project implementation. NMFS also concluded that the Southern resident killer whale DPS is not likely to be adversely affected because the adult salmonid populations that are prey for killer whales would not be reduced. Finally, NMFS concluded that the action, as proposed, is not likely to jeopardize the continued existence of SONCC coho salmon, CC Chinook salmon, or NC steelhead; and is not likely to result in the destruction or adverse modification of designated critical habitat for SONCC coho salmon, CC Chinook salmon, or NC steelhead. NMFS expects the proposed action will result in the incidental take of SONCC coho salmon, CC Chinook salmon, and NC steelhead. An incidental take statement is included with the enclosed biological opinion. The incidental take statement includes non-discretionary reasonable and prudent measures and terms and conditions that are expected to further reduce incidental take of SONCC coho salmon, CC Chinook salmon, and NC steelhead occurring as a result of the proposed action.

The enclosed EFH consultation (Enclosure 2) was prepared pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). The proposed action includes areas identified as EFH for coho salmon and Chinook salmon, Pacific Salmon species managed under the Pacific Coast Salmon Fishery Management Plan. Based on our analysis, NMFS concludes that the project would adversely affect EFH for coho salmon and Chinook salmon. However, the proposed action contains adequate measures to avoid, minimize, mitigate, or otherwise offset the adverse effects to EFH. Therefore, NMFS has no additional Conservation Recommendations.

If you have any questions regarding this consultation, please contact Dan Free at (707) 825-5164.

Sincerely,

for Rodney R. McInnis
Regional Administrator

cc: AR151422SWR2006AR00113

Enclosure 1

DRAFT
BIOLOGICAL OPINION

ACTION AGENCY: U.S. Army Corps of Engineers

ACTION: Salt River and Riverside Ranch Restoration Project

CONSULTATION CONDUCTED BY: National Marine Fisheries Service, Southwest Region

FILE NUMBER: 151422SWR2006AR00113

DATE ISSUED: **January 25, 2012**

TABLE OF CONTENTS

1 BACKGROUND AND CONSULTATION HISTORY 5

2 DESCRIPTION OF THE PROPOSED ACTION 5

2.1 PROJECT COMPONENTS 5
2.1.1 Tidal Marsh Restoration at Riverside Ranch (Phase 1) 6
2.1.2 Restoration of the Salt River Channel and Riparian Floodplain (Phase 2) 7
2.1.3 Construction, Revegetation, and Maintenance 10
2.1.4 Sacramento Pikeminnow Control 14
2.2 DESCRIPTION OF THE ACTION AREA 15

3 ANALYTICAL APPROACH 15

3.1 JEOPARDY ANALYSIS 16
3.2 ADVERSE MODIFICATION ANALYSIS 16

4 STATUS OF LISTED RESOURCES 18

4.1 SPECIES LIFE HISTORY, DISTRIBUTION, AND ABUNDANCE 18
4.1.1 Southern DPS Green Sturgeon 18
4.1.2 California Coastal Chinook Salmon 19
4.1.3 Southern Resident Killer Whales 21
4.1.4 NC Steelhead 22
4.1.5 SONCC Coho Salmon 23
4.2 FACTORS RESPONSIBLE FOR SALMONID DECLINE (ESU OR DPS SCALE) 26
4.2.1 Timber Harvest 26
4.2.2 Road Construction, Use and Maintenance 27
4.2.3 Hatcheries 28
4.2.4 Water Diversions and Habitat Blockages 29
4.2.5 Predation 29
4.2.6 Disease 30
4.2.7 Fish Harvest 31
4.2.8 Climate Change 32
4.2.9 Ocean Conditions 33
4.2.10 Marine Derived Nutrients 33
4.3 VIABILITY OF THE ESUS/DPS 33
4.3.1 Population Size 34
4.3.2 Population Productivity 35
4.3.3 Spatial Structure 36
4.3.4 Diversity 37
4.3.5 Summary 39

5 STATUS OF CRITICAL HABITAT 39

5.1 NC STEELHEAD AND CC CHINOOK SALMON 40
5.2 SONCC COHO SALMON 40
5.3 CONSERVATION VALUE OF CRITICAL HABITAT 41
5.4 CURRENT CONDITION OF THE CRITICAL HABITAT 42
5.4.1 NC Steelhead 42
5.4.2 CC Chinook Salmon 42
5.4.3 SONCC Coho Salmon 42
5.4.4 Summary 42

6 ENVIRONMENTAL BASELINE 43

6.1 SALMONID DISTRIBUTION, DIVERSITY, TRENDS AND ABUNDANCE IN THE SALT RIVER 43

6.1.1 Salmonid Distribution 43
6.1.2 Spatial Structure and Diversity....44
6.1.3 Number of Individuals and Productivity....44
6.1.4 Summary....44
6.2 General Setting and Location 44
6.3 Historic and Current Impacts to Watershed Conditions and Salmonids in the Action Area....45
6.3.1 Floods....45
6.3.2 Timber Harvest....45
6.3.3 Historic and Current Salmonid Fisheries 46
6.3.4 Reservoirs and Flow Regulation....46
6.3.5 Urbanization and Agriculture....46
6.3.6 Recently Completed or Ongoing Projects within the Action Area 46
6.3.7 Restoration 47
6.4 Conservation Value of the Designated Critical Habitat....47
6.4.1 Description of Habitat in the Action Area 47
6.4.2 Salt River and Francis Creek Baseline Summary 47

7 EFFECTS OF THE ACTION 48

7.1 Exposure....48
7.2 Insignificant, Discountable or Wholly Beneficial Effects 48
7.2.1 Beneficial Effects....48
7.2.2 All Other Effects 49
7.2.3 Adverse Effects to Listed Species 50
7.2.4 Effects to Critical Habitat....53
7.2.5 Effects of Interrelated and Interdependent Actions....55

8 CUMULATIVE EFFECTS 55

9 INTEGRATION AND SYNTHESIS 55

9.1 NC Steelhead Risk of Extinction 56
9.1.1 Population Size....56
9.1.2 Population Productivity....56
9.1.3 Spatial Structure 56
9.1.4 Diversity 56
9.1.5 Summary....56
9.2 Effects on SONCC Coho Salmon 56
9.2.1 Population Size....56
9.2.2 Population Productivity....57
9.2.3 Spatial Structure 57
9.2.4 Diversity 57
9.2.5 Summary....57
9.3 Effects to CC Chinook Salmon 57
9.3.1 Population Size....57
9.3.2 Population Productivity....57
9.3.3 Spatial Structure 58
9.3.4 Diversity 58
9.3.5 Summary....58
9.4 Effects on Critical Habitat....58

10 CONCLUSION 59

11 INCIDENTAL TAKE STATEMENT 59

11.1 Amount or Extent of Take 59
11.2 Effect of the Take 60

11.3 REASONABLE AND PRUDENT MEASURES 60
11.4 TERMS AND CONDITIONS 60

12 REINITIATION NOTICE 61

13 CONSERVATION RECOMMENDATIONS 61

14 REFERENCES 63

1. BACKGROUND AND CONSULTATION HISTORY

On January 31, 2011, NOAA's National Marine Fisheries Service (NMFS) received a letter from the US Army Corps of Engineers (Corps) requesting formal consultation pursuant to section 7(a)(2) of the Endangered Species Act (ESA), as amended (16 U.S.C. 1531 *et seq*.) and its implementing regulations (50 CFR Part 402) for the proposed issuance of a section 404 Clean Water Act Permit to the Humboldt County Resource Conservation District (HRCD) for the proposed Salt River and Riverside Ranch Restoration Project (project) on the Salt River, a tributary of the lower Eel River, in Humboldt County, California. The Corps suspended the original consultation request because the scope of the project was not yet finalized, and then requested consultation in a July 13, 2011, letter. NMFS received the final biological assessment for the project on October 14, 2011, marking the completion of the initiation package and the initiation of formal consultation. The request for consultation concerns the effects of the proposed project and associated activities on threatened Southern Oregon/Northern California Coast (SONCC) coho salmon (*Oncorhynchus kisutch*), California Coastal (CC) Chinook salmon (*O. tshawytscha*) and Northern California (NC) steelhead (*O. mykiss*) and their designated critical habitats. This document represents NMFS' biological opinion (Opinion) on the Corps' proposal to issue a permit to HRCD for the project. This Opinion is based on our review of the Corps/HRCD's biological assessment for the proposed project, status review documents for threatened Pacific salmon and steelhead, listing documents and Salt River watershed assessment documents (Downie, *et al*. 2005). This Opinion has been prepared in accordance with section 7 of the ESA and its associated implementing regulations. The complete record for this consultation is on file in NMFS' Northern California Area Office.

2. DESCRIPTION OF THE PROPOSED ACTION

The Corps proposes to issue a section 404 Clean Water Act permit to the Humboldt County Resource Conservation District (HRCD) for the restoration and maintenance of the Salt River and Riverside Ranch near the City of Ferndale, in Humboldt County, California (project). The restoration and maintenance of the Salt River and Riverside Ranch will restore habitat for salmonids and riverine and estuarine ecosystems in the lower Eel River Basin. The HRCD will complete the project over a three-year period (2012-2014) with additional maintenance, as necessary, occurring over a ten-year period (2012-2022).

2.1 Project Components

The following narrative describes the four major components of the project:

- Tidal marsh restoration at Riverside Ranch (Phase 1)
- Restoration of the Salt River channel and riparian floodplain (Phase 2)
- Adaptive Management: Riverside Ranch, Channel and Riparian Floodplain, Sediment Maintenance and Management
- Upslope sediment reduction (this portion of the project will not be part of the 404 Permit, but is an interrelated action that will be discussed further in that section of this opinion).

2.1.1 Tidal Marsh Restoration at Riverside Ranch (Phase 1)

2.1.1.1 Excavation of the Tidally-influenced Portion of the Salt River

The HRCD and the Corp propose to excavate the tidally influenced reach of the Salt River (between Cutoff Slough and the Reas Creek confluence) to expand the tidal prism. Excavation of the tidal reach of the Salt River channel below Reas Creek to Cutoff Slough will restore hydraulic connection to the upstream fluvial reach and between Riverside Ranch tidal marsh and the Eel River estuary. The HRCD designed the channel corridor capacity to optimize tidal exchange to restore wetlands and to provide flood flow conveyance. The channel will be sized to accommodate unrestricted tidal exchange of the restored wetland tidal prism, with a characteristic tidal channel shape with relatively steep (1.5:1 H:V) side slopes. Channel dimensions (width, depth and area) decrease in an upstream direction in response to reduced tidal prism volumes conveyed by the Salt River channel. The channel is designed to maximize tidal amplitudes through the reach to the wetland inlet channels. The tidal channel is also designed to maintain naturally high flow velocities during both neap and spring tides to maintain channel equilibrium morphology. The channel will experience regular wetting and drying through tidal cycles; scour velocities and salinity exchange will control the establishment of salt- through brackish-marsh vegetation within the mainstem channel. The channel is designed to maintain water depths that promote eelgrass (*Zostera* sp.) colonization.

The single-thread project tidal channel cuts into the existing channel alignment, maintaining the historical channel sinuosity and adjacent marsh plain habitat. Tides at and above mean higher high water (MHHW) will overtop the tidal channel, flowing onto the adjacent marsh plains. Natural recruitment of wetland vegetation would occur on the adjacent marsh plain after construction. The design of the Salt River tidal reach is not intended to erode or aggrade substantially after construction. Thus, HRCD does not expect that maintenance removal of sediment from the Salt River tidal channel will be necessary. Tidal exchange would extend upstream approximately 12,900 feet. Tidal waters will be predominantly restricted to the active channel.

2.1.1.2 Riverside Ranch

The project includes the construction of a new berm approximately 9,060 feet long along the eastern boundary of the Riverside Ranch property to protect adjacent parcels from tidal flooding. The berm will be constructed from approximately 185,000 cubic yards (cy) of fine sediment excavated from the Salt River channel, and will have a very gentle (10:1 or greater) interior slope to minimize wave erosion and create upland transition habitat and expanded high marsh ecotone. The berm will have a crest height of 14.75 feet (NAVD88) and top width of at least 12 feet; the outboard slope would be 4:1. The design includes culverts, future transport of livestock, maintenance access, and potential floodways for Eel River flooding. Approximately 3,500 feet of existing berm along the northern boundary of Riverside Ranch will be refurbished to match the dimensions of the new berm described above.

Excavations through the existing perimeter levees will open the Riverside Ranch site to tidal inundation from the adjacent Salt River. In the northern half of Riverside Ranch, HRCD will excavate at a historical slough location to reconnect the channel with remnant slough networks. This approach will expedite natural development of complex and sustainable channel networks.

In the southern half of the site, the connection will be located as far upstream along the Salt River as possible, to maximize the length of Salt River channel exposed to tidal exchange.

The HRCD will also lower portions of the outboard Riverside Ranch levee adjacent to the Salt River to approximately MHHW to create high marsh habitat and restore the high-tide hydraulic connection between the river and the property. However, the majority of flows will be directed to the designed breach locations to maximize the tidal prism and subsequent scour in the Salt River. Lowering of the outboard levees will also remove barriers to the deposition of debris and wrack as in more natural systems. Much of the existing ranch levee will be retained to preserve existing willow riparian habitat.

New marsh channels (approximately 19,700 feet) will be excavated to connect the breach locations with the waters of the Salt River. Internal wetland improvements will include the excavation of new internal slough channels and the deepening of existing drainage ditches and/or remnant sloughs to facilitate channel development. A number of small terminal ponds and earthen weirs are designed into the primary internal channels to promote low energy perennial ponding and emulate desirable habitat for the tidewater goby (*Eucyclogobius newberryi*) and juvenile salmonids. Most of the internal slough channels are also designed to provide adequate water depths and conditions for eelgrass recruitment.

Fill generated from marsh channel excavation, or from excavation of the main Salt River channel, will be used to selectively fill existing drainage ditches. Some ditches will remain unfilled to create and promote long-term habitat complexity and diversification. Existing culverts, those that provide internal drainage and those that drain to the Salt River, will be selectively removed or blocked to facilitate proper drainage and a more natural channel network. New culverts with tide gates will be added to ensure proper drainage from adjacent parcels through the setback levees and into the restored tidal areas of Riverside Ranch.

2.1.2 Restoration of the Salt River Channel and Riparian Floodplain (Phase 2)

The Salt River channel between Reas Creek and Perry Slough near the confluence of Williams Creek, including approximately 2,900 feet of Francis Creek has been designed so the proposed channel corridor is connected to passive and active sediment management areas (SMAs), and to the existing floodplain. The channel design objective is to minimize sediment deposition in the active channel by promoting higher water velocities, while allowing the active bench and floodplain to function as a sediment deposition zone where minimally intrusive channel maintenance activities can occur in the future. The active bench and floodplain (hereafter any area outside of the active channel) will be re-established as riverine wetland habitat populated by sedges, grasses, and forbs within the active channel, while Sitka spruce (*Picea sitchensis*), cottonwood (*Populus* sp.*)*, and other species will be planted at the edge of the active bench. The capacity of the proposed channel depends on topographic relief of the adjoining floodplain and fluctuates between the 1- and 1.5-year flow return periods. Within the channel, there are two principal geomorphic features: the active channel and the active bench. Excavated sediments will be placed in upland areas, spread on existing pasture, or will be used for the construction of berms as described above.

The active channel is intended to function as a higher energy channel that will transport sediment and water over a wide range of flows. Woody vegetation planted on the banks will confine the active channel and provide bank stability, promote sediment deposition and natural levee build up adjacent to the active channel, and provide vegetated cover and shading once established.

The HRCD will plant vegetation in discontinuous segments along the vegetated banks of the active channel to allow hydraulic connectivity to the active bench. High flows will flow onto the active bench and re-enter the active channel, encouraging deposition and the formation of side channels and topographic diversity on the active bench. The active channel will contain summer base flows and high flow capacity that will be exceeded approximately 60 to 70 days/year, limiting the woody vegetation species to those that tolerate the frequent flow and sediment inundation. Sustained flow velocities in the active channel will impede re-colonization of woody vegetation that would otherwise promote aggradation.

Flows exceeding the active channel capacity will occupy the active bench, providing an area for sediment deposition, morphological diversity outside of the active channel and the establishment of riparian vegetation and wildlife habitat. The project includes grading topographic diversity into the active bench to both create slower water areas for deposition as well as low-flow constrictions that promote scour of side channels and allow return of flow back into the active channel. Vegetation throughout the active bench will be limited to areas where control of morphology and hydraulics are desired and compatible with passive and active sediment management areas. Outside of active sediment management areas, natural recruitment of woody vegetation is anticipated on the active bench and will be maintained and managed pursuant to the channel design intent. The transition slope from the active bench up to the existing floodplain will be vegetated with a variety of riparian species including alder (*Alnus* sp.), cottonwood, maple (*Acer* sp.), Sitka spruce, and redwood (*Sequoia sempervirens*). The active bench will likely transition from riparian dominated habitats to tidal wetland habitat between Dillon Road Bridge and the Reas Creek confluence, in response to increased tidal influence with the lower Salt River and Eel River estuary.

Multi-function habitat elements are integrated into the channel corridor design to provide habitat and morphologic benefits. These elements include elevated vegetated berms, engineered log jams (ELJs), high flow pathways, backwater slough alcoves, areas of seasonal ponding, and in-stream wood structures. These elements,situated at the interface between the active channel and the active bench, provide aquatic habitat diversity and morphological complexity, and promote and minimize sediment accumulation on the active bench. Such elements will also be used to force flow into passive and active sediment management areas and backwater slough alcoves.

The existing Port Kenyon Road Crossing over Francis Creek will be removed and replaced with a bottomless pre-cast concrete arch culvert that will provide flow conveyance consistent with the up- and downstream restored Francis Creek. The project also includes the removal of an existing failed bridge crossing over Francis Creek located approximately 500 feet upstream from Port Kenyon Road. The project proposes to replace the existing crossing with a free-span, pre-fabricated bridge that will span the top width of the restored Francis Creek channel.

The proposed channel improvements also include reconnecting the Eastside Drainage ditch to Francis Creek with an approximately 500-foot-long drainage channel. The project also includes implementing an agricultural access road crossing over the realigned Eastside Drainage channel to provide ingress and egress from Port Kenyon Road for agricultural purposes.

2.1.2.1 Sediment Management Areas (SMAs)

The primary purpose of SMAs will be to trap and manage sediment efficiently over the full spectrum of winter flows. SMAs will be constructed in designated areas to reduce flow velocity and create conditions that promote settling of fine sand- to silt-sized grains. The SMAs will be constructed to emulate natural floodplains along the mainstem Salt River by separating existing or created floodplain and low-lying areas from the channel, with a low-relief berm and/or barrier consisting of native riparian vegetation. Large portions of the SMAs will be subject to periodic (every 1 to 5 years) sediment removal to maintain topography. SMAs will need to have sediment removed on a regular basis to maintain function and high sediment trapping efficiency.

Accumulated sediment in these SMAs will be reworked (leveled or tilled) to accommodate desired dry season land management practices. Once dry, HRCD will excavate and remove sediment, and the area could be seeded and used for agricultural production, cattle grazing, etc. Three discrete SMAs are designed into the corridor, and their total area will comprise approximately 13 acres.

In the downstream direction, three SMAs are proposed and located at the confluence of Francis Creek with Salt River, immediately upstream from the Dillon Road Bridge crossing and approximately 1,500 downstream from Dillon Road Bridge. The two SMAs located immediately upstream and downstream of Dillon Road Bridge include an expanded active bench that will accommodate sediment deposition and accumulation on the active bench through natural fluvial processes. The designation of these areas will accommodate long-term removal of deposited sediment as necessary and per the Adaptive Management Plan. Sediment accretion in these SMAs is anticipated to occur at a much slower rate relative to the SMA located at the confluence of Francis Creek with the Salt River. The Francis Creek confluence SMA will be located between the new Francis Creek alignment and the embankment of the existing City of Ferndale wastewater treatment pond. The HRCD will excavate the SMA to form an oblong “alcove” approximately 1,000 feet long and up to 350 feet wide. A narrow mouth will join the outlet of the alcove with the Salt River. No grade-control structures will be installed at the outlet. The HRCD will excavate the alcove to elevation 9.6 feet (NAVD88), which is one foot below the thalweg of the excavated Salt River. If groundwater levels permit, the HRCD will excavate the alcove deeper. The alcove is designated as “full” when the level of sediment aggrades to the level of the active bench in the adjacent Salt River. This allows for up to 3 feet of sediment to accumulate within the alcove before requiring sediment removal. At a depth of 3 feet across the entire alcove, the total sediment storage volume is 8,000 cubic yards.

The project includes diverting stream flows from Francis Creek into the alcove in two locations: the upper chute and the lower chute. Slopes and elevations of the chutes are sufficient to keep sediment in transport until they reach the alcove. Once in the alcove, water velocities are reduced to a level sufficient to promote sedimentation of sands and gravels. Waters will travel through the 1,000-foot long alcove and then drain to the Salt River. The narrow outfall

configuration and tailwater elevation from the Salt River will control flow depths and velocities within the alcove.

A water control structure is placed at the head of the upper chute and designed to divert a portion of Francis Creek flows into the SMA. The floor of the structure is set 0.5 feet below the constructed thalweg of Francis Creek. It contains stoplogs that set the elevation of the chute crest, allowing for adaptive management of the facility. Changes to stoplogs will occur on a seasonal basis (i.e. spring and fall).

The stoplog setting used for evaluation of the SMA performance places the crest of the upper chute 0.5 feet above the channel bed elevation of Francis Creek. If operating the structure with stoplogs prevents coarser bed material (i.e. coarse sands and gravels) from entering the SMA and results in sedimentation in Francis Creek downstream of the upper chute, then operation of the structure can occur without stoplogs. In this situation, flows and associated bedload are continuously routed through the SMA, with a portion of the higher flows bypassing the upper chute and continuing downstream through Francis Creek. During cleanout periods, the stoplogs would be raised and streamflow directed down Francis Creek.

Crest elevation of the lower chute is constructed of a log sill and placed 2.3 feet above the elevation of adjacent Francis Creek thalweg. Water begins flowing into the lower chute at flows slightly greater than a 1-year return period. The crest height would maintain stream power in Francis Creek for sediment transport.

Maintenance access will be through a locked gate adjacent to the wastewater treatment facility. The project includes construction of a permanent equipment access ramp to provide entry to the alcove for sediment removal. An access road will be provided that runs along the western rim of the SMA, ending at the upper chute water control structure.

In the event that channel transport and SMA performance are not capable of eliminating undesirable sediment accumulation in the mainstem Salt River channel, or if sediment accumulation poses an undesirable threat to property or project performance, excavation may be performed on a smaller scale within the Salt River corridor (excavating specific areas of the channel). Larger-scale excavation across the entire width of the channel corridor may be necessary at sediment deposition-prone areas such as at the confluence with Francis Creek, if designed SMAs and adjacent Salt River corridor are overwhelmed with sediment, which overflows into the adjacent river corridor. Routine vegetation maintenance within SMAs will occur during late summer or early fall months when the channel flows are lowest to minimize potential erosion and sediment transport and to minimize impacts to salmonids and wildlife species. Vegetation removal methods include controlled grazing, manual removal and mechanical removal.

2.1.3 Construction, Revegetation, and Maintenance

In-channel construction and maintenance activities will be limited to the June 15-October 15 dry season, but may be extended until November 30 if weather conditions allow. Before any de-watering activities begin in any creeks or channels within the project area, the HRCD will install cofferdams and, with the assistance of a qualified fishery biologist, will relocate all native

aquatic vertebrates and larger invertebrates out of the construction area into a flowing channel segment. In deeper or larger areas, the HRCD will first lower water levels to manageable levels using methods that ensure fish and other special status aquatic species are not adversely affected. A qualified fisheries biologist or aquatic ecologist will then seine, dip net, electrofish, or use other trapping procedures to remove fish and other aquatic species from the construction area. These fish will be kept in insulated coolers equipped with battery operated aerators to ensure survival, and will be relocated to an appropriate flowing channel segment or other appropriate habitat as identified by the HRCD in consultation with NMFS, the California Department of Fish and Game (CDFG), and the US Fish and Wildlife Service (USFWS). If fish mortalities occur, individuals will be collected and frozen for delivery to NMFS (for salmonids) or USFWS (for tidewater goby). A combination of pumped and/or gravity diversion pipes will be used to route flow around the active work areas. Fish screens (maximum 1/16 inch opening mesh screen) will be installed immediately upstream from the cofferdams to prevent aquatic organisms from being transported into the bypass pipe. Construction activities shall be prohibited from unnecessarily disturbing aquatic habitat. Introduced species, particularly Sacramento pikeminnow shall be documented and euthanized. The HRCD will not remove cofferdams until significant freshwater flows occur in the fall to minimize water quality degradation from suspended sediment and turbidity in the estuary.

During excavation of the Salt River during both Phases 1 and 2, a combination of pumped and/or gravity diversion pipes and or ditches will be used to route flow around the active work areas. Nuisance water (i.e., turbid water seeping into excavated areas from ground water) will be pumped to adjacent fields for infiltration or into settling basins. Clean water (e.g., water from the Salt River and contributing tributaries) will be diverted using cofferdams that will prevent clean freshwater and clean tidal water from entering the exaction. The HRCD will install cofferdams during low tide and during low summer flows. The diversion options for diverting clean freshwater flow from the Salt River around the channel excavation include:

Phase 1 – Riverside Ranch Tidal Marsh Restoration

Diversion from the upstream side of the uppermost cofferdam, with a pump or gravity pipe to:

1. An existing or a temporary ditch or by pipe (or some combination of ditches/pipes) on Riverside Ranch or along the existing Salt River channel (but not in the way of the construction work) downstream to the tidal side of the lowermost cofferdam or an existing outfall downstream of the lowermost cofferdam on the Salt River.
2. Smith Creek and existing adjacent drainage ditches that will direct flow to an outfall on the downstream side of the existing tide-gate structure.

Phase 2 – Salt River Channel and Riparian Floodplain Corridor

1. Diversion of Francis Creek thru pumped or gravity pipe or ditches and conveyed outside the limits of excavation that will direct flow to an outfall at the Meridian Road storm drain pipe, Reas Creek, Smith Creek or an intermediate location in the Salt River, or a combination thereof.

2. Diversion of Francis Creek thru pumped or gravity pipe or ditches conveyed within the limits of excavation (but not in the way of the construction work) and to a downstream location in the Salt River.

Diversion of Williams Creek thru pumped or gravity pipe or ditches that will direct flow to Perry Slough following the current topographic relief.

The primary excavation methods available include track-mounted excavators, scrapers and large clamshell excavators. The HRCD may use track-mounted excavators to excavate material perpendicular to the flow direction if located outside of the channel or parallel to the flow direction if used within the channel. Scrapers are an efficient method to excavate material above the saturated zone, and for transport and emplacement in specified areas. Clamshell buckets may be utilized and allow removal of material from within either the stream channel or from the bank. Clamshell buckets are generally attached to excavators, cranes or dredges and can be used to excavate both saturated and unconsolidated material.
Best Management Practices (BMPs) that will be implemented as part of the Storm Water Pollution Prevention Plan (SWPPP) include:

- Cofferdams or other temporary fish barriers/water control structures placed in the channel during low tide, and removed during low tide (if possible), after work is completed.

- Operation of equipment in isolated areas only. Because cofferdams will be installed and the channel will be dewatered prior to excavation, equipment will not be operated directly within tidal waters or stream channels of flowing streams, after fish removal efforts have been completed.

- Silt fences and or silt curtains installed near the cofferdams and at excavation of sloughs at culvert installation and removal areas to prevent any sediment from flowing into the creek or wetted channels. If the silt fences are not adequately containing sediment, construction activity will cease until remedial measures are implemented that prevents sediment from entering the waters below.

- Using fiber rolls, sediment basins, and/or check dams to control sediment during and after grading activities. Seeding, mulching, and other erosion control will be implemented after construction is completed. HRCD would remove all controls after the site has stabilized.

- Pumping water into the surrounding fields to prevent sediment-laden water from entering the stream channel. When internal sloughs are connected to the mainstem Salt River, excavation will occur during a rising tide so that water flows into the marsh and sediment has a chance to settle out, allowing impacts of turbid water generated from excavations necessary for connection of the sloughs to the mainstem to be minimized by settlement and dilution.

- Using appropriate energy dissipation devises to reduce or prevent erosion at discharge end of dewatering activity.

- Storage and placement of construction materials, debris, and waste in areas where it will not enter into or wash into waters of the US/State.

- Refueling equipment in upland areas away from watercourses. If equipment washing, if necessary, will occur where wash water cannot flow into wetlands or waters of the US/State.

- Instructing operators of heavy equipment, vehicles, and construction work to avoid sensitive habitat areas. To ensure construction occurs in the designated areas and does not impact environmentally sensitive areas, the boundaries of the work area will be fenced or marked with flagging.

- Storing equipment when not in use outside of the slough channel and above high tide elevations.
- Maintaining construction equipment to prevent leaks of fuels, lubricants or other fluids into the slough. The HRCD will not service and refuel equipment where there is potential for fuel spills to seep or wash into the slough.

- Handling and/or storing chemicals and hazardous wastes (e.g., fuel and hydraulic fluid) near waterways will follow applicable laws and regulations. Appropriate materials will be on site to prevent and manage spills.

- Containment and removal of trash and waste items generated by construction or crew activities.

Temporary construction areas are necessary for staging equipment, storing and transporting material. Temporary construction areas are predominantly located within areas already identified as permanently altered, such as excavation and fill placement areas (berms, channel corridor, agricultural beneficial reuse lands), and within areas where grading will occur such as lowered berms and areas graded to MHW or lower on Riverside Ranch. Temporary construction activities outside permanent impact areas will be limited to temporary construction buffers, haul routes, material and equipment staging/stockpiling areas, and temporary egress/ingress areas adjoining County Roads and as shown on the design plans.

For Phase 2, County roads are anticipated to be used to transport excavated material from the channel corridor to the agricultural reuse areas. The construction of temporary haul roads will be required to transport excavated materials from the channel corridor to the County Roads. Haul roads will also provide stable working and staging areas for excavation and loading activities. Haul roads will be constructed and maintained within permanently impacted areas to the extent feasible.

The project includes the complete removal of all haul roads and restoration to pre-construction conditions. Haul roads will be designed to include the removal and stockpiling of the upper 6 inches of organic-rich material, which will be used for restoration of the road area once complete. All non-native material will be removed.

The HRCD will use a combination of native trees, shrubs, and other plants to replace vegetation removed during construction and enhance vegetation along the newly constructed project. Plants removed for construction will be salvaged and reused, if possible and appropriate. Invasive species will be controlled through planting native trees that will shade invasive plants (*e.g.*, spruce and cottonwoods to shade invasive reed canary grass). Invasive species control methods will include controlled grazing, manual removal and mechanical removal.

As described above, SMAs will require some periodic removal of sediment; HRCD will remove accumulated sediment as frequently as annually, depending on the amount of sediment captured in SMAs. Excavators, bulldozers, backhoes, or other earth excavation equipment may be used to remove sediment. Sediment will be moved to areas away from the stream channel and other wetland areas.

2.1.4 Sacramento Pikeminnow Control

Pikeminnow are present in the project area. As part of the project, the HRCD would conduct annual monitoring for at least five years to assess pikeminnow population levels, habitat preferences, dietary preferences, movement patterns, and other factors. Pikeminnow will be euthanized with non-toxic methods such as pithing, and stomach contents will be examined to assess piscivory. Standard population monitoring methods will be used for both assessment and control to ensure the avoidance of take of listed species, and the protection of water quality during the sampling period.

The goal of this effort is to determine if adult pikeminnow capable of piscivory are present and/or dominant in the project area, if their presence is harmful to native species, and if so, what practicable measures can control their numbers while native species are recolonizing newly created habitat. Documentation of both pikeminnow and native species will help characterize population dynamics within the project area. The HRCD will document and report the presence and abundance of both pikeminnow and native species in order to help assess trends and population response to the project. Monitoring will follow standard protocol to avoid take of state or federally listed species.

In the event that adult, picivorous pikeminnow (adults greater than 10 inches long with evidence of piscivory, such as stomach contents) become dominant in the project area, to the exclusion of native species, the HRCD will conduct a three-year, pilot, pikeminnow-control-program subsequent to the five year monitoring program. The anticipated approach includes annual seining or netting of the main channel with a suitable mesh size in order to trap, document and euthanize pikeminnow. The HRCD will document and return native species unharmed to the channel.

The program will be conducted in coordination with the CDFG and the Redwood Sciences Lab over a three-year period, culminating in a survey report of the Salt River fish assemblage no later than twelve years after project implementation. The reports would be posted online at Calfish.org, and made available to the CDFG and the Redwood Sciences Lab for interpretation. Eradication of the introduced Sacramento pikeminnow is considered infeasible, so no extension

of the pilot program is proposed. However, the pilot program will serve as an intermediate measure to promote the occupation of newly created habitat by native species.

2.2 Description of the Action Area

Action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR Part 402.02). The action area for this consultation includes approximately 7.9 miles of the Salt River from Perry Slough downstream to its confluence to the Eel River and includes approximately 2,900 feet of Francis Creek upstream from its confluence with the Salt River. The action area also includes the, 264-acre Riverside Ranch, adjacent riparian areas, upland areas used for sediment disposal, and any temporary or permanent roads used for hauling sediment. The action area is defined by where the activity is occurring and the downstream extent of any sediment plume generated by the Project.

3. ANALYTICAL APPROACH

Pursuant to ESA section 7(a)(2), Federal agencies are directed to insure that any federal action is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. To evaluate whether an action is likely jeopardize listed species or result in the destruction or adverse modification of designated critical habitat, NMFS considers the combination of the status of the species and critical habitat, effects of the action, including the interrelated and interdependent actions, the Environmental Baseline, and cumulative effects. An action that is not likely to jeopardize the continued existence of the listed species is one that is not likely to appreciably reduce the likelihood of both the survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution (50 CFR Part 402.02). This Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR Part 402.02. Instead, the statutory provisions of the ESA are relied upon with respect to critical habitat.

NMFS uses a conceptual model of the species and their critical habitat to evaluate the effects of proposed actions. The guiding principle behind this conceptual model is that the likelihood of both the survival and recovery of a species is dependent on the likelihood of both the survival and recovery of populations, and diversity strata, in the species. Additionally, the likelihood of survival and recovery of a population unit is dependent upon the fitness (*i.e.*, reproductive success) of the individuals that comprise each population.

One prerequisite for predicting the risks posed by a proposed action on a population includes an understanding of whether the population is likely to experience viability, *i.e*., the hypothetical state in which extinction risk of the broad population is negligible over 100 years and full evolutionary potential is retained (McElhany *et al.* 2000). NMFS equates this likelihood of viability with the likelihood of both the survival and recovery for purposes of conducting jeopardy analyses under section 7(a)(2) of the ESA. Four principal parameters will be used to evaluate the extinction risk for the threatened SONCC coho salmon ESU, NC steelhead DPS, and CC Chinook salmon ESU: abundance, population growth rate, population spatial structure, and population diversity.

The expected response of salmonid populations is determined by assessing any reductions in the numbers, reproduction, distribution or diversity of listed salmonid populations in the action area. We then determine whether any anticipated reductions would appreciably reduce the likelihood of both the survival and recovery of the affected listed salmonid populations. Finally, NMFS considers the status and trends of the ESU or DPS, the factors currently and cumulatively affecting them, and the role the affected population likely plays in the conservation of the ESU or DPS to determine if reductions in the populations' likelihood of both survival and recovery would be expected to reduce both the likelihood of survival and recovery of the species at the ESU or DPS level.

NMFS adopted the general life cycle approach outlined by McElhany *et al.* (2000), and the concept of Viable Salmonid Populations (VSP) as an organizing framework in consultations. In this Opinion, the concept of VSP is used to systematically examine the complex linkages between project effects and viability. The four VSP parameters (abundance, population growth rate (productivity), population spatial structure, and population diversity) reflect general biological and ecological processes that are critical to the growth and survival, and are used to evaluate the risk of extinction (McElhany *et al.* 2000). These parameters are used as surrogates for the "reproduction, numbers, or distribution" criteria found within the regulatory definition of jeopardy (50 CFR Part 402.02). The fourth VSP parameter, diversity, relates to all three criteria.

3.1 Jeopardy Analysis

Analysis of "jeopardy" is conducted in a series of steps. First, available evidence is examined to identify direct and indirect physical, chemical, and biotic effects of the proposed actions on individual members of listed species or aspects of the species' environment in the action area. These effects are considered in the context of what also is affecting them, as discussed in the environmental baseline and cumulative effects sections. For example, if a proposed project is expected to result in increased water temperature, then the effects of that additional temperature increase to salmonids is considered in the context of the existing temperature, which may be influenced by the environmental baseline and future, state, Tribal, or private activities.

After identifying the effects of the action in the context of other effects as identified in the *Environmental Baseline and Cumulative Effects* sections, available evidence is evaluated to identify the probable response of individuals of a species, including behavioral responses. These responses are then assessed to determine if they can reasonably be expected to reduce a species' reproduction, numbers, distribution, or diversity. Lastly, the results are considered in assessing whether any reductions would reasonably be expected to appreciably reduce a species' likelihood of surviving and recovering in the wild.

3.2 Adverse Modification Analysis

Analysis of "destruction or adverse modification" of designated critical habitat involves a series of steps. First, available evidence is used to determine the current condition of critical habitat across the entire designated area and in the action area, including the primary constituent elements of critical habitat (such as spawning habitat, rearing habitat, or freshwater migration corridors) and essential features (including spawning gravels, water quality, cover/shelter, and food), the factors responsible for that condition, and the current conservation value. The

importance of critical habitat to species conservation (*e.g.*, key spawning sites) in the action area is identified. Proposed activities are assessed in regard to how they are likely to affect the primary constituent elements or habitat qualities essential to species conservation in the action area (*e.g.*, destabilizing spawning substrate). Finally, anticipated stressors are examined to determine if they could reasonably be expected to appreciably reduce the value of critical habitat for species conservation across the entire designated area.

4. STATUS OF LISTED RESOURCES

NMFS has determined that the following species and their designated critical habitat (together, listed resources) may be affected by the proposed Salt River and Riverside Ranch Restoration project (Table 1):

Table 1. Species[1] and Critical Habitat Designations Considered in this Consultation.

	SONCC Coho Salmon ESU	NC Steelhead DPS	CC Chinook Salmon ESU	Southern DPS N. American Green Sturgeon	Southern Resident Killer Whale
Scientific Name	*Oncorhynchus kisutch*	*O. mykiss*	*O. tshawytscha*	*Acipenser medirostris*	*Orcinus orca*
Listing Status	Threatened	Threatened	Threatened	Threatened	Endangered
Federal Register Notice	8/15/2011 (76 FR 50447)	12/7/2011 (76 FR 76386)	8/15/2011 (76 FR 50447)	6/6/2006 (71 FR 17757)	11/18/2005 (70FR66903)
Critical Habitat Designation	5/5/1999 (64 FR 24049)	9/2/2005 (70 FR 52488)	9/2/2005 (70 FR 52488)	11/9/09 (74 FR 52300)	

4.1 Species Life History, Distribution, and Abundance

Life history diversity of federally listed species substantially contributes to their persistence, and conservation of such diversity is a critical element of recovery efforts (Beechie *et al.* 2006). Waples *et al.* (2001) and Beechie *et al.* (2006) found that life history and genetic diversity of Pacific salmon and steelhead (*Oncorhynchus* spp.) show a strong, positive correlation with the extent of ecological diversity experienced by a species.

4.1.1 Southern DPS Green Sturgeon

On April 7, 2006, NMFS listed the Southern DPS of North American green sturgeon as threatened under the ESA (71 FR 17757). The Southern DPS of North American green sturgeon currently consists of a single spawning population in the Sacramento River basin. Southern DPS of North American green sturgeon travel long distances along the coasts of California, Oregon, and Washington and have been regularly observed as far north as the southern edge of Vancouver Island. Bays and estuaries for which NMFS has data on the presence of Southern DPS green sturgeon are Humboldt Bay, Columbia River, Willapa Bay, and Grays Harbor. For

[1] In this section of this Opinion, we use the word species as it has been defined in Section 3 of the ESA, which includes "any subspecies of fish and wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature (16 USC 1532)."

most estuaries on the West Coast, there are either no data available and the presence of Southern DPS of North American green sturgeon are uncertain, or data indicating presence of green sturgeon is available, but uncertainty exists whether the sturgeon are Southern DPS of North American green sturgeon. In the meantime, NMFS expects that green sturgeon may be present in the following California bays and estuaries: Klamath River, Mad River, Eel River, Rogue River, Noyo Harbor, Tomales Bay, Half Moon Bay, and Monterey Bay. This finding is based on NMFS' examination of the available data and inference of likely sturgeon presence based on the physical and chemical characteristics of these estuaries.

In summer and fall, Southern DPS of North American green sturgeon may enter estuarine habitat, including the Eel River, to forage. However, we do not expect green sturgeon to migrate into the Salt River during the project because of the shallow depth and lack of forage in the Salt River. However, green sturgeon may use the action area for the project following its completion as the water depth will increase and forage for green sturgeon may increase. Since green sturgeon are not expected to occur in the action area during project implementation and the project will provide only benefits to green sturgeon following implementation, NMFS concludes the project is not likely to adversely affect Southern DPS of North American green sturgeon. Therefore, the southern DPS of North American green sturgeon are not considered further in this Opinion.

4.1.2 California Coastal Chinook Salmon

4.1.2.1 Life History

Adult Chinook salmon reach sexual maturity usually at 3 to 5 years of age, and die soon after spawning. Precocious 2 year olds, especially male jacks, make up a relatively small percentage of the spawning population. Healey (1991) describes two basic life history strategies for Chinook salmon, stream-type and ocean-type, within which there is a tactical component that encompasses variation within race. Like most salmonids, Chinook salmon have evolved with variation in juvenile and adult behavioral patterns, which can help decrease the risk of catastrophically high mortality in a particular year or habitat (Healey 1991).

Fall-run Chinook salmon are ocean-type (Moyle 2002); specifically adapted for spawning in lowland reaches of big rivers and their tributaries (Moyle 2002, Quinn 2005). Sexually mature adults move into rivers and streams from the ocean in the fall or early winter and spawn within a few weeks or days upon arrival on the spawning grounds (Moyle 2002). Juveniles emerge from the gravel in late winter or early spring and within a matter of months, migrate downstream to the estuary and the ocean (Moyle 2002, Quinn 2005). This life history strategy allows fall-run Chinook salmon to utilize quality spawning and rearing areas in the valley reaches of rivers, which are often too warm to support juvenile salmonid rearing in the summer (Moyle 2002).

Spring-run Chinook salmon are often stream-type (Healey 1991, Moyle 2002). Sexually immature adults return to lower-order headwater streams in the spring or early summer and hold in deep pools and coldwater areas until they spawn in early fall (Healey 1991, Moyle 2002). This strategy allows spring-run Chinook salmon to take advantage of mid-elevation habitats that are inaccessible during the summer and fall due to low flows and high water temperatures

(Moyle 2002). Juveniles emerge from the gravel in the early spring and typically spend one year in freshwater before migrating downstream to estuaries and then the ocean (Moyle 2002).

4.1.2.2 Current Distribution and Abundance

CC Chinook salmon occur at the southern end of the species' North American range; only Central Valley fall Chinook spawn further south. Only fall-run Chinook salmon currently occur in the CC Chinook salmon ESU. Spring-run stocks no longer occur in the ESU; however, historical information indicates that spring-run Chinook salmon may have historically existed in the Mad River and the North and Middle forks of the Eel River (Keter 1995, Myers *et al*. 1998, Moyle 2002).

NMFS identified four regions of this portion of the California coast with similar basin-scale environmental and ecological characteristics (Bjorkstedt *et al*. 2005). Sixteen watersheds were identified in the four regions that have the minimum amount of habitat available to support independently viable populations. In the North Mountain-Interior Region, the Upper Eel and Middle Fork Eel rivers contain independent CC Chinook stocks while the Lower Eel and Van Duzen rivers have the potential to support viable populations. Chinook salmon are observed annually in the Middle Fork Eel River, Black Butte River, and near Williams Creek. They continue to be observed annually in Outlet Creek and in the smaller tributaries feeding Little Lake Valley (Scott Harris, pers. comm. 2009).

In the North Coastal Region, Redwood Creek and the Mad, Lower Eel, South Fork Eel, Bear and Mattole Rivers all contain sufficient habitat for independently viable CC Chinook salmon populations. NMFS also identified Little River and Humboldt Bay tributaries as containing potentially independent populations. In the North-Central Coastal Region, numerous watersheds in Mendocino County contain (or contained) small runs of CC Chinook salmon that are dependent upon self-sustaining stocks in Ten Mile, Noyo, and Big rivers for persistence.

Along the Central Coastal Region, the Navarro, Garcia and Gualala rivers historically had independent populations but apparently no longer do. Additionally, the Russian River appears to support a self-sustaining population although the role of hatcheries and straying from the Eel River (by fish attracted to Eel River water diverted into the Russian River) is uncertain. Additionally, NMFS identified 17 watersheds that contain CC Chinook salmon, but due to limited habitat were not likely supporting persistent populations (Good *et al.* 2005). While Chinook salmon are also encountered in the San Francisco Bay region, these fish most likely originated from Central Valley populations and are not included in the ESU (Moyle *et al*. 2008).

Available information on the historical abundance of CC Chinook salmon are summarized in Myers *et al.* (1998). The following are excerpts from this document:

> Estimated escapement of this ESU was 73,000 fish, predominantly in the Eel River (55,500) with smaller populations in Redwood Creek, Mad River, Mattole River (5,000 each), Russian River (500), and several small streams in Del Norte and Humboldt Counties.

Observed widespread declines in abundance and distribution of small populations with sometimes sporadic occurrences contribute to the risks faced by this ESU. Low abundance, generally negative trends in abundance, reduced distribution, and profound uncertainty due to limited population monitoring in California, contributed to NMFS' conclusion that CC Chinook salmon are at risk of becoming endangered in the foreseeable future throughout all or a significant portion of their range (64 FR 50394, September 16, 1999; Good *et al.* 2005; NMFS 2011).

Good *et al.* (2005) found that historical and current information indicates that CC Chinook salmon populations are depressed in basins where they are being monitored. Uncertainty about abundance, natural productivity, and poor distribution continues to affect this ESU. Concerns about current abundances relative to historical abundances, mixed trends in the few time series available, and potential extirpations in the southern part of the range contributed to the conclusion that CC Chinook salmon are "likely to become endangered" (Good *et al.* 2005).

4.1.3 Southern Resident Killer Whales

The Southern Resident killer whale DPS (Southern Residents) was listed as endangered under the ESA on November 18, 2005 (70 FR 69903). Southern Residents are designated as "depleted" under the Marine Mammal Protection Act (MMPA; 68 FR 31980, May 29, 2003). Southern Residents are found throughout the coastal waters off Washington, Oregon, and Vancouver Island and are known to travel as far south as central California and as far north as the Queen Charlotte Islands, British Columbia. There is limited information on the distribution and habitat use of Southern Residents along the outer Pacific Coast.

Several factors identified in the final recovery plan (NMFS 2008) for Southern Residents may have caused the decline or may be limiting recovery of the DPS. These factors include quantity and quality of prey, toxic chemicals that accumulate in top predators, disturbance from sound, and vessel effects. Oil spills are also a potential risk factor for this species. Research has yet to identify which threats are most significant to the survival and recovery of Southern Residents. It is likely that multiple threats are acting in concert to inhibit the conservation of the whales.

Southern Residents consume a variety of fish species (22 species) and one species of squid (Scheffer and Slipp 1948, Ford *et al*. 1998, 2000, Saulitis *et al*. 2000, Ford and Ellis 2006), but salmon are their preferred prey (96 percent of prey consumed during spring, summer and fall, from a long-term study of resident killer whale diet (Ford and Ellis 2006). Feeding records for Southern and Northern Residents show a strong preference for Chinook salmon (72 percent of identified salmonids) during late spring to fall (Ford and Ellis 2006). Killer whales also eat chum salmon (23 percent) in significant amounts, especially in the autumn. Ford and Ellis (2006) found that Chinook salmon were preferred despite the much lower abundance of Chinook salmon in the study area in comparison to other salmonids (primarily sockeye salmon), probably because of the species' large size, high fat and energy content, and year-round occurrence in the area.

When prey are scarce, whales must spend more time foraging than when prey are plentiful. Increased energy expenditure due to reduced prey could lead to lower reproductive rates and higher mortality rates. Food scarcity could cause whales to draw on fat stores, mobilizing

contaminants stored in their fat and affecting reproduction and immune function (discussed further below). Ford *et al*. (2005) correlated coastwide reductions in Chinook salmon abundance (Alaska, British Columbia, and Washington) with decreased survival of resident killer whales (Northern and Southern Residents), but changes in killer whale abundance have not been definitively linked to local areas or changes in specific salmon stock groups. Ward *et al*. (2009) correlated Chinook salmon abundance trends with changes in fecundity of Southern Residents, and reported the probability of calving increased by 50 percent between low and high Chinook salmon abundance years.

The ongoing research provides insight into the river of origin of Chinook salmon consumed by the Southern Residents. The results of genetic analysis of fecal and prey samples led the researcher to conclude that Southern Residents consume Fraser River origin Chinook salmon, as well as salmon from Puget Sound, Washington and Oregon coasts, the Columbia River, and Central Valley California (Hanson *et al*. 2007, NWFSC unpubl. data).

NMFS anticipates that the proposed action will result in an insignificant reduction in prey for Southern Residents that may intercept salmon originating from within the action area. NMFS concludes that a small reduction in juvenile salmonids due to the proposed action may affect, but is not likely to adversely affect Southern Resident killer whales because there will be no change to the adult populations of listed salmonids. Thus, Southern Resident killer whales are not considered further in this Opinion.

4.1.4 Northern California Steelhead

4.1.4.1 Life History

Steelhead probably have the most diverse life history of any salmonid (Quinn 2005). There are two basic steelhead life history patterns, winter-run and summer-run (Moyle 2002, Quinn 2005). Winter-run steelhead enter rivers and streams from December to March in a sexually mature state and spawn in tributaries to mainstem rivers, often ascending long distances. Summer steelhead (also known as spring-run steelhead) enter rivers in a sexually immature state during receding flows of spring and migrate to headwater reaches of tributary streams where they hold in deep pools until spawning the following winter or spring (Moyle 2002). Spawning for all runs generally takes place in the late winter or early spring. Eggs hatch in 3 to 4 weeks and fry emerge from the gravel 2 to 3 weeks later (Moyle 2002). Juveniles spend 1 to 4 years in freshwater before migrating to estuaries and the ocean where they spend 1 to 3 years before returning to spawn. "Half pounder" steelhead are sexually immature steelhead that spend about 3 months in estuaries or the ocean before returning to lower river reaches on a feeding run (Moyle 2002). Then they return to the ocean where they spend 1 to 3 years before returning to freshwater to spawn. Unlike Pacific salmon, steelhead are iteroparous (capable of spawning more than once before death (Busby *et al.* 1996). However, it is rare for steelhead to spawn more than twice before dying, and most that do are females (Busby *et al.* 1996). Some steelhead "residualize," becoming resident rainbow trout and never adopt the anadromous life history.

4.1.4.2 Current Distribution and Abundance

Along the eastern Pacific, rainbow trout, including steelhead, are distributed from Southern California north to Alaska and range west to Siberia (Sheppard 1972). In California, steelhead

occur in coastal streams from the Oregon border down to San Diego County and inland to barriers to migration throughout their distribution. The NC steelhead DPS includes all naturally spawning populations of steelhead in California coastal river basins from Redwood Creek, Humboldt County to just south of the Gualala River, Mendocino County (Spence *et al*. 2007). This distribution includes the Eel River, the third largest watershed in California. Spence *et al.* (2007) identified 32 historically self-sustaining populations in the DPS region based on habitat availability and gene flow among watersheds. An additional 33 small populations are likely dependent upon immigration of non-natal steelhead from the more permanent populations (Bjorkstedt *et al*. 2005). With few exceptions, NC steelhead are present wherever streams are accessible to anadromous fishes and have sufficient flows. Big and Stone lagoons, between Redwood Creek and Little River, contain steelhead following natural breaching of the lagoons in the early winter, although the source of these fish is unknown (M. Sparkman, pers. comm., 2007; Moyle *et al*. 2008).

Quantitative information on NC steelhead is scarce, but there are a few survey index estimates of stock trends. Most data come from fish counts from the 1930s and 1940s at three dams: Sweasey Dam on the Mad River (annual adult average 3,800 in the 1940s), Cape Horn Dam on the upper Eel River (4,400 annual average in the 1930s), and Benbow Dam on the South Fork Eel River (18,784 annual average in the 1940s; Murphy and Shapovalov 1951 *op. cit.*, Shapovalov and Taft 1954, Busby *et al.* 1996). These data can be compared to the annual average at Sweasey Dam of 2,000 steelhead in the 1960s, annual average at Cape Horn Dam in the 1980s at 1,000, and annual average at Benbow Dam of 3,355 steelhead in the 1970s (McEwan and Jackson 1996, Busby *et al.* 1996). In the mid-1960s, CDFG estimated the number of steelhead spawning in many rivers in the DPS area to total about 198,000 adults (McEwan and Jackson 1996).

The most abundant population is likely in the Middle Fork Eel River, where, in 1996, an estimated 2,000 fish occurred (McEwan and Jackson 1996). Substantial declines from historic levels at major dams indicate a probable decline from historic levels at the DPS scale. Adams (2000) concluded that the status of the population had changed little since the 1996 status review. Based on the declining abundance and the inadequate implementation of conservation measures, NMFS concluded that the NC steelhead ESU warranted listing as a threatened species (65 FR 36074, June 7, 2000).

Steelhead abundance estimates are summarized west coast steelhead status reviews (Good *et al* 2005, NMFS 2011a). The Biological Review Team (BRT) made a few conclusions, albeit with limited data: (1) population abundances are low, compared to historical estimates; (2) recent trends are downward (except for a few small summer-run stocks), and (3) summer-run steelhead abundance was "very low" (Good *et al.* 2005, NMFS 2011). Lack of data on run sizes within the DPS was a major source of uncertainty in the BRT's assessment.

4.1.5 Southern Oregon/Northern California Coast Coho Salmon

4.1.5.1 Life History

Adult coho salmon reach sexual maturity at 3 years of age, and are semelparous (die after spawning). Precocious 2 year olds, especially males, also make up a small percentage of the

spawning population. Coho salmon adults migrate and spawn in small streams that flow directly into the ocean, or tributaries and headwater creeks of larger rivers (Sandercock 1991, Moyle 2002). Adults migrate upstream to spawning grounds from September through late December with migration peaking in October and November. Spawning occurs mainly in November and December with fry emerging from the gravel in the spring, approximately 3 to 4 months after spawning. Juvenile rearing usually occurs in tributary streams with a gradient of 3 percent or less, although they may move up to streams of 4 percent or 5 percent gradient. Juvenile coho salmon may spend 1 to 2 years rearing in freshwater (Bell and Duffy 2007), or emigrate to an estuary shortly after emerging from spawning gravels (Tschaplinski 1988). Coho salmon juveniles are also known to redistribute into non-natal rearing streams, lakes, or ponds, often following rainstorms, where they continue to rear (Peterson 1982). At a length of 38 to 45 mm, fry may migrate upstream a considerable distance to reach lakes or other rearing areas (Godfrey 1965 *op. cit.* Sandercock 1991, Nickelson *et al.* 1992). Emigration from streams to the estuary and ocean generally takes place from March through May.

4.1.5.2 Current Distribution and Abundance

Although population-level estimates of abundance for most independent populations are lacking, available data indicate that spawner abundance has declined for all populations in the ESU and none of the seven diversity strata appears to support a single viable population as defined by McElhaney et al. (2000). Brown and Moyle (1991) estimated that naturally-spawned adult coho salmon runs in California streams were less than one percent of their abundance at mid-century, and that wild coho salmon populations in California did not exceed 100 to 1,300 individuals.

The listing of SONCC coho salmon includes all hatchery-produced coho salmon in the ESU range (70 FR 37160, June 28, 2005). CDFG (1994) summarized most information for the northern California portion of this ESU, and concluded that coho salmon in California, including hatchery stocks, have experienced at least a 70 percent decline in numbers since the 1960s. Coho salmon populations have been virtually eliminated in many streams, and adults are observed only every third year in some streams, suggesting that two of three brood cycles may have already been eliminated (CDFG 1994). Trinity River Hatchery maintains high production, with a significant number of hatchery SONCC coho salmon straying into the wild population (NMFS 2001). The Mad River Hatchery ceased coho salmon production in 1999. Iron Gate Hatchery has had a production goal of 75,000 juvenile coho salmon since 1966. This production goal had been substantially exceeded until 1994 when the hatchery reduced production to be more consistent with their goals. Brown et al. (1994) estimated that rivers and tributaries in the California portion of the SONCC coho salmon ESU produced an average of 7,080 naturally spawning coho salmon and 17,156 hatchery returns. Combining California run-size estimates with Rogue River estimates, Weitkamp et al. (1995) arrived at a rough minimum run-size estimate for the SONCC coho salmon ESU of about 10,000 natural fish and 20,000 hatchery fish.

The apparent decline in wild production in these rivers, in conjunction with significant hatchery production, suggests that natural populations of coho salmon are not self-sustaining (Weitkamp et al. 1995, Good et al. 2005). Coho salmon populations continue to be depressed relative to historical numbers, and there are strong indications that breeding groups have been lost from a significant percentage of streams within their historical range (Good et al. 2005).

Most of the 30 independent populations in the ESU are at high risk of extinction because they are below or likely below their depensation threshold. Sharr et al. (2000) modeled the probability of extinction of most Oregon Coast Natural populations and found that as spawner density dropped below four fish per mile (2.4 spawners/km), the risk of extinction rose rapidly. Chilcote (1999) tracked the collapse of four coho salmon populations in the Lower Columbia River and found the depensation threshold was 2.4 spawners/km. Using spawner-recruit relationships from 14 populations of coho salmon, Barrowman et al. (2003) found evidence of depensatory effects when spawner densities were less than 1 female per km (2 spawners/km). Small-population demographic risks are very likely to be significant when spawner density is below 0.6 spawner per km (Wainwright et al. 2008). Williams et al. (2008) estimated that this is approximately 1 spawner/IP-km and used this density for setting the depensation threshold. Because the depensation threshold for SONCC coho salmon populations is set at such a low density, populations that do not meet their depensation threshold are definitely at a high, if not a very high, risk of extinction.

In addition, populations that are below depensation have increased likelihood of being extirpated. Extirpations have already occurred in the Eel River basin and are likely in the interior Klamath River basin for one or all year classes (e.g., Shasta and Scott rivers), Bear River, and Mattole River. Yoshiyama and Moyle (2010) concluded that coho salmon populations in the Eel River basin appear to be headed for extirpation by 2025. Although long term spawner data are not available, both NMFS and CDFG believe the Lower Eel/Van Duzen River, Middle Mainstem Eel and Mainstem Eel River populations are very likely below the depensation threshold, and some brood years have low abundance or may even be absent in some areas (e.g., Shasta River, Scott River, Mattole River, Mainstem Eel River), which further restricts the diversity present in the ESU. The ESU's current genetic variability and variation in life history likely contribute significantly to long-term risk of extinction.

Many SONCC coho salmon populations have declined in abundance, which reflects declining productivity. For instance, the Shasta River population has decreased in abundance by almost 50 percent from one generation to the next (Williams *et al.* 2011). Data from Prairie Creek, Freshwater Creek, and the Rogue River basin also show recent negative trends. In general, SONCC coho salmon have declined substantially from historic levels. Because productivity appears to be negative for most, if not all SONCC coho salmon populations, this ESU is not currently viable in regard to population productivity.

NMFS recently completed a 5-year status review of the SONCC coho salmon ESU, including consideration of hatchery fish in the risk analysis (NMFS 2011). The status assessment involved viability attributes of abundance, productivity, spatial structure, and diversity, and concluded that this ESU remains at risk of becoming endangered in the foreseeable future. This conclusion was based on the facts that: the SONCC coho ESU has not demonstrated the recent increases in abundance that have been observed in the Oregon Coast Coho ESU; abundance continues to decline in areas not supported by hatcheries; new information on disease and associated mortality of wild and hatchery fish may be limiting recovery; and there is evidence of continuing adverse effects associated with degraded habitat. Based on this revised risk analysis, NMFS has proposed to retain SONCC coho on the threatened species list. Reviewers also considered new genetic and biogeographic information to evaluate geographic boundaries, and found no new information indicating that the current boundaries should change (NMFS 2011).

4.2 Factors Responsible for Salmonid Decline (ESU or DPS Scale)

4.2.1 Timber Harvest

Timber harvest and associated activities have occurred and continue to occur over a large portion of the range of the affected species. Timber harvest caused widespread increases in sediment delivery to channels through both increased landsliding and surface erosion from harvest units log decks, and logging roads. Much of the riparian vegetation was removed, reducing future sources of LWD needed to form and maintain stream habitat that salmonids depend on during various life stages.

Road construction, use, and maintenance, tree-felling, log hauling, slash disposal, site preparation for replanting, and soil compaction by logging equipment are all potential sources of fine sediment that could ultimately deliver to streams in the action area (Hicks *et al.* 1991, Murphy 1995). The potential for delivering sediment to streams increases as hillslope gradients increase (Murphy 1995). The soils in virgin forests generally resist surface erosion because their coarse texture and thick layer of organic material and moss prevent overland flow (Murphy 1995). All of the activities associated with timber management in the action area have contributed to decreases in the ability of forest soils to resist erosion and contribute to the production of non-point sources of stream pollution by fine sediment. Yarding activities that cause extensive soil disturbance and compaction can increase splash erosion and channelize overland flow. Site preparation and other actions that reduce or remove the protective humic layer can increase the potential for surface erosion (Hicks *et al.* 1991). Controlled fires can also consume downed wood that had been acting as sediment dams on hillslopes. After harvesting, root strength declines, often leading to slumps, landslides, and surface erosion (FEMAT 1993, Thomas *et al.* 1993). Riparian tree roots provide bank stability and streambank sloughing and erosion often increases if these trees are removed, leading to increases in sediment and loss of overhanging banks, which are important habitat for rearing Pacific salmonids (Murphy 1995). Where rates of timber harvest are high, the effects of individual harvest units on watercourses are cumulative. Therefore, in sub-watersheds where timber harvest is temporally and spatially concentrated, we expect that fine sediment delivery and associated habitat degradationwill be similarly concentrated.

In the smaller Class II and III streams, recruited wood usually cannot transported by stream flows, so logs remain in place and act as check-dams that store sediment eroded from hillsides (Reid 1998). Sediment storage in smaller streams can persist for decades (Nakamura and Swanson 1993). In assessing the characteristics of Class III watercourses, including within the Mad River watershed, Simpson (2002) found that coniferous woody debris was the predominant channel-grade control. Furthermore, in areas prone to debris flows, woody debris and adjacent riparian stands can provide roughness that limit the distance debris flows may travel down into channels and also functions to store and meter out sediment (Ketcheson and Froehlich 1978, Pacific Watershed Associates (PWA) 1998). For example, in Bear Creek, a tributary to the Eel River, PWA (1998) noted that debris flows now travel farther downstream and channel aggradation extends farther downstream because of inadequate large wood from landslide source areas and streamside vegetation.

On larger channels, wood also stores sediment and provides a critical element in the habitat of aquatic life forms (Spence *et al.* 1996, Reid 1998). Sullivan *et al.* (1987) found that woody debris forms abundant storage sites for sediment in forest streams as large as fourth-order (20 to 50 km^2 drainage area), where storage is otherwise limited by steep gradients and confinement of channels between valley walls. Studies of this storage function in Idaho by Megahan and Nowlin (1976) and in Oregon by Swanson and Lienkamper (1978) indicated that annual sediment yields from small-forested watersheds are commonly less than 10 percent of the sediment stored in channels.

In fish-bearing streams, large wood is also important for storing sediment, reducing habitat degradation from debris flows, storing water, which results in muted flood peaks, and its role as a habitat element becomes directly relevant for Pacific salmon species (Reid 1998). LWD alters the longitudinal profile and reduces the channel gradient, especially when log dams create slack pools above or plunge pools below them, or when they are sites of sediment accumulation (Swanston 1991).

Cumulatively, increased sediment delivery and reduced supply of large woody debris has led to widespread impacts to stream habitats and salmonids. These impacts include reduced spawning habitat quality, loss of pool habitat for adult holding and juvenile rearing, loss of velocity refugia, and increases in the levels and duration of turbidity, which reduce the ability of juvenile fish to feed and, in some cases, may cause physical harm by abrading the gills of individual fish. These changes in habitat have led to widespread decreases in the carrying capacity of streams that support salmonids which, in turn have reduced the likelihood of the recovery of NC steelhead, CC Chinook salmon, and SONCC coho salmon.

4.2.2 Road Construction, Use and Maintenance

Road construction has caused widespread adverse effects to salmonids (Furniss *et al.* 1991). Where roads cross salmonid-bearing streams, improperly placed culverts have eliminated or reduced salmonid access to many miles of stream habitat. Landslides and chronic road surface erosion are large sources of sediment across the affected species' ranges. Roads with inboard ditches increase peak flows, resulting in channel instability and habitat degradation and reduce summer base flows; thereby reducing summer rearing habitat. Roads have led to widespread impacts on salmonids by increasing the sediment loads. The consequent impacts on habitat include reductions in spawning, rearing and holding habitat, and increases in turbidity.

The delivery of road-related sediment to streams is either chronically delivered, or more episodic in nature. Chronic delivery, or surface erosion, occurs through rain splash and overland flow. Therefore, surface erosion occurs often and is associated with rainfall. More episodic delivery, on the order of every few years, occurs in the form of mass wasting events, or landslides, that deliver large volumes of sediment during large storm events.

Construction and use of road networks greatly accelerate erosion rates within a watershed (Haupt 1959, Swanson and Dyrness 1975, Swanston and Swanson 1976, Reid and Dunne 1984, Hagans and Weaver 1987). Existing road networks are a chronic source of sediment to streams (Swanston 1991) and often are the main cause of accelerated surface erosion in forests across the western United States (Harr and Nichols 1993). Processes initiated or affected by roads include

landslides, surface erosion, secondary surface erosion (landslide scars exposed to rain splash), and gullying. Roads and related ditch networks, which are often connected to streams via surface flow paths, provide a direct conduit for sediment to streams. Where roads and ditches are maintained periodically by blading, the amount of sediment delivered continuously to streams may temporarily increase as bare soil is exposed, and ditch roughness features which store and route sediment and armor the ditch are removed. Hagans and Weaver (1987) found that fluvial hillslope erosion associated with roads in the lower portions of the Redwood Creek watershed produced about as much sediment as landslide erosion between 1954 and 1980. The Mattole Salmon Group (1997) found, in the Mattole River watershed, which is south of the action area, that roads, including logging haul roads and skid trails, were the source of 76 percent of all erosion problems mapped in the watershed, although this figure does not specifically address road surface erosion. This suggests that roads are a primary source of sediment in managed watersheds. In particular, road surface erosion is affected by traffic, which increases sediment yields substantially (Reid and Dunne 1984). Other important factors that affect road surface erosion include condition of the road surface, timing of when the roads are used in relation to rainfall, road prism moisture content, location of the road relative to watercourses, methods used to construct the road, the steepness on which the road is located, and if the road is insloped, outsloped, or crowned. Roads and their associated effects to stream habitat will continue to affect the recovery of SONCC coho salmon, CC Chinook salmon, and NC steelhead populations.

4.2.3 Hatcheries

Hatchery operations potentially conflict with salmon recovery. Three large mitigation hatcheries release roughly 14,215,000 hatchery salmonids into SONCC coho salmon ESU rivers annually. Additionally, a couple of smaller hatcheries, such as Mad River Hatchery and Rowdy Creek Hatchery (Smith River) produce hatchery fish. The Mad River hatchery releases fish into the Mad River which has SONCC coho salmon, CC Chinook salmon and NC steelhead. Both intra- and inter-specific interactions between hatchery and wild salmonids occur in freshwater and saltwater.

Spawning by hatchery salmon is often not controlled (ISAB 2002). Hatchery fish also stray into other rivers and streams, transferring genes from hatchery populations into naturally spawning populations (Pearse *et al.* 2007). This is thought to be problematic because hatchery programs alter the genetic composition (Reisenbichler and Rubin 1999, Ford 2002), phenotypic traits (Hard *et al.* 2000, Kostow 2004), and behavior (Berejikian *et al.* 1996, Jonsson 1997) of hatchery-reared fish. Genetic interactions between hatchery and naturally produced stocks decrease the amount of genetic and phenotypic diversity of a species by homogenizing once disparate traits of hatchery and natural fish. The result has been progeny with lower survival (McGinnity *et al.* 2003, Kostow 2004) and ultimately, a reduction in the fitness of the natural stock (Reisenbichler and McIntyre 1977, Chilcote 2003, Araki *et al.* 2007), and outbreeding depression (Reisenbichler and Rubin 1999).

Flagg *et al.* (2000) found that, except in situations of low wild fish density, increasing releases of hatchery fish leads to displacement of wild fish from portions of their habitat. Competition between hatchery- and naturally-produced salmonids has also been found to lead to reduced growth of naturally produced fish (McMichael *et al.* 1997). Kostow *et al.* (2003) and Kostow

and Zhou (2006) found that over the duration of the steelhead hatchery program on the Clackamas River, Oregon, the number of hatchery steelhead in the upper basin regularly caused the total number of steelhead to exceed carrying capacity, triggering density-dependent mechanisms that reduced the natural population. Competition between hatchery and natural salmonids in the ocean also leads to density-dependent mechanisms that affect natural salmonid populations, especially during periods of poor ocean conditions (Beamish *et al.* 1997a, Levin *et al.* 2001, Sweeting *et al.* 2003).

NMFS specifically identified the past practices of the Mad River Hatchery as potentially damaging to NC steelhead. CDFG out-planted non-indigenous Mad River Hatchery brood stocks to other streams within the ESU, and attempted to cultivate a run of non-indigenous summer steelhead within the Mad River. CDFG ended these practices in 1996. The currently operating Mad River Hatchery, Trinity River Hatchery, Iron Gate Hatchery, and Rowdy Creek Hatchery operate in areas overlapping the ESUs and DPS (in part) and have all been identified as having potentially harmful effects to wild salmon populations.

4.2.4 Water Diversions and Habitat Blockages

Stream-flow diversions are common throughout the species' ranges. Unscreened diversions for agricultural, domestic and industrial uses were a significant factor for salmonid declines in many basins. Reduced stream-flows due to diversions reduce the amount of habitat available to salmonids and can degrade water quality, such as causing water temperatures to elevate more easily. Reductions in water quantity will reduce carrying capacity of an affected stream reach. Where warm-water return flows enter a stream, fish may seek reaches with cooler water, thus increasing competitive pressures in other areas.

Habitat blockages have occurred in relation to road construction as discussed previously. However, hydropower, flood control, and water supply dams of different municipal and private entities, particularly in the Klamath Basin, have permanently blocked or hindered salmonid access to historical spawning and rearing grounds. Since 1908, the Potter Valley Project dams have blocked access to historic salmonid habitat within the Eel River watershed. As a result, salmon and steelhead populations have been confined to lower elevation mainstem habitat that historically only were used for migration and rearing. Population abundances have declined in many streams due to decreased quantity, quality, and spatial distribution of spawning and rearing habitat. Higher temperatures at these lower elevations during late summer and fall are also a major stressor to adult and juvenile salmonids.

4.2.5 Predation

Predation probably did not play a major role in the decline of salmon populations; however, it may have had substantial impacts at local levels. For example, Higgins *et al.* (1992) and CDFG (1994) observed Sacramento River pikeminnow in the Eel River basin, which are considered a major threat to native salmonids (this is discussed further in the *Environmental Baseline* section). Furthermore, populations of California sea lions and Pacific harbor seals, known predators of salmonids that occur in most estuaries and rivers where salmonid runs occur on the West Coast, have increased to historical levels because harvest of these animals has been prohibited by the Marine Mammal Protection Act of 1972 (Fresh 1997). However, salmonids appear to be a minor

component of the diet of many marine mammals (Scheffer and Sperry 1931, Jameson and Kenyon 1977, Graybill 1981, Brown and Mate 1983, Roffe and Mate 1984, Hanson 1993). In the initial rule listing the SONCC coho salmon ESU (62 FR 24588, May 6, 1997), for example, NMFS indicated that it was unlikely that pinniped predation was a significant factor in the decline of coho salmon on the West Coast, although they may be a threat to existing depressed local populations. NMFS (1997) determined that although pinniped predation did not cause the decline of salmonid populations, predation may preclude recovery of these populations in localized areas where they co-occur with salmonids (especially where salmonids concentrate or passage may be constricted). Specific areas where pinniped predation may preclude recovery cannot be determined without extensive studies.

Normally, predators play an important role in the ecosystem, culling out unfit individuals, thereby strengthening the species as a whole. The increased effect of certain predators has been, to a large degree, the result of ecosystem modification. Therefore, it would seem more likely that increased predation is but a symptom of a much larger problem, namely, habitat modification and a decrease in water quantity and quality. With the decrease in quality riverine and estuarine habitats, increased predation by freshwater, avian, and marine predators will occur. Without adequate avoidance habitat (*e.g.*, deep pools and estuaries, and undercut banks) and adequate migration and rearing flows, predation may play a role in the reduction of some coho salmon, Chinook salmon, and steelhead populations.

4.2.6 Disease

Relative to effects of overfishing, habitat degradation, and hatchery practices, disease is not likely to have played a major role in the decline of salmon populations. However, disease may limit recovery of salmon populations in some areas. Although naturally occurring, many of the disease issues salmon currently face have been exacerbated by human-induced environmental factors such as water regulation (damming and diverting) and habitat alteration.

Salmonids are exposed to numerous bacterial, protozoan, viral, and parasitic organisms in spawning and rearing areas, hatcheries, migratory routes, and the marine environment. However, disease outbreaks result only when the complex interaction among host, pathogen, and environment is altered. Natural populations of salmon have co-evolved with diseases that are endemic to the areas they inhabit and have developed levels of resistance to these pathogens. In general, diseases do not cause significant mortality in native coho salmon stocks in natural habitats (Shapovalov and Taft 1954, Bryant 1994); however, our understanding of mortality caused by pathogens in the wild is limited by the difficulty in determining the proximate and ultimate causes of death (*e.g.*, when fish weakened by disease are consumed by predators). Within the last few decades, the introduction of pathogens and prevalence of disease in wild stocks has become an increasing concern. Diseases will likely continue to play some role in restricting the recovery of coho salmon, CC Chinook salmon, and NC steelhead as long as habitat remains degraded and physiological stress compromises the immune response of individuals.

4.2.7 Fish Harvest

Salmon and steelhead once supported important tribal, commercial, and recreation fisheries. Harvest of adult salmonids for commercial and recreational fisheries has been identified as a significant factor in their decline. The proportion of harvest taken by sport and commercial fisheries has varied over the years according to abundance, social, and economic priorities. Steelhead are rarely caught in the ocean fisheries. Ocean salmon fisheries are managed by NMFS to achieve Federal conservation goals for west coast salmon in the Pacific Coast Salmon Fishery Management Plan (FMP). The goals specify numbers of adults that must be allowed to spawn annually, or maximum allowable adult harvest rates. The key stocks that comprise the ocean fisheries in California are Klamath River fall-run Chinook salmon and Sacramento River fall-run Chinook salmon which are not listed, but co-mingle in the ocean with threatened CC Chinook salmon. In addition to the FMP goals, salmon fisheries must meet requirements developed through NMFS intra-agency section 7 consultations.

Ocean exploitation rates have dropped substantially in response to the non-retention regulations for coho salmon put in place in 1994, as well as general reductions in Chinook salmon-directed effort. Directed recreational river harvest of coho salmon has not been allowed within the SONCC coho salmon ESU since 1994 (CDFG 2002). However, Tribal harvest for subsistence, ceremonial, and commercial purposes by the Yurok, Hoopa Valley, and Karuk tribes occurs in the Klamath and Trinity rivers. SONCC-origin coho salmon that migrate north of Cape Blanco experience incidental morality due to hooking and handling in this fishery; however, estimated total incidental mortality from this fishery and Chinook-directed fisheries north of Humbug Mountain is less than 7 percent of the total mortality of coho salmon between 1999 and 2003 (PFMC 1999, 2000, 2003).

Since 1998, total fishery harvest rates have been limited to no more than 13 percent on Rogue/Klamath hatchery coho salmon (surrogate stock) and no retention of coho salmon in California ocean fisheries. Only marked hatchery coho salmon can be legally harvested in the Rogue and Klamath Rivers. All other recreational coho salmon fisheries in the Oregon portion of the ESU are closed.

Coho salmon harvested by Native American tribes is primarily incidental to larger Chinook salmon subsistence fisheries in the Klamath and Trinity Rivers. Tribal harvest was not likely a major factor in the decline of coho salmon. The Yurok fishery, which has been monitored since 1992, has resulted in annual harvest that ranged from 27 to 1,168 fish caught annually. Based on estimates of upstream escapement (in-river spawners and hatchery returns) this fishery is thought to amount to an average harvest rate of 4.4 percent for the period (CDFG 2004). Harvest management practiced by tribes is conservative and has resulted in limited effects on SONCC coho salmon.

The commercial and recreational ocean fisheries for salmon and steelhead were closed off California in 2008, due to record low returns of Sacramento River fall-run Chinook salmon and were extended through the 2009-2010 fishing season. The only exception to the 2009-2010 closure was a 10-day recreational ocean salmon season along the northern California coast targeting Klamath River fall-run Chinook salmon, due to projected spawner estimates surpassing conservation goals. Closure of the commercial and recreational fisheries likely decreased the

incidental harvest of listed salmonids, and therefore assisted in their recovery. A full season fishery reopened in 2011.

4.2.8 Climate Change

Climate change is postulated to have a negative impact on salmonids throughout the Pacific Northwest due to large reductions in available freshwater habitat (Battin *et al.* 2007). Widespread declines in springtime snow water equivalent (SWE), which is the amount of water contained in the snowpack, have occurred in much of the North American West since the 1920s, especially since mid-century (Knowles and Cayan 2004, Mote 2006). This decrease in SWE can be largely attributed to a general warming trend in the western United States since the early 1900s (Mote *et al.* 2005, Regonda *et al.* 2005, Mote 2006), even though there have been modest upward precipitation trends in the western United States since the early 1900s (Hamlet *et al.* 2005). The largest decreases in SWE are taking place at low to mid elevations (Mote 2006, Van Kirk and Naman 2008) because the warming trend overwhelms the effects of increased precipitation (Hamlet *et al.* 2005, Mote *et al.* 2005, Mote 2006). These climactic changes have resulted in earlier onsets of springtime snowmelt and streamflow across western North America (Hamlet and Lettenmaier 1999, Regonda *et al.* 2005, Stewart *et al.* 2005), as well as lower flows in the summer (Hamlet and Lettenmaier 1999, Stewart *et al.* 2005).

The projected runoff-timing trends over the course of the twenty first century are most pronounced in the Pacific Northwest, Sierra Nevada, and Rocky Mountain regions, where the eventual temporal centroid of streamflow (*i.e.*, peak streamflow) shifts 20 to 40 days earlier in many streams (Stewart *et al.* 2005). Although climate models diverge with respect to future trends in precipitation, there is widespread agreement that the trend toward lower SWE and earlier snowmelt will continue (Zhu *et al*. 2005, Vicuna *et al*. 2007). Thus, availability of water resources under future climate scenarios is expected to be most limited during the late summer (Gleick and Chalecki 1999, Miles *et al*. 2000). A one-month advance in timing centroid of stream flow would also increase the length of the summer drought that characterizes much of western North America, with important consequences for water supply, ecosystem, and wildfire management (Stewart *et al.* 2005). These changes in peak streamflow timing and snowpack will negatively affect salmonid populations due to habitat loss associated with lower water flows, higher stream temperatures, and increased human demand for water resources.

The global effects of climate change on river systems and salmon must be evaluated in the context ofthe local effects of logging, water utilization, harvesting, hatchery interactions, and development within river systems (Bradford and Irvine 2000, Mayer 2008, Van Kirk and Naman 2008). For example, total water withdrawal in California, Idaho, Oregon and Washington increased 82 percent between 1950 and 2000, with irrigation accounting for nearly half of this increase (MacKichan 1951, Hutson *et al.* 2004), while during the same period climate change was taking place. Therefore, changes in climate are likely affecting the resilience and recovery of salmonid habitats and consequent threatened status of CC Chinook salmon, SONCC coho salmon, and NC steelhead.

4.2.9 Ocean Conditions

Variability in ocean productivity has been shown to affect fisheries production both positively and negatively (Chavez *et al.* 2003). Beamish and Bouillion (1993) showed a strong correlation between North Pacific salmon production and marine environmental factors (*e.g.*, copepod production and the Aleutian Low Pressure Index) from 1925 to 1989. Beamish *et al.* (1997b) noted decadal-scale changes in the production of Fraser River sockeye salmon that they attributed to changes in the productivity of the marine environment. Warm ocean regimes are characterized by lower ocean productivity (Behrenfeld *et al.* 2006, Wells *et al.* 2006), which may affect salmon by limiting the availability of nutrients regulating the food supply, thereby increasing competition for food (Beamish and Mahnken 2001). Data from across the range of coho salmon on the coast of California and Oregon reveal there was a 72 percent decline in returning adults in 2007/08 compared to the same cohort in 2004/05 (MacFarlane *et al.* 2008). The Wells Ocean Productivity Index, an accurate measure of Central California ocean productivity, revealed poor conditions during the spring and summer of 2006, when juvenile coho salmon and Chinook salmon from the 2004/05 spawn entered the ocean (McFarlane *et al.* 2008). Data gathered by NMFS suggest that strong upwelling in the spring of 2007 may have resulted in better ocean conditions for the 2007 coho salmon cohort (MacFarlane *et al.* 2008). The quick response of salmonid populations to changes in ocean conditions (MacFarlane *et al.* 2008) strongly suggests that density dependent mortality of salmonids is a mechanism at work in the ocean (Beamish *et al.* 1997a, Levin *et al.* 2001, Greene and Beechie 2004). Long-term declines in the status of CC Chinook salmon, coho salmon, and NC steelhead are likely tied to decadal or longer changes in ocean productivity.

4.2.10 Marine Derived Nutrients

Marine-derived nutrients (MDN) are nutrients and carbon that accumulate in the biomass of salmonids while they are feeding in the ocean, and transferred to streams when salmon return to spawn and die. The return of salmonids to rivers makes a significant contribution to the flora and fauna of both terrestrial and riverine ecosystems (Gresh *et al.* 2000), and has been shown to be vital for the growth of juvenile salmonids (Bilby *et al.* 1996, 1998). Fisheries, hatcheries, and depressed and declining populations reduce the amount of marine-derived nutrients in streams ecosystems. Evidence of the role of MDN and energy in ecosystems suggests this deficit may result in a failure of the carcass-dependent food chain contributing to the downward spiral of salmonid abundance (Bilby *et al.* 1996). Reduction of MDN to watersheds is a consequence of the past century of decline in salmon abundance (Gresh *et al.* 2000) and is likely contributing to continued low population abundance and the threatened status of the NC steelhead DPS, CC Chinook salmon ESU, and the SONCC coho salmon ESU.

4.3 Viability of the ESUs/DPS

Frequently, an ESU or DPS is composed of multiple populations. The viability of an ESU or DPS can be assessed by considering the viability of its component populations, and the effects of a proposed action on an ESU or DPS can be assessed by first considering the effects of the proposed action on its component populations. To integrate population information into viability criteria at the ESU/DPS scale, NMFS has identified “diversity strata”, which are “groups of populations that span the diversity and distribution that currently exists or historically existed within an ESU” (Bjorkstedt *et al.* 2005). Diversity strata account for the important variability

that exists in environments and in the physical characteristics and genetic makeup of salmonids. Bjorkstedt *et al.* (2005) and Williams *et al*. (2006) provide a set of rules that are expected to result in certain configurations of populations within each diversity stratum that they believe will result in a viable ESU. A population is part of a particular diversity stratum, which is part of a particular ESU or DPS. The ESU or DPS is not viable unless all the diversity strata comprising the ESU or DPS are viable, and each diversity stratum is not viable unless the majority of the populations it comprises meet the criteria described by Bjorkstedt *et al.* (2005) and Williams *et al.* (2006). A diversity stratum could be considered viable even if one or more of its component populations were not viable, if the remaining populations met all the viability characteristics including, abundance, productivity, diversity, and spatial structure (McElhany *et al.* 2000, Bjorkstedt *et al*. 2005, Williams *et al*. 2006).

In this Opinion, the current viability of the Salt River and Lower Eel River populations of Chinook salmon, coho salmon, and steelhead is discussed in the *Environmental Baseline*. Then the effects of the project on the viability of the Salt River and Lower Eel River population of coho salmon, Chinook salmon, and steelhead will be assessed in the *Effects of the Action* section. Finally, the implications for viability of the ESUs and DPS will be analyzed in the *Integration and Synthesis* section.

In order to determine the current viability of each ESU or DPS, we use the concept of a Viable Salmonid Population (VSP) and its parameters for evaluating populations (McElhany *et al.* 2000). The four parameters are population size, productivity, spatial structure, and diversity. Each parameter is described below, followed by an assessment of the viability of each parameter for each ESU or DPS that may be affected by the project.

4.3.1 Population Size

Population size provides an indication of the risk of extinction that a population faces. For instance, smaller populations may be at a greater risk of extinction than large populations, primarily because the processes that affect populations may operate differently in small populations than in large populations (McElhany *et al.* 2000). One risk of low population size is depensation. Depensation occurs when populations are reduced to very low densities and per capita growth rates decrease as a result of a variety of mechanisms [*e.g*., failure to find mates and therefore reduced probability of fertilization, failure to saturate predator populations (Liermann and Hilborn 2001)]. Depensation results in a negative feedback that accelerates a decline toward extinction (Williams *et al.* 2007).

Data for the SONCC coho salmon ESU, CC Chinook salmon, and the NC steelhead DPS concluded are insufficient to set specific numeric population targets for viability (Spence *et al.* 2007, Williams *et al.* 2007). In the absence of such targets, McElhany *et al.* (2000) suggested ESUs, ". . . have been historically self-sustaining and the historical number and distribution of populations serves as a useful 'default' goal in maintaining viable ESUs."

4.3.1.1 NC Steelhead

Reviewers participating in the most recent status review determined these data showed population abundances were low relative to historical estimates, and that summer-run steelhead abundance was very low (NMFS 2011a). NMFS concludes this DPS falls far short of McElhany

et al.'s (2000) 'default' goal of historic population numbers and distribution and is therefore not viable in regards to population size (abundance) (NMFS 2011a).

4.3.1.2 SONCC Coho Salmon

NMFS 2005 status review concluded SONCC coho salmon populations ". . . continue to be depressed relative to historical numbers, and [there are] strong indications that breeding groups have been lost from a significant percentage of streams within their historical range (Good *et al.* 2005)." NMFS concludes this ESU falls far short of McElhany *et al.*'s (2000) 'default' goal of historic population numbers and distribution and is therefore not viable in regards to the population size VSP parameter (NMFS 2011).

Since the 2005 review, the apparent negative trends across the ESU are of great concern, as is the lack of information necessary to determine if there has been a substantial improvement in freshwater habitat and survival. However, these recent negative trends must be considered in the context of the apparent extremely low marine survival rates over the past five years that most likely contributed to the observed declines. Overall, this new information, while cause for concern, does not appear to indicate there has been a change in biological extinction risk since the last status review (NMFS 2011).

4.3.1.3 CC Chinook Salmon

The most recent status review found continued evidence of: (1) low population sizes relative to historical abundance, (2) mixed trends in the few time series of abundance indices available for analysis, and (3) low abundances and potential extirpations of populations in the southern part of the ESU (NMFS 2011). NMFS concludes this ESU falls far short of McElhany *et al.*'s (2000) 'default' goal of historic population numbers and distribution and is therefore not viable in regards to population size (NMFS 2011b).

4.3.2 Population Productivity

The productivity (growth) of a population (*i.e.*, the number of individuals generated over a specified time interval) can reflect conditions (*e.g.*, environmental conditions) that influence the dynamics of a population and determine abundance. In turn, the productivity of a population allows an understanding of the performance of a population across the landscape and habitats in which it exists and its response to those habitats (McElhany *et al.* 2000).

4.3.2.1 NC Steelhead

As described in section 4.1.4.2, populations of NC steelhead have declined substantially from historic levels. As productivity does not appear sufficient to maintain viable abundances in many NC steelhead populations, NMFS concludes this DPS is not viable in regards to population productivity (NMFS 2011a).

4.3.2.2 SONCC Coho Salmon

As described in the section 4.1.5.2, populations of SONCC coho salmon have declined substantially from historic levels. As productivity does not appear sufficient to maintain viable abundances in many SONCC coho salmon populations, NMFS concludes this ESU is not viable in regards to population productivity (NMFS 2011).

4.3.2.3 CC Chinook Salmon

As described in section 4.1.2.2, populations of CC Chinook salmon have declined substantially from historic levels. As productivity does not appear sufficient to maintain viable abundances in many CC Chinook salmon populations, NMFS concludes this ESU is not viable in regards to population productivity (NMFS 2011b).

4.3.3 Spatial Structure

The spatial structure of a population is important because the population structure can affect evolutionary processes and, therefore, alter the ability of a population to adapt to spatial or temporal changes in the species' environment (McElhany *et al*. 2000).

4.3.3.1 NC Steelhead

Experts consulted during the 2005 status review gave this DPS a mean risk score of 2.2 (out of 5) for the spatial structure and connectivity VSP category (Good *et al.* 2005), indicating it is unlikely this factor contributes significantly to risk of extinction by itself, but there is some concern that it may, in combination with other factors. Blockages to fish passage exist on two major rivers in the DPS and on numerous small tributaries (Good *et al.* 2005). These blockages degrade the spatial structure and connectivity of populations within the DPS. As the 'default' historic spatial processes described by McElhany *et al.* (2000) have likely not been preserved, In 2011, NMFS did not identify any major improvements to spatial structure since the 2005 review (NMFS 2011a). Therefore, NMFS concludes this DPS is not viable in regards to spatial structure.

4.3.3.2 SONCC Coho Salmon

Low levels of observed presence in historically occupied coho salmon streams (32 to 56 percent from 1986 to 2000) indicate continued low abundance in the California portion of the SONCC coho salmon ESU. The relatively high occupancy rate of historical streams observed in brood year 2001 suggests that much habitat remains accessible to coho salmon (70 FR 37160, June 28, 2005). Brown *et al*. (1994) summarized survey information on 115 streams within the SONCC coho salmon ESU, of which 73 (64 percent) still supported coho salmon runs while 42 (36 percent) did not. The streams Brown *et al*. (1994) identified as presently lacking coho salmon runs were all tributaries of the Klamath River and Eel River basins. The Biological Review Team (BRT) was also concerned about the loss of local populations in the Trinity, Klamath, and Rogue River basins (70 FR 37160, June 28, 2005). CDFG (2002) reported a decline in SONCC coho salmon occupancy, with the percent reduction dependent on the data sets used. Although there is considerable year-to-year variation in estimated occupancy rates, it appears that there has been no dramatic change in the percent of coho salmon streams occupied from the late 1980s and early 1990s to 2000 (Good *et al*. 2005). In summary, recent information for SONCC coho salmon indicates that their distribution within the ESU has been reduced and fragmented, as evidenced by an increasing number of previously occupied streams from which they are now absent (NMFS 2001). However, extant populations can still be found in all major river basins within the ESU (70 FR 37160, June 28, 2005).

Experts consulted during the 2005 status review gave this ESU a mean risk score of 3.1 (out of 5) for the spatial structure and connectivity VSP category (Good *et al.* 2005), indicating its

current spatial structure contributes significantly to long-term risk of extinction but does not in itself constitute a danger of extinction in the near future. In 2011, NMFS concluded that the spatial structure of the SONCC coho salmon ESU continues to degrade. As the historic spatial processes described by McElhany *et al.* (2000) have likely not been preserved, due to the habitat fragmentation described above, NMFS concludes this ESU is not viable in regards to spatial structure.

4.3.3.3 Chinook Salmon

Experts consulted during the 2005 status review gave this ESU a mean risk score of 3.2 (out of 5) for the spatial structure and connectivity VSP category (Good *et al.* 2005), indicating its current spatial structure contributes significantly to long-term risk of extinction but does not in itself constitute a danger of extinction in the near future. However, Good *et al.* (2005) found that "reduction in geographic distribution, particularly for spring-run Chinook [salmon], and for basins in the southern portion of the ESU, continues to present substantial risk." In 2011, NMFS noted that there has been no improvement since the 2005 review (NMFS 2011b). As the 'default' historic spatial processes described by McElhany *et al.* (2000) have likely not been preserved, due to the reduction in geographic distribution described above, NMFS concludes this ESU is not viable in regards to spatial structure.

4.3.4 Diversity

Diversity, both genetic and behavioral, is critical to success in a changing environment. Salmonids express variation in a suite of traits, such as anadromy, morphology, fecundity, run timing, spawn timing, juvenile behavior, age at smolting, age at maturity, egg size, developmental rate, ocean distribution patterns, male and female spawning behavior, and physiology and molecular genetic characteristics. The more diverse these traits (or the more these traits are not restricted), the more diverse a population is, and the more likely that individuals, and therefore the species, would survive and reproduce in the face of environmental variation (McElhany *et al.* 2000). However, when this diversity is reduced due to loss of entire life history strategies *(e.g*., loss of summer-run NC steelhead and spring-run CC Chinook salmon), or to loss of habitat used by fish exhibiting variation in life history traits, the resilience of the species to withstand stochastic events is diminished.

Genetic variability of wild stocks is maintained, in part, by straying from natural populations in nearby streams, which results in gene flow and often sustains or even increases the genetic diversity of a population over time. Straying is a normal and important part of the life history and evolution of Pacific salmon (Quinn 2005), but human activities can increase the rate of straying and cause more genetic interaction between populations than would naturally occur. Founding hatchery populations with broodstock from outside the watershed can make straying more common, as seen in the Columbia River (Pascual *et al*. 1995). Therefore, the genetic makeup of hatchery steelhead from the Mad River could detrimentally affect steelhead in many other rivers within and even outside the geographic range of the NC steelhead DPS. Excessive straying can also be detrimental to wild fish populations born in their natal streams. When habitat becomes degraded, or inaccessible due to dams or road crossings, salmonid spatial distribution can become fragmented. In this situation, straying into non-natal streams is likely to increase when salmonids are denied access to their natal areas and are forced to enter other

streams that are accessible. Increased stray rates would be expected to reduce population viability, particularly if the strays are accessing unsuitable habitat or are mating with genetically unrelated individuals (McElhany *et al*. 2000).

4.3.4.1 NC Steelhead

Millions of steelhead from outside the Mad River or outside the DPS have been stocked into rivers in the NC steelhead DPS many times since the 1970s, but has since ceased. Bjorkstedt *et al.* (2005) documented 39 separate releases of this kind, and many of these releases occurred over multiple years. Of particular concern is the practice of rearing Eel River-derived steelhead in a hatchery on the Mad River before restocking them into the Eel River (Bjorkstedt *et al.* 2005). Over 10 years, more than one-half million yearlings were reared and released in this way. This practice may have reduced the effectiveness of adult homing to the Eel River (Bjorkstedt *et al.* 2005). In addition, the abundance of summer-run steelhead was considered "very low" in 1996 (Good *et al.* 2005), indicating an important part of the life history diversity in this DPS may be at risk.

Experts consulted during the 2005 status review gave this DPS a mean risk score of 2.5 (out of 5) for the diversity VSP category (Good *et al.* 2005), indicating this factor may contribute significantly to the long-term risk of extinction, but does not itself constitute a danger of extinction in the near future. In the most recent status review (NMFS 2011a), the abundance and distribution of summer-run steelhead remained a key concern. NMFS concludes the current behavioral diversity in this ESU is much reduced compared to historic levels, so by McElhany's criteria, it is not viable in regards to the diversity VSP parameter. In addition, the genetic integrity of the DPS may have been compromised by hatchery introductions.

4.3.4.2 SONCC Coho Salmon

Genetic variability is important because differing genetic traits favor a population being able to survive and reproduce under changing environmental conditions. With regard to the SONCC coho salmon ESU, human activities (including construction of migration barriers, *e.g*., Iron Gate Dam on the Klamath River and Lewiston Dam on the Trinity River) have eliminated portions of some coho salmon populations from the ESU. In addition, runs of coho salmon within the Klamath River basin are now composed largely of hatchery fish from Iron Gate and Trinity River Hatcheries.

The high hatchery production in some systems in the SONCC coho salmon ESU may mask trends in ESU population structure and pose risks to ESU diversity (70 FR 37160, June 28, 2005). NMFS determined that the Cole Rivers Hatchery, Trinity River Hatchery, and Iron Gate Hatchery coho salmon hatchery programs are part of the ESU, and that these artificially propagated stocks are no more divergent relative to the local natural populations than what would be expected between closely related natural populations within the ESU (70 FR 37160, June 28, 2005). Within the 10 historical populations that have dams, 26.4 percent of historical habitat is currently located upstream of the dams (Table 5 in Williams *et al*. 2007). Loss of or limiting spawning and rearing opportunities are expected to adversely affect the species' basic demographic and evolutionary processes, causing a reduced potential that the ESU can withstand environmental fluctuations. Activities that affect evolutionary processes (*e.g*., natural selection) have the potential to alter the diversity of the species.

The primary factors affecting the diversity of SONCC coho salmon appear to be the influence of hatcheries and out-of-basin introductions. In addition, some brood years have abnormally low abundance levels or may even be absent in some areas (*e.g.,* Shasta River and Scott River), further restricting the diversity present in the ESU. Experts consulted during the 2005 status review gave this ESU a mean risk score of 2.8 (out of 5) for the diversity VSP category (Good *et al.* 2005). In 2011, NMFS concluded that populations have continued to decline. NMFS concludes the current phenotypic diversity in this ESU is much reduced compared to historic levels, and is not viable in regards to the diversity VSP parameter.

4.3.4.3 Chinook Salmon

Experts consulted during the 2005 status review gave this ESU a mean risk score of 3.1 (out of 5) for the diversity VSP category (Good *et al.* 2005). This score indicates the ESU's current genetic variability and variation in life history factors contribute significantly to long-term risk of extinction but, alone, does not constitute a danger of extinction in the near future. Therefore, low genetic diversity is not the most important factor to this ESU's viability. In 2011, NMFS concluded that the CC Chinook salmon ESU is not viable in regards to the diversity VSP parameter (NMFS 2011b).

4.3.5 Summary

4.3.5.1 NC Steelhead

Based on the above descriptions of the population viability parameters, and qualitative viability criteria presented in Spence *et al.* (2007), NMFS believes that the NC steelhead DPS is currently not viable and is at an elevated risk of extinction.

4.3.5.2 SONCC Coho Salmon

Based on the above descriptions of the population viability parameters, and qualitative viability criteria presented in Williams *et al*. (2007), NMFS believes that the SONCC coho salmon ESU is currently not viable and is at moderate risk of extinction.

4.3.5.3 CC Chinook Salmon

Based on the above descriptions of the population viability parameters, and qualitative viability criteria presented in Williams *et al*. (2007), NMFS believes that the CC Chinook salmon ESU is currently not viable and is at moderate risk of extinction.

5. STATUS OF CRITICAL HABITAT

This Opinion analyzes the effects of the project on critical habitat for SONCC coho salmon (64 FR 24049, May 5, 1999), CC Chinook salmon (70 FR 52488, September 2, 2005), and NC steelhead (70 FR 52488, September 2, 2005).

Critical habitat is defined in the ESA as the specific areas within the geographical areas occupied by the species, at the time it is listed, on which are found those physical and biological features essential to the conservation of the species and which may require special management considerations or protection, or specific areas outside the geographical area occupied by the

species at the time it is listed when the Secretary determines that such areas are essential for the conservation of listed species.

This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 C.F.R. 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

The ESA defines conservation as "to use all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to the ESA are no longer necessary." As a result, NMFS approaches its "destruction and adverse modification" determinations by examining the effects of actions on the conservation value of the designated critical habitat, that is, the value of the critical habitat for the conservation of threatened or endangered species.

5.1 NC Steelhead and CC Chinook Salmon

Designated critical habitat for NC steelhead and CC Chinook salmon includes the stream channels up to the ordinary high water line (50 CFR Part 226.211). In areas where the ordinary high water line is not defined pursuant to 50 CFR Part 226.211, the lateral extent is defined by the bankfull elevation. 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.

NMFS designated critical habitat for NC steelhead as occupied watersheds from the Redwood Creek watershed, south to and including the Gualala River watershed. Critical habitat for CC Chinook salmon is designated as occupied watersheds from the Redwood Creek watershed, south to and including the Russian River watershed. Humboldt Bay and the Eel River estuary contain designated critical habitat for both the NC steelhead DPS and CC Chinook salmon ESU. Some areas within the geographic range were excluded due to economic considerations or because they overlap with Indian lands (70 FR 52488, September 2, 2005).

The action area includes designated critical habitat for NC steelhead and CC Chinook salmon. In designating critical habitat for NC steelhead and CC Chinook salmon, NMFS focused on the known primary constituent elements (PCEs) essential for the conservation of each species. 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 and NC steelhead critical habitats 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 (70 FR 52488, September 2, 2005).

5.2 SONCC Coho Salmon

Critical habitat for the SONCC coho salmon ESU encompasses accessible reaches of all rivers (including estuarine areas and tributaries) between Cape Blanco, Oregon and Punta Gorda,

California (64 FR 24049, May 5, 1999). Excluded are: (1) areas above specific dams identified in the FR notice, (2) areas above longstanding natural impassible barriers (*i.e.*, natural waterfalls in existence for at least several hundred years), and (3) tribal lands.

The action area includes designated critical habitat for SONCC coho salmon. In designating critical habitat for SONCC coho salmon, NMFS focused on the known physical and biological features within the designated area that are essential to the conservation of the species. These essential features may include, but are not limited to, spawning sites, food resources, water quality and quantity, and riparian vegetation. Within the essential habitat types (spawning, rearing, migration corridors), essential features of coho 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, and (10) safe passage conditions (64 FR 24049, May 5, 1999). The current condition of critical habitat for SONCC coho salmon is discussed in the factors affecting the species below.

5.3 Conservation Value of Critical Habitat

The essential habitat types of designated critical habitat for SONCC coho salmon and PCE of designated critical habitat for NC steelhead and CC Chinook salmon are those accessible freshwater habitat areas that support spawning, incubation and rearing, migratory corridors free of obstruction or excessive predation, and estuarine areas with good water quality and that are free of excessive predation. Timber harvest and associated activities, road construction, urbanization and increased impervious surfaces, migration barriers, water diversions, and large dams throughout a large portion of the freshwater range of the ESUs and DPS continue to result in habitat degradation, reduction of spawning and rearing habitats, and reduction of stream flows. The result of these continuing land management practices in many locations has limited reproductive success, reduced rearing habitat quality and quantity, and caused migration barriers to both juveniles and adults. These factors limit the conservation value *(i.e.*, limit the ability of habitat to contribute to the conservation of the species) of designated critical habitat within freshwater habitats at the ESU/DPS scale.

Watershed restoration activities have improved freshwater critical habitat conditions in some areas, especially on Federal lands. In addition, the five northern California counties affected by the Federal listing of coho salmon (which includes Humboldt County) created a 5 County Conservation Plan that establishes continuity among the counties for managing anadromous fish stocks (Voight and Waldvogel 2002). The plan identifies priorities for monitoring, assessment, and habitat restoration projects.Although watershed restoration activities have improved freshwater critical habitat conditions in isolated areas, reduced habitat complexity, poor water quality, and reduced habitat availability as a result of past and continuing land management practices continue to exist in many locations.

5.4 Current Condition of the Critical Habitat

5.4.1 NC Steelhead

The condition of NC steelhead critical habitat, specifically its ability to provide for their conservation, has been degraded from conditions known to support viable salmonid populations. NMFS has determined that present depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat: logging, agricultural and mining activities, urbanization, stream channelization, dams, freshwater and estuarine wetland loss, and water withdrawals for irrigation. All of these factors were identified when NC steelhead were listed as threatened under the ESA, and they all continue to affect this ESU. However, efforts to improve NC steelhead critical habitat have been widespread and are expected to increase the ability of the habitat to provide for the conservation of the species.

5.4.2 CC Chinook Salmon

The condition of CC Chinook salmon critical habitat, specifically its ability to provide for their conservation, has been degraded from conditions known to support viable salmonid populations. NMFS has determined that current depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat: logging, agricultural and mining activities, urbanization, stream channelization, dams, freshwater and estuarine wetland loss, and water withdrawals for irrigation. All of these factors were identified when CC Chinook salmon were listed as threatened under the ESA, and they all continue to affect this ESU. However, efforts to improve CC Chinook salmon critical habitat have been widespread and are expected to increase the ability of the habitat to provide for the conservation of the species.

5.4.3 SONCC Coho Salmon

The condition of SONCC coho salmon critical habitat, specifically its ability to provide for their conservation, has been degraded from conditions known to support viable salmonid populations. NMFS has determined that present depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat: logging, agricultural and mining activities, urbanization, stream channelization, dams, freshwater and estuarine wetland loss, and water withdrawals for irrigation. All of these factors were identified when SONCC coho salmon were listed as threatened under the ESA, and they all continue to affect this ESU. However, efforts to improve SONCC coho salmon critical habitat have been widespread and are expected to increase the ability of the habitat to provide for the conservation of the species. Within the SONCC recovery domain, from 2000 to 2006, the following improvements were completed: 242 stream miles have been treated; 31 stream miles of instream habitat were stabilized; 41 cubic feet per second of water has been returned for instream flow; and thousands of acres of upland, riparian, and wetland habitat have been treated (NMFS 2007). Therefore, the condition of SONCC coho salmon critical habitat is likely improved or trending toward improvement compared to when it was designated in 1999.

5.4.4 Summary

Although watershed restoration activities have improved freshwater and estuarine critical habitat conditions in isolated areas, reduced habitat complexity, poor water quality, and reduced habitat

availability as a result of historical and continuing land management practices persist in many locations and are limiting the conservation value of designated critical habitat within these freshwater and estuarine habitats at the ESU and DPS scale.

6. ENVIRONMENTAL BASELINE

The environmental baseline includes "the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process" (50 CFR 402.02). The environmental baseline provides a reference condition to which we add the effects of the project, as required by regulation ("effects of the action" in 50 CFR 402.02).

The evaluation in the *Environmental Baseline* of the current extinction risk of each population of each listed species within the Salt River, and the condition and utilization of critical habitat for each species provides a reference condition for the fitness of individual fish and also at the Lower Eel River population scale to determine if the action is expected to affect the population's risk of extinction. The action area is a subset of the entire lower Eel River basin.

In this *Environmental Baseline* section, NMFS presents information on the distribution, diversity, population abundance and population trends of the CC Chinook salmon, SONCC coho salmon and NC steelhead within the Salt River. Next, the general setting and location of the action area is described. Thirdly, a description of the historic and current impacts to watershed conditions that continue to affect salmonid populations and their designated critical habitats within the action area of the Salt River is provided. Next, the conservation value of designated critical habitat within the action area is described. This information is used to describe the species' likelihood of survival and recovery, and the role that the action area plays in the overall conservation of the species and their designated critical habitats.

6.1 Salmonid Distribution, Diversity, Trends and Abundance in the Salt River

6.1.1 Salmonid Distribution

Juvenile coho salmon were observed in the Salt River channel during surveys in summer (June-August) in 1973-74 (Puckett 1976), and in the Salt River estuary during surveys in winter (December-February) in 1994-95 (Cannata and Hassler 1995). Coho salmon were also detected in Francis Creek in Ferndale during the summer of 2005 (Downie et al. 2005), and they have been reported in tributaries to the Salt River. They were observed in 1972 in Reas Creek, 100 yards from the confluence with the Salt River (CDFG 1972, from Downie et al. 2005), and in 1984, one was captured in Centerville Slough near the Centerville Road crossing (CDFG 1984). California DFG field notes (P. Divine) in August 2005 observed 4-5 coho on two visits and in October 2005 observed 12-14 coho on two visits (all thought to be yearlings ~70-100 mm). A single coho was observed in the most recent surveys during the summer of 2010 (G. Goldsmith, USFWS, pers. comm. 2010). Based on their presence in the Salt River estuary, channel, and tributaries, the action area may provide passage to upstream spawning and rearing habitat, but is likely used primarily for non-natal rearing. Sediment deposition in the Salt River and its

tributaries has reduced the access to upstream spawning areas in most years (Downie et al. 2005). Salmonid presence in the action area is primarily expected in the lower section of the Salt River that is tidally influenced (approximately from the confluence of the Salt River with the Eel River upstream to Reas Creek). Spawning habitat in the action area is non-existent.

6.1.2 Spatial Structure and Diversity

The current condition of the Salt River and its tributaries severely limits the use of the action area for rearing, but it may provide some non-natal rearing habitat.

6.1.3 Number of Individuals and Productivity

The number of salmonids expected in the action area during the project is expected to be no more than 100 coho salmon juveniles, 100 Chinook salmon juveniles, and 100 NC steelhead juveniles. We expect that this number would decline by the summer in-water construction period given the increased salinities expected in the lower Salt River as freshwater flows decrease and fish either migrate to the ocean or move to other areas outside the action area. Productivity in the Salt River is expected to be negative or non-existent in most years except for non-natal rearing salmonids because access to spawning areas is severely restricted or non-existent.

6.1.4 Summary

SONCC coho salmon, CC Chinook salmon, and NC steelhead primarily use the Salt River for non-natal rearing because access to upstream spawning areas in severely restricted or non-existent. The number of coho salmon, Chinook salmon, and NC steelhead rearing in the Salt River is likely positively correlated with the year class strength from contributing watersheds.

6.2 General Setting and Location

The Salt River Basin encompasses approximately 47 square miles (30,425 acres). The Salt River Basin is comprised of the Wildcat tributaries (12,775 acres) (Coffee, Williams, Francis, Smith and Reas creeks) and the alluvial delta (17,650 acres). The headwaters of the Salt River Basin in the Wildcat Mountains reach an average elevation of 800 feet with maximum elevations of 1,750 feet. The Salt River Basin is part of the Eel River Delta and Estuary, although its role as an estuarine slough has lessened over the years. At one time the Salt River was a significant part of the Eel River Estuary and was a tidal stream at all times. The Salt River occupies a former channel of the Eel River that was left behind as the dominant channel of the Eel River migrated north across the delta over centuries of change. The Riverside Ranch is a 264 acre parcel that was formerly estuarine marsh that was developed for agriculture through a series of dikes and tide gates.

6.3 Historic and Current Impacts to Watershed Conditions and Salmonids in the Action Area

6.3.1 Floods

Major floods in 1955 and 1964 occurred during a period of intense land use, primarily related to timber harvest (CDFG 1997), which resulted in major adverse changes to the quantity and quality of salmonid habitat across the action area. Floods and large deposits of sediment in the Salt River and Francis Creek have virtually eliminated any salmonid rearing or migratory habitat in the action area except for the lowest portion of the Salt River from Cuttoff Slough to Reas Creek, which is still tidally influenced.

6.3.2 Timber Harvest

The Salt River watershed has historically been severely impacted by timber harvest. This portion of the *Environmental Baseline* provides an overview of how timber harvesting has influenced watershed processes and consequently, salmonids and their habitat in the action area, by examining the following changes to the supply of large woody debris, sediment delivery, and hydrologic regime (Downie et al. 2005).

6.3.2.1 Large Woody Debris

As described more thoroughly in the *Status of the Species* Section, large woody debris entering streams from adjacent uplands provides a fundamental salmonid habitat component. Wood provides areas of localized scour and deposition, thus creating pools necessary for juvenile rearing and. In-stream woody debris also stores sediment at the upstream end and meters them to downstream reaches, thereby moderating the impacts of upstream sediment inputs. Conifers provide the most functional woody debris because they are larger and more resistant to decay.

Large woody debris is potentially available to the action area from upstream sources. However, the existing Salt River and Francis Creek channels in the action are aggraded to the point that most areas do not have a definable channel and, therefore, will not transport large woody debris.

6.3.2.2 Sediment Delivery

Erosion from the Wildcat Mountains and historical timberland contribute significant amounts of sediment to the action area (Downie et al. 2005). This sediment results in an almost complete loss of rearing habitat for juvenile Chinook salmon, coho salmon, and steelhead.

6.3.2.3 Hydrologic Processes

Timber harvest activities can have significant effects on hydrologic processes that determine streamflow. Timber harvest and road construction alter runoff by accelerating surface flows from hillsides to stream channels (Chamberlin *et al.* 1991).

Little is known about the magnitude of changes that have occurred to the natural hydrologic regime in the Salt River, but the extensive road network in the watershed and timber harvest activities are reasonably expected to have increased peak flows. The discussion on roads and stream diversions suggests that hillslope runoff may be delivered more efficiently to receiving stream channels via gullies, roadside ditches and skid trails. Therefore, streams may respond

quicker to storm events, and rise and fall much faster than in undisturbed conditions. Increased peak flows can have adverse effects on salmonids because the resulting increased stream power can scour stream channels, decreased aquatic invertebrate populations, and displace juvenile salmon from winter cover (Tschaplinski and Hartman 1983). Consequently, the carrying capacity of the habitat to support salmonids will decrease.

Tidal flow into the action area currently occurs in the Salt River from cutoff Slough to Reas Creek. This length of tidal influence is much reduced from the historical condition because of severe aggradation in the Salt River.

6.3.3 Historic and Current Salmonid Fisheries

The effects of ocean harvest on salmonids were previously described in the *Status of the Species* section. In-river sport fishing does not occur in the action area.

6.3.4 Reservoirs and Flow Regulation

Water diversions and shallow wells on the Salt River and its tributaries may influence freshwater flows in the action area, but the extent of water removal from the Salt River watershed is not currently known.

6.3.5 Urbanization and Agriculture

The Salt River watershed includes portions of the City of Ferndale and unincorporated areas, thereof. Urbanization has impacted salmonid habitat in the Salt River mostly through housing development and associated road construction and land clearing. Run-off from paved roads and other impervious surfaces increase the flow during storms and decrease recharge of the aquifer resulting in a decrease in summer flows. In addition, run-off from urban areas may contain contaminants such as polyaromatic hydrocarbons (PAHs) and metals, which, depending upon concentrations, adversely affect salmonid survival.

Much of the Salt River watershed was river and estuary floodplain and salt marsh before being reclaimed for agriculture in the late 1800s. Because of the proximity to the Eel River, the low elevation of the reclaimed lands, and the high sediment loads from the Wildcat Mountains in the headwaters of tributary streams, significant channelization, diking, and other land alterations have been conducted in the Salt River watershed to maintain the land for agriculture.

6.3.6 Recently Completed or Ongoing Projects within the Action Area

The City of Ferndale recently completed an upgrade to their Wastewater Treatment Plant. In addition, the County of Humboldt has excavated and diverted the lower 2,000 feet of Francis Creek for emergency flood control. The upgraded wastewater treatment plant will eliminate the discharge of raw sewage into Francis Creek, which will improve water quality conditions for salmonids. The diversion of Francis Creek eliminated or severely reduced downstream flows to the Salt River which temporarily eliminated some freshwater habitat in Francis Creek and the Salt River.

6.3.7 Restoration

Upslope sediment reduction efforts have occurred in the Francis Creek watershed and are expected to continue in the Salt River watershed as part of the larger Salt River restoration effort (HRCD 2011). Projects have included riparian fencing and road and stream crossing upgrades which should reduce sediment input to Francis Creek and result in an improvement in habitat over the life of the permit for this project.

6.4 Conservation Value of the Designated Critical Habitat

6.4.1 Description of Habitat in the Action Area

Based on the Federal Register Notices describing Critical Habitat for all three listed salmonid species, their habitat conditions are degraded relative to conditions that would support healthy salmonid populations. NMFS has not previously described the conservation value of the Salt River watershed. Most of the essential habitat types of juvenile rearing areas, juvenile migration corridors, and areas for growth and development are all absent or severely degraded in critical habitat in the Salt River watershed.

The action area, which includes the Salt River upstream to Perry Slough, including 2,900 feet of Francis Creek, contains primarily estuary habitat in the lower section of the Salt River. The action area contains non-natal juvenile rearing habitat for all three salmonid species. The Salt River and Francis Creek in the action area is severely aggraded and often manipulated to increase floodwater conveyance.

6.4.2 Salt River and Francis Creek Baseline Summary

Historically, the Salt River was a large, complex estuarine slough with adjacent marshland and interconnected freshwater streams and smaller slough channels. Prior to major changes in land use and major floods, the Salt River served as a shipping channel for large ocean-going ships. As previously discussed, the action area reflects a long legacy of watershed disturbances. Streamside vegetation removal, channel modifications, development for agriculture, and urban/rural development dating back more than a century, combined with intensive upslope activities such as timber harvest and road construction, and large floods in 1955 and 1964 have had a significant influence on the baseline condition of the Salt River. These disturbances resulted in a degradation of habitat and decline in salmonid abundance. For example, extensive timber harvest upstream and reclamation and channelization for agriculture in the floodplain throughout the 20th century increased sediment loads and altered the hydrology within the action area. Consequently, a reduction in habitat complexity due to aggradation of the Salt River and Francis Creek virtually eliminated salmonid habitat

This loss of habitat continues to limit salmonid numbers in the action area by limiting habitat available for rearing. Based upon the relationships between habitat quality and the health of salmonid populations, NMFS expects the numbers of ESA-listed anadromous salmonids to remain depressed in the foreseeable future relative to historic estimates.

Distribution of salmonids in the Salt River watershed indicates that the action area has limited value, but may provide a small amount of non-natal rearing habitat. Wallace (2010) has observed higher growth rates of coho salmon rearing in non-natal areas as compared to coho salmon rearing in natal stream areas. Juvenile salmonid size at ocean entry is directly related to survival to maturity (Bilton *et. al*. 1982).

7. EFFECTS OF THE ACTION

7.1 Exposure

NMFS expects that juvenile coho salmon, Chinook salmon, and steelhead may be present in the Phase I construction area, primarily in the Salt River from Cutoff Slough to Reas Creek. Salmonids will be exposed to capture and handling, a short-term, insignificant pulse osf sediment when flows are returned to the newly constructed channel, and the improved habitat conditions following project completion. Juvenile salmonids will be removed from the dewatered sections, so they will not be exposed to construction activities. NMFS expects that all salmonids will be removed because the removal will occur during low tide when removal methods are highly efficient.

7.2 Insignificant, Discountable or Wholly Beneficial Effects

7.2.1 Beneficial Effects

The purpose of the project is to benefit salmonids and other aquatic dependent species. In summary, the project will:

- rehabilitate 7.7 miles of Salt River channel and riparian floodplain corridor that will contain aquatic habitat features including alcoves and instream wood structures for salmonid refugia,
- create 264 acres of tidal marsh habitat suitable for salmonid rearing habitat,
- create 8.7 acres of channel slough habitat suitable for eel grass beds, an essential fish habitat for salmonids, and
- create 32 acres of riparian forest/scrub that will provide aquatic habitat cover and complexity, while promoting long-term large wood recruitment potential.

The addition of large woody debris will more than offset any loss of future large woody debris recruitment from the riparian trees that will be removed during the project. The benefits of riparian habitat restoration will take longer to realize, but should increase stream shading, provide future LWD, and contribute to properly functioning conditions for the riparian ecosystem. Finally, the removal of sediment and reestablishment and reconnection of the Salt River with its tributary streams will increase the access to approximately 15 miles of salmonid spawning and rearing habitat.

7.2.2 All Other Effects

The proposed project may also produce effects, such as habitat disturbance from heavy equipment operation, riparian vegetation disturbance, chemical contamination, and reduced benthic macroinvertebrate production that are not likely to adversely affect listed species or their critical habitats. These effects are expected to be insignificant or discountable as explained further below.

7.2.2.1 Noise, Motion, and Vibration Disturbance from Heavy Equipment Operation

Noise, motion, and vibration produced by heavy equipment operation is expected in the project area. However, the use of equipment will occur outside the active channel, and is expected to result in insignificant adverse effects to listed fish species because fish will be removed from areas nearby the construction area. Heavy equipment will not be used in the wetted channel except after fish removal; therefore, sound transmittal should be minimized as sound travels easier through water than soil.

7.2.2.2 Chemical Contamination from Equipment Fluids

Equipment refueling, fluid leakage, and maintenance activities within and near the stream channel pose some risk of contamination and potential injury to salmonids. However, no refueling will occur near wetlands of the stream, spill containment protocol and materials will be available, and machinery will be checked daily for leaks, which will address and minimize pollution risk from equipment operation. Therefore, we expect that the water quality degradation from toxic chemicals associated with the project would be discountable and insignificant.

7.2.2.3 Reduced Benthic Macroinvertebrate Community

Benthic (*i.e.*, bottom dwelling) aquatic macroinvertebrates may be temporarily lost or their abundance reduced when stream habitat is dewatered (Cushman 1985). Effects to aquatic macroinvertebrates resulting from stream flow diversions and dewatering will be temporary because instream construction activities will occur only during the low flow season, and rapid recolonization (about one to two months) of disturbed areas by macroinvertebrates is expected following rewatering (Cushman 1985, Thomas 1985, Harvey 1986). In addition, the effect of macroinvertebrate loss on juvenile coho salmon, Chinook salmon, and steelhead is likely to be negligible because food from upstream sources (via drift) would be available downstream of the dewatered areas since stream flows will be maintained around the project work site. Based on the foregoing, the loss of aquatic macroinvertebrates resulting from dewatering activities is expected to be insignificant and not result in a decrease in forage for coho salmon, Chinook salmon, or steelhead.

7.2.2.4 Increased Mobilization of Sediment Within the Stream Channel

The proposed project involves earth disturbance within the dewatered stream channel. Inherent with earth disturbance is the potential to increase background suspended sediment loads for a short period following project completion once water is returned to the disturbed areas of the stream channel.

Short-term increases in turbidity are anticipated to occur during dewatering activities and/or during construction of a cofferdam. Research with salmonids has shown that high turbidity concentrations can: reduce feeding efficiency, decrease food availability, reduce dissolved

oxygen in the water column, result in reduced respiratory functions, reduce tolerance to diseases, and can also cause fish mortality (Berg and Northcote 1985, Gregory and Northcote 1993,Velagic 1995, Waters 1995). Mortality of very young coho salmon and steelhead fry can result from increased turbidity (Sigler *et al.* 1984). Even small pulses of turbid water will cause salmonids to disperse from established territories (Waters 1995), which can displace fish into less suitable habitat and/or increase competition and predation, decreasing chances of survival. Nevertheless, much of the research mentioned above focused on turbidity levels significantly higher than the temporary increases in turbidity that are likely to result from the proposed project activities, especially with implementation of the proposed avoidance and minimization measures. Stream flow is expected to be very low during the project, so mobilization of sediment because of low stream power. Increased turbidity resulting from the proposed project is expected to be of limited duration and level and not result in physical effects to juvenile coho salmon, Chinook salmon, or steelhead. Similar turbidities of up to 60 NTUs for 8 hours did not apparently affect feeding of steelhead during the Mad River Bridge Replacement Project (M. Kelly, Caltrans, pers. comm., 2010). The increased turbidity downstream of the project may induce a short-term behavioral response, but this response is not expected to result in reduced growth or permanent displacement from established territories and is therefore insignificant.

7.2.2.5 Decrease in Riparian Habitat

A short-term (2-3 years) decrease in riparian habitat, primarily in areas that currently lack a defined stream channel, will occur as a result of clearing for excavation. However, this decrease in riparian habitat is not expected to result in an increase in water temperature because of the moderating influence of the coastal climate. A discountable decrease in terrestrial subsidies will occur as a result of the riparian clearing, but this decrease will be more than offset by new riparian planting as well as increased nutrient exchange through increased tidal exchange and salt marsh development. Any cover lost from the riparian clearing is expected to be replaced by tha addition of large woody debris structures and increased depth of the excavated channel.

7.2.3 Adverse Effects to Listed Species

This section identifies the direct and indirect adverse effects of the proposed action on SONCC coho salmon, CC Chinook salmon, and NC steelhead and designated critical habitat for SONCC coho salmon, NC steelhead, and CC Chinook salmon.

In water activities associated with the project will occur between June 15 and October 15, during the summer low flow period, which will reduce the number of juvenile coho salmon and steelhead exposed to the project. The potential adverse effects to listed coho salmon and steelhead primarily result from fish relocation. The fish relocation will result in harassment and lethal injury to coho salmon, CC Chinook salmon, and steelhead.

7.2.3.1 Dewatering

Dewatering encompasses placing temporary barriers, such as a cofferdam, to hydrologically isolate the work area, re-routing streamflow around the dewatered area, pumping water out of the isolated work area, relocating fish from the work area (discussed separately), and restoring the project site upon project completion. The length of contiguous stream reach that will be dewatered at any one time will vary depending on the conditions at the time of dewatering.

7.2.3.1.1 Exposure

Because the proposed dewatering occurs during the low flow period, the species and life stages most likely to be exposed to potential effects of dewatering are juvenile coho salmon, Chinook salmon, and steelhead. Adult coho salmon, Chinook salmon, and steelhead will not be exposed to dewatering because they will not be present during the instream work window.

7.2.3.1.2 Response

The effects of dewatering result from the placement of the temporary barriers, the trapping of individuals in the isolated area, and the diversion of streamflow. Rearing juvenile coho salmon, Chinook salmon, and steelhead could be killed or injured if crushed during placement of the temporary barriers, such as cofferdams, though direct mortality is not expected because fish will be herded from barrier placement areas and the general evasiveness of salmonids. Stream flow diversions could harm salmonids by concentrating or stranding them in residual wetted areas (Cushman 1985) before they are relocated, or causing them to move to adjacent areas of poor habitat (Clothier 1953; Clothier 1954; Kraft 1972; Campbell and Scott 1984). However, effects associated with dewatering activities will be eliminated due to the removal of all fish.

Changes in flow are anticipated to occur within and downstream of project sites during dewatering activities. These fluctuations in flow, outside of dewatered areas, are anticipated to be small, gradual, and short-term, which should not result in any harm to salmonids. Stream flow in the vicinity of each project site should be the same as free-flowing conditions, except during dewatering and at the dewatered reach where stream flow is bypassed.

7.2.3.2 Fish Relocation Activities

All project sites that require dewatering will include efforts to relocate fish. Qualified fishery biologists capture and relocate fish away from the project work site to eliminate adverse effects of dewatering to listed salmonids. Fish in the immediate project area will first be herded downstream of the dewatered area. Then, any remaining fish will be captured by seine, dip net and/or by electrofishing, and then transported and released to a suitable instream location.

7.2.3.2.1 Exposure

Since fish relocation is required when dewatering, the species and life stages most likely to be exposed to potential effects of fish relocation are juvenile Chinook salmon, coho salmon, and steelhead which are the species expected to be present during the project.

7.2.3.2.2 Response

Any fish collecting gear, whether passive or active (Hayes 1983) has some associated risk to fish, including stress, disease transmission, injury, or death. The amount of unintentional injury and mortality attributable to fish capture varies widely depending on the method used, the ambient conditions, and the expertise and experience of the field crew. The effects of seining and dipnetting on juvenile salmonids include stress, scale loss, physical damage, suffocation, and desiccation. Electrofishing can kill juvenile salmonids, and researchers have found serious sublethal effects including spinal injuries (Reynolds 1983; Habera *et al.* 1996; Habera *et al.* 1999; Nielsen 1998; Nordwall 1999). The long-term effects of electrofishing on salmonids are not well understood. Although chronic effects may occur, most impacts from electrofishing occur at the time of sampling.

Most of the injury and death from handling result from differences in water temperature between the stream and the temporary holding containers, dissolved oxygen conditions, the amount of time that fish are held out of the water, and physical injury. Handling-related stress increases rapidly if water temperature exceeds 18°C or dissolved oxygen is below saturation. Since fish relocation activities will be conducted by designated qualified fisheries biologists following both CDFG and NMFS electrofishing guidelines, direct effects to, and mortality of, juvenile coho salmon, Chinook salmon, steelhead, or all during capture will be greatly minimized.

Although sites selected for relocating fish will likely have similar water temperature as the capture site and should have ample habitat, in some instances relocated fish may endure short-term stress from crowding at the relocation sites. Relocated fish may also have to compete with other salmonids or other fish species, which can increase competition for available resources such as food and habitat. Some of the fish at the relocation sites may choose not to remain in these areas and may move either upstream or downstream to areas that have more habitat and lower fish densities. As each fish moves, competition remains either localized to a small area or quickly diminishes as fish disperse.

Fish relocation activities are expected to affect a small number of rearing juvenile Chinook salmon, coho salmon, and steelhead at and near the project site and relocation release site(s) because only a small number of fish are expected to be there during the work period and during low tides when the removal efforts will be conducted. Rearing juvenile coho salmon, Chinook salmon, and steelhead present in the immediate project work area will be subject to disturbance, capture, relocation, and related short-term effects. Most of the take associated with fish relocation activities is anticipated to be in the form of non-lethal capture; however, a low number (3% or less) of rearing juvenile (mostly YOY) coho salmon and/or steelhead captured may become injured or die. Since 2004, data on fish relocation activities associated with habitat restoration projects authorized under CDFG's Restoration Grant Program (RGP), show that most mortality rates associated with individual fish relocation sites are well below three percent and the mean annual mortality rates are below one percent for either coho salmon, Chinook salmon, or steelhead (Collins 2004, 2005; CDFG 2006, 2007, 2008, 2009, 2010). In addition, the number of fish affected by increased competition is not expected to be significant at the fish relocation sites, based upon the suspected low number of relocated fish inhabiting the project areas.

Effects associated with fish relocation activities will be significantly minimized due to the multiple minimization measures that will be utilized. NMFS expects that fish relocation activities associated with implementation the project will not reduce the number of returning listed salmonid adults in their natal streams in the Eel River. Fish relocation activities will occur during low tide and during the summer low-flow period after emigrating smolts have left the project site. Therefore, the majority of listed salmonids that will be captured during relocation activities will be age-0 coho salmon, Chinook salmon, and juvenile steelhead parr of various ages. Although most unintentional mortalities of coho salmon, Chinook salmon and steelhead during fish relocation activities will occur almost exclusively at the YOY stage, there is a potential for unintentional mortality of a one or two year old steelhead.

7.2.4 Effects to Critical Habitat

7.2.4.1 Adverse effects to PCEs

The project is expected to result in the temporary dewatering of the Salt River and Francis Creek. However, water will be routed around these areas, so downstream areas are not expected to be affected. Stream flow diversion and project work area dewatering are expected to cause temporary loss, alteration, and reduction of aquatic habitat. Dewatering may result in the temporary loss of rearing habitat for juvenile salmonids. The extent of temporary loss of juvenile rearing habitat should be minimal because habitat at the project site is extremely degraded. Salmonid food is expected to be temporarily decreased in the project area as a result of dewatering. However, we expect rapid recolonization of aquatic invertebrates to re-watered areas and salmonid food will increase as a result of the project from the improvements to the stream channel and development of salt and freshwater marsh. In addition, a small amount of sediment may be mobilized after water is returned to the dewatered areas. Trees will be removed, but replanting will occur upon completion. Trees in the action area are not important for temperature control because of the proximity of the project to the Pacific ocean and its consequent effect on climate in coastal areas. The project will occur during the summer months when water quality conditions are poor and salmonid populations are sparse. The Salt River is primarily used by salmonids during the winter for non-natal rearing. Therefore, the stream habitat will return to pre-project conditions when juvenile salmonids reoccupy the area. The limited project impacts are expected to be temporally and spatially limited and, therefore, insignificant and discountable.

7.2.4.2 Beneficial Effects to the PCEs

7.2.4.2.1 Placement of Large Woody Debris (LWD)

Placement of LWD into streams can result in the creation of pools that influence the distribution and abundance of juvenile salmonids (Beechie and Sibley 1997; Spalding *et al.* 1995). LWD influences the channel form, retention of organic matter and biological community composition. In small (<10 m bankfull width) and intermediate (10-20 m bankfull width) streams, LWD contributes channel stabilization, energy dissipation and sediment storage (Cederholm *et al.* 1997). Proper placement of LWD will create scour pools that will provide complex rearing habitat, with overhead cover, for juvenile salmonids. Presence and abundance of LWD is correlated with growth, abundance and survival of juvenile salmonids (Spalding *et al.* 1995; Fausch and Northcote 1992).

7.2.4.2.2 Riparian Planting

Streamside riparian zones include the area of living and dead vegetative material adjacent to a stream. They extend from the edge of the ordinary high water mark of the wetted channel upland to a point where the zone ceases to have an influence on the stream channel. Riparian zones provide hydraulic diversity and structural complexity to the stream channel, buffer runoff energy from storm events, moderate water temperatures through shading, protect water quality, and provide a source of food and nutrients. Riparian zones are especially important as a LWD source for streams. LWD creates stream habitat complexity critical to anadromous species survival and recovery by forming and maintaining pool structures in streams. Pools provide refuge for

juvenile salmon from predators and high-flow events, especially coho salmon, Chinook salmon, and steelhead that rear for extended periods in freshwater.

All vegetation planting or removal (in the case of exotic species) will occur on streambanks and floodplains adjacent to the wetted channel and not in flowing water. Since the majority of work will occur during the summer growing season, riparian plantings should be sufficiently established prior to the following winter storm season. Thus, project-related erosion following the initial planting season is unlikely since established plants will help anchor the worksite. The long-term benefit from riparian restoration will be the establishment of a mixed conifer/hardwood, functional riparian corridor providing juvenile and adult fish with abundant food and cover. Riparian habitat restoration proposed for the project is not likely to adversely affect critical habitat.

The proposed riparian planting will increase stream shading and instream cover habitat for rearing juveniles, moderate stream temperatures and peak flows, increase terrestrial subsidies, and improve water quality through pollutant filtering. It will also help control invasive plant species like reed canary grass.

7.2.4.2.3 Fish Passage Improvement

Juvenile salmonids often migrate relatively long distances (*i.e.*, several kilometers) in response to: (1) changes in their environment (*e.g.*, summer warming or pollution events), (2) changes in resource needs as they grow, and (3) competition with other individuals. The movements of stream-dwelling salmonids have been the subject of extensive research (Chapman 1962, Edmundson *et al.* 1968, Fausch and White 1986, Gowan *et al.* 1994, Bell 2001, Kahler *et al.* 2001, Wallace 2010). Although many juvenile salmonids are territorial or exhibit limited movement, many undergo extensive migrations (Gowan *et al.* 1994; Fausch and Young 1995). For example, salmonid fry often disperse downstream from headwater spawning sites. Additional movements can occur as intraspecific competition for resources causes the additional dispersal of subordinate individuals (Chapman 1966; Everest and Chapman 1972; Hearn 1987). Juvenile salmonids may also move in response to growth or simply because environmental conditions such as water depth or velocity are no longer suitable (Edmundson *et al.* 1968; Leider *et al.* 1986; Lau 1994; Kahler *et al.* 2001).

In a recent study with coho salmon and steelhead in streams in the state of Washington, 28 to 60 percent of the salmonids moved during the summer within the study streams and 14 to 36 percent of them moved more than once (Kahler *et al.* 2001). Upstream movement of juvenile salmonids was predominate (Kahler *et al.* 2001). However, in streams with more step-pool/cascade channel types there was less upstream movement and more movement further downstream (Kahler *et al.* 2001). The movement of over 60 percent of tagged coho salmon in a study in Prairie Creek, California, also illustrates that coho salmon do not rear exclusively in the habitat that they were initially tagged (Bell 2001). Finally, Wallace (2010) studied streams throughout Humboldt Bay, and found extensive movement and use of non-natal habitats by juvenile coho salmon.

The project is expected to result in the removal of sediment that will provide access to currently inaccessible or partially inaccessible habitat in approximately 15 miles of stream habitat.

7.2.4.2.4 Salt Marsh, Slough Channel, and Floodplain Development and Rehabilitation

Restoration of the tidal freshwater marsh is expected to provide important overwintering habitat for juvenile coho and Chinook salmon, steelhead, and cutthroat trout, as has been observed in restored freshwater tidal ecotones of Humboldt Bay (Wallace and Allen 2009) and in other restored estuaries of the Pacific Northwest (Miller and Simenstad 1997, Simensted and Cordell 2000, Koski 2009). Food, shelter, and rearing space will increase. Juvenile coho salmon in particular have been found using low gradient freshwater tidal habitats to overwinter after high winter flows.

7.2.5 Effects of Interrelated and Interdependent Actions

Effects of the Proposed Action are analyzed together with the effects of other activities that are interrelated to, or interdependent with, that action. These include actions that are part of the proposed action and depend on the proposed action for their justification (interrelated actions) as well as actions that have no independent utility apart from the Proposed Action (interdependent actions, 50 CFR § 402.02). As part of the larger Salt River restoration effort, upslope sediment source remediation is expected to occur concurrently with and after the project is completed. However, much of this work will likely require separate section 404 permits and section 7 consultation. These actions are expected to reduce the sediment loads to the Salt River watershed, thereby improving fish habitat and decreasing the need for long-term maintenance of the Salt River and its tributaries. The actions will be primarily focused on the removal or upgrading of roads, riparian fencing, and other off-channel sediment treatments. The effects of these actions are expected to provide long-term benefits to salmonids and their habitats.

8. CUMULATIVE EFFECTS

NMFS must consider both the "effects of the action" and the cumulative effects of other activities in determining whether the action is likely to jeopardize the continued existence of the SONCC coho salmon ESU and the NC steelhead DPS considered in this opinion. Under the ESA, cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area. Listed salmonid species may be affected by numerous future non-federal activities, including timber harvest, road construction, residential development, and agriculture, etc., which are described in the Environmental Baseline section. A search of upcoming timber harvest plans on the CalFire website confirms that timber harvesting is expected to continue in the next ten years (http://www.fire.ca.gov/ResourceManagement/THPStatusUpload/THPStatusTable.html). NMFS assumes these activities, and similar resultant effects, on listed salmonids species will continue during this project.

9. INTEGRATION AND SYNTHESIS

The preceding analyses focused on both the likely direct and indirect effects from the HRCD's project on listed salmonids and their habitat in the action area. This section considers the effects to individual salmonids and determines how effects to individuals would affect the VSP parameters of their constituent populations. The Salt River is not considered a distinct population, but is part of a larger Lower Eel River independent population unit. The effects to individuals as described below incorporates the environmental baseline and cumulative effects, as described in those sections. Then, NMFS analyzes whether the effects to the populations

would jeopardize the continued existence of the ESU/DPS. In addition, this section assesses the effects of the proposed action on critical habitat to determine whether the effects rise to the level that the action results in the destruction or adverse modification of critical habitat for SONCC coho salmon, NC steelhead, or CC Chinook salmon.

9.1 NC Steelhead Risk of Extinction

9.1.1 Population Size

Since only a small percentage (3%) of a low number (<100) of individual steelhead will be injured or killed, we expect a small reduction in the juvenile steelhead population, but this reduction is not expected to result in a reduction in the abundance of adult steelhead in the Lower Eel River population because the ocean survival rate of juvenile fish is expected to be less than 5%. Therefore, 5% of 3% of 100 or fewer juveniles equates to a negligible (less than 1 adult) reduction in the adult population..

9.1.2 Population Productivity

The project is not expected to reduce the productivity of the Lower Eel River steelhead population because adult steelhead numbers are not expected to be reduced. Rather, in time the project is likely to beneficially affect the productivity of the population..

9.1.3 Spatial Structure

The spatial structure of the Salt River steelhead population is not expected to be affected because the adult steelhead population is not expected to be affected and because the spatial structure is expected to increase as a result of the project.

9.1.4 Diversity

The diversity of affected steelhead populations is not expected to be reduced.

9.1.5 Summary

The proposed project will not negatively affect the viability of the Lower Eel River steelhead population. Since the number of spawners in the Lower Eel River steelhead population is not expected to be reduced, then we do not expect an appreciable reduction in the numbers, distribution, or reproduction of the SONCC coho salmon ESU.

9.2 Effects on SONCC Coho Salmon

9.2.1 Population Size

Since only a small percentage (3%) of a low number (<100) of individual coho salmon will be injured or killed, we expect a small reduction in the juvenile coho salmon population, but this reduction is not expected to result in a reduction in the abundance of adult coho salmon in the Lower Eel River population because the ocean survival rate of juvenile fish is expected to be less

than 5%. Therefore, 5% of 3% of 100 or fewer juveniles equates to a negligible (less than 1 adult) reduction in the adult population..

9.2.2 Population Productivity

The productivity of the Lower Eel River population is not expected to be reduced because adult coho salmon numbers are not expected to be reduced. The productivity of the population is expected to increase as a result of the project.

9.2.3 Spatial Structure

NMFS does not expect that the project to negatively affect the spatial structure of the Lower Eel River coho salmon population. Rather, the proposed action will likely improve the spatial structure of SONCC coho salmon as previously unavailable streams become accessible as a result of the project.

9.2.4 Diversity

The diversity of the Lower Eel River SONCC coho salmon population is not expected to be reduced by the loss of a small number of juvenile coho salmon because the adult population will not be reduced.

9.2.5 Summary

A decrease in the viability of the Lower Eel River population of SONCC coho salmon is not expected because the action is not expected to reduce the population productivity, spatial structure, or diversity of the Lower eel River coho salmon population. Since the number of spawners in the Lower Eel River coho salmon population is not expected to be reduced, then we do not expect an appreciable reduction in the numbers, distribution, or reproduction of the SONCC coho salmon ESU.

9.3 Effects to CC Chinook Salmon

9.3.1 Population Size

Since only a small percentage (3%) of a low number (<100) of individual Chinook salmon will be injured or killed, we expect a small reduction in the juvenile Chinook salmon population, but this reduction is not expected to result in a reduction in the abundance of adult Chinook salmon in the Lower Eel River population because the ocean survival rate of juvenile fish is expected to be less than 5%. Therefore, 5% of 3% of 100 or fewer juveniles equates to a negligible (less than 1 adult) reduction in the adult population.

9.3.2 Population Productivity

The productivity of the Lower Eel River population is not expected to be reduced because adult Chinook salmon numbers are not expected to be reduced. The productivity of the population is expected to increase as a result of the project.

9.3.3 Spatial Structure

The spatial structure of the Lower Eel River Chinook salmon population is not expected to decrease, but may actually improve as previously unavailable streams become accessible as a result of the project.

9.3.4 Diversity

The diversity of the Lower Eel River Chinook salmon population is not expected to be reduced by the loss of a small number of juvenile Chinook salmon because there will not be a reduction in the number of adults in the population.

9.3.5 Summary

A decrease in the viability of the Lower Eel River population of CC Chinook salmon is not expected because the action is not expected to reduce the population productivity, spatial structure, or diversity of the Lower Eel River Chinook salmon population. Since the number of spawners in the Lower Eel River Chinook salmon population is not expected to be reduced, then we do not expect an appreciable reduction in the numbers, distribution, or reproduction of the CC Chinook salmon ESU.

9.4 Effects on Critical Habitat

As discussed previously, adverse effects to critical habitat are not expected. Therefore, the conservation value of the SONCC coho salmon, NC steelhead, or CC Chinook salmon critical habitat will not be reduced.

10. CONCLUSION

After considering the best available scientific and commercial information, the current status of NC Steelhead, CC Chinook salmon, and SONCC coho salmon, and their designated critical habitat, the environmental baseline for the action area, the effects of the HRCD's proposed project, and the cumulative effects, it is NMFS' biological opinion that the Corps' issuance of an individual CWA section 404 permit to the HRCD for implementation of the Salt River and Riverside Ranch Restoration project, as proposed, is not likely to jeopardize the continued existence of NC steelhead, CC Chinook salmon or SONCC coho salmon. NMFS also concludes that the action, as proposed, is not likely to adversely affect Southern DPS green sturgeon, Southern Resident killer whales, or critical habitat for CC Chinook salmon, SONCC coho salmon, and NC steelhead

11. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS as an act that actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are nondiscretionary, and must be undertaken by the Corps so that they become binding conditions of any grant or permit issued to the HRCD for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require the HRCD to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps or the HRCD must report the progress of the action and its impact on the species to NMFS as specified in the incidental take statement (50 CFR §402.14(i)(3)).

11.1 Amount or Extent of Take

NMFS expects the proposed project will result in incidental take of listed SONCC coho salmon, CC Chinook salmon, and NC steelhead. Juvenile coho salmon, Chinook salmon, and steelhead will be captured during fish relocating activities at the project sites. Specifically, incidental take is expected to be in the form of capture during fish relocation. Mortality from relocation activities is expected to be no more than three percent of juvenile salmonids inhabiting the 7.7 miles of Salt River channel dewatered for the project.

Given the lack of comprehensive monitoring data, NMFS cannot quantify the number of fish from each federally listed species expected to be taken during fish relocation because of the uncertainty in the number of juvenile coho salmon, Chinook salmon, and steelhead that will inhabit the dewatered stream areas. We previously used a maximum of 100 fish for each listed species to conduct the jeopardy analysis, but we believe these numbers are conservative and likely much higher than what would be expected to occur in the action area when the project is implemented. In instances where the amount of take is difficult to quantify, NMFS can use the extent of take as a surrogate. Therefore, NMFS estimates that all juvenile coho salmon, Chinook salmon, and steelhead in the areas to be dewatered will be exposed to relocation. A small number (less than 3% of the fish in each area) will be injured or killed during capture for relocation efforts. The total extent of take is limited to 7.7 miles of habitat.

11.2 Effect of the Take

In the accompanying opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to the SONCC coho salmon, Cc Chinook salmon, or NC steelhead.

11.3 Reasonable and Prudent Measures

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of SONCC coho salmon, CC Chinook salmon, and NC steelhead:

1. Measures shall be taken to minimize harm and mortality to juvenile coho salmon and steelhead resulting from fish relocation, dewatering, or instream construction activities.

2. Measures shall be taken to ensure that the Corps and/or HRCD monitor and report take of listed salmonids.

11.4 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Corps and the Applicant (HRCD) must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

1. The following terms and conditions implement Reasonable and Prudent Measure 1, which states that measures shall be taken to minimize harm and mortality to coho salmon and steelhead resulting from fish relocation, dewatering, or instream construction activities:

    a. Fish relocation data must be provided as described in Term and Condition 2 below. If injury or mortality exceeds 3% of the coho salmon or steelhead captured then activities must immediately cease so that the cause of excessive injury or mortality can be assessed and ameliorated. NMFS shall be contacted at the address below within 24 hours. Fish killed shall be placed immediately in alcohol or placed on ice and delivered to the NMFS office identified under Term and Condition 2 below.

2. The following terms and conditions implement Reasonable and Prudent Measure 2, which states that measures shall be taken to ensure that the project will minimize take of listed salmonids, monitor and report take of listed salmonids, and to obtain specific project information to better account for the effects and benefits the project.

    a. In order to monitor the impact to, and to track incidental take of coho salmon and steelhead, the Corps and/or the HRCD must submit to NMFS a project completion report The report shall include the following:

        - A summary detailing fish relocation activities, including the number and species of fish relocated and the number and species injured or killed. Any injuries or mortality from a fish relocation site that exceeds 3.0 % of the affected listed species shall have an explanation describing why.

        - The length of streambank (feet) stabilized or planted with riparian species.

        - The distance (feet) of aquatic habitat disturbed at each project site.

    This report shall be submitted after completion of the project to the following NMFS office:

    National Marine Fisheries Service
    Northern California Office Supervisor
    1655 Heindon Road
    Arcata, California 95521

12. REINITIATION NOTICE

This concludes formal and informal consultation on the actions outlined in the Salt River and Riverside Ranch Restoration project. As provided in 50 CFR §402.16, reinitiation of formal consultation is required and shall be requested by the Federal agency or by NMFS, where discretionary Federal involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the action that may affect listed species in a manner or to an extent not previously considered, (3) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be reinitiated immediately.

13. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and

threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. NMFS provides the following conservation recommendations:

1. NMFS should have the opportunity to provide input on any channel maintenance activities to minimize any adverse effects to critical habitat or listed coho salmon, Chinook salmon, or steelhead from maintenance activities. Therefore, NMFS should be contacted for input at least one month prior to the scheduled maintenance activities.

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

14. REFERENCES

Adams, P. 2000. Status Review Update for the Steelhead Northern California Evolutionarily Significant Unit. NMFS Southwest Science Center.

Aitkin, J.K. 1998. The Importance of Estuarine Habitats to Anadromous Salmonids of the Pacific Northwest: A Literature Review. USFWS. Lacey, Washington.

Allendorf, F. W., and N. Ryman. 1987. Genetic management of hatchery stocks. Pages 141-159 in N. Ryman and F. Utter, editors. Population genetics and fishery management. University of Washington Press, Seattle, Washington.

Araki, H., B. Cooper, and M.S. Blouin. 2007. Genetic Effects of Captive Breeding Cause A Rapid, Cumulative Fitness Decline in the Wild. Science 318(5847): 100.

Barngrover, B. 1994. Annual Report, Mad River Salmon and Steelhead Hatchery, 1982-83 Through 1990-91. California Department of Fish and Game, Anadromous Fisheries Branch. Administrative Report 83-13, 86-02, 87-4, 87-10, 88-3, 90-2, 90-14, 91-9, 92-10.

Barnhart, R.A. 1986. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest)--steelhead. U.S. Fish and Wildlife Service Biological Report 82(11.60). 21 pp.

Battin, J., M. W. Wiley, M. H. Ruckelshaus, R. N. Palmer, E. Korb, K. K. Bartz, and H. Imaki. 2007. Projected impacts of climate change on salmon habitat restoration. Proceedings of the National Academy of Sciences of the United States of America 104: 6720-6725.

Beechie, T.J. and T.H. Sibley. 1997. Relationships between channel characteristics, woody debris, and fish habitat in northwestern Washington streams. Transactions of the American Fisheries Society 26:217-229.

Beamish, R. J., C. Mahnken, and C. M. Neville. 1997a. Hatchery and wild production of Pacific salmon in relation to large-scale, natural shifts in the productivity of the marine environment. ICES Journal of Marine Science. 54: 1200-1215

Beamish, R. J., C. M. Neville, and A. J. Cass. 1997b. Production of Fraser River sockeye salmon (*Oncorhynchus nerka*) in relation to decadal-scale changes in the climate and the ocean. Canadian Journal of Fisheries and Aquatic Sciences 54:435-554.

Beamish, R. J. and D. R. Bouillion. 1993. Pacific salmon production trends in relation to climate. Canadian Journal of Fisheries and Aquatic Sciences 50:1002-1016.

Beamish R. J., and C. Mahnken. 2001. A critical size and period hypothesis to explain natural regulation of salmon abundance and the linkage to climate and climate change. Progress in Oceanography 49:423–437.

Beechie, T., E. Buhl, M. Ruckelshaus, A. Fullerton, and L. Holsinger. 2006. Hydrologic regime and the conservation of salmon life history diversity. Biological Conservation 130: 560-572

Behrenfeld, M. J., R. T. O'Malley, D. A. Siegel, C. R. McClain, J. L. Sarmiento, G. C. Feldman, A. J. Milligan, P. G. Falkowski, R. M. Letelier, and E. S. Boss. 2006. Climate-driven trends in contemporary ocean productivity. Nature 444: 752–755.

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. Master of Science Thesis, Humboldt State University, Arcata, California.

Bell, E. and W.G. Duffy. 2007. Previously undocumented two-year freshwater residency of juvenile coho salmon in Prairie Creek, California. Transactions of the American Fisheries Society 136: 966-970.

Berejikian, B. A., S. B. Mathews and T. P. Quinn. 1996. Effects of hatchery and wild ancestry and rearing environments on the development of agonistic behavior in steelhead trout (Oncorhynchus mykiss) fry. Can. J. Fish. Aquat. Sci. 53:2004-2014.

Berg, L., and T.G. Northcote. 1985. Changes in territorial, gill-flaring, and feeding behavior in juvenile coho salmon (*Oncorhynchus kisutch*) following short-term pulses of suspended sediment. Canadian Journal of Fisheries and Aquatic Sciences 42:1410-1417.

Berman CH and T.P. Quinn. 1991. Behavioral thermoregulation and homing by spring chinook salmon, *Oncorhynchus tshawytscha* (Walbaum), in the Yakama River. Journal of Fish Biology 39: 301-312.

Beschta, R.L., R.E. Bilby, G.W. Brown, L.B. Holtby, and T.D. Hofstra. 1987. Stream temperature and aquatic habitat: fisheries and forestry interactions. Pp. 191-232 *In:* E.O. Salo and T.W. Cundy (*eds*.). 1987. Streamside Management: Forestry and Fishery Interactions. Contribution 57, University of Washington, College of Forest Research, Seattle, Washington.

Bilby, R. E., B. R. Fransen, and P. A. Bisson. 1996. Incorporation of nitrogen and carbon from spawning coho salmon into the trophic system of small streams: evidence from stable isotopes. Canadian Journal of Fisheries and Aquatic Sciences 53:164-173.

Bilby, R. E., B. R. Fransen, P. A. Bisson, and J. K. Walter. 1998. Response of juvenile coho salmon (*Oncorhynchus kisutch*) and steelhead (*Oncorhynchus mykiss*) to the addition of salmon carcasses to two streams in southwestern Washington, USA. Canadian Journal of Fisheries and Aquatic Sciences 55:1909-1918.

Bilton, H.J., D.F. Alderice, J.T. Schnute. 1982. Influence of time and size at release of juvenile coho salmon (*Oncorhynchus kisutch*) on returns at maturity. Canadian Journal of Fisheries and Aquatic Sciences 39(3):426-447.

Bjorkstedt, E. P., B. C. Spence, J. C. Garza, D. G. Hankin, D. Fuller, W. E. Jones, J. J. Smith, and R. Macedo. 2005. An analysis of historical population structure for evolutionarily significant units of Chinook salmon, coho salmon, and steelhead in the north-central California Coast recovery domain. NOAA-TM-NMFS-SWFSC-382. October. 195 p. Plus 15 plates.

Bjornn, T.C., M.A. Brusven, M.P. Molnau, J.H. Milligan, R.A. Klamt, E. Chaco, and C. Schaye. 1977. Transport of granitic sediment in streams and its effects on insects and fish. U.S. DOI, Office of Water Research Technology. Research Technical Completion Report Project B-036-IDA

Bjornn, T.C. and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. Pp. 83-138 In: W.R. Meehan (*ed.*). Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19. Bethesda, MD. 751 pp.

Bradford, M.J. and P.S. Higgins. 2001. Habitat-, season-, and size-specific variation in diel activity patterns of juvenile chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*Oncorhynchus mykiss*). Canadian Journal of Fisheries and Aquatic Sciences 58:365-374.

Bradford, M. J. and J. R. Irvine. 2000. Land use, fishing, climate change, and the decline of Thompson River, British Columbia, coho salmon. Can. J. Fish. Aquat. Sci. 57:13-16

Brown, L. R., P. B. Moyle, and R. M. Yoshiyama. 1994. Historical Decline and Current Status of Coho Salmon in California. North American Journal of Fisheries Management 14(2):237-261.

Brown, R.F. and B.R. Mate. 1983. Abundance, movement and feeding habits of harbor seals, *Phoca vitulina*, at Netarts and Tillamook bays, Oregon. NOAA Fishery Bulletin. 81(2):291-301.

Brown, L.R, and P.B. Moyle. 1991. Status of coho salmon in California. Report to the National Marine Fisheries Service, 114 pp. Available from National Marine Fisheries Service, Environmental and Technical Services Division, 525 N.E. Oregon Street, Portland, OR 97232

Brownell, N. F., Kier, W. M., Reber, M.L. 1999. Historic and Current Presence and Absence of Coho Salmon, *Onchorhynchus kisutch*, in the Northern California Portion of the Southern Oregon-Northern California Evolutionarily Significant Unit. Prepared for NMFS Southwest Science Center. Kier Associates.

Bryant, G. J. 1994. Status review of coho salmon in Scott Creek and Waddell Creek, Santa Cruz

County, California. Natl. Mar. Fish. Serv., SW Region, Protected Species Management Division, 102 p.

Bugert, R.M., T.C. Bjornn. 1991. Habitat use by steelhead and coho salmon and their responses to predators and cover in laboratory streams. Transactions of the American Fisheries Society 120:486-493.

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. DOC, NOAA Technical Memo NMFS-NWFSC-27, Seattle, Washington.

California Department of Fish and Game. 1967. An evaluation of the fish and wildlife resources of the Mad River as affected by the U.S. Corps of Engineers Mad River project with special reference to the proposed Butler Valley Dam. CDFG. Eureka, CA.

California Department of Fish and Game. 1968. WPB Administrative Report, Table 2, salmon and steelhead counts Mad River (Sweasey Dam). CDFG, Eureka, CA.

California Department of Fish and Game. 1994. Petition to the California Board of Forestry to list coho salmon (*Oncorhynchus kisutch*) as a sensitive species. California Department of Fish and Game Report. 35 pp. plus appendices. (Available from California Board of Forestry, 1416 Ninth, Sacramento, CA 95814). *In:* Weitkamp *et al*. (1995).

California Department of Fish and Game. 1997. Final review draft - Eel River salmon and steelhead restoration action plan. Inland Fisheries Division, 1416 Ninth Street, Sacramento, CA 95814.

California Department of Fish and Game. 2000 – Mad River Spawner Survey Data - Cañon Creek and North Fork Mad River. Eureka, CA.

California Department of Fish and Game. 2002. Status Review of California Coho Salmon North of San Francisco: Report to the California Fish and Game Commission. April 2002

California Department of Fish and Game (CDFG). 2004. Annual Report: 2004. Shasta River Fish Counting Facility, Chinook and Coho Salmon Observations, Siskiyou County, CA

California Department of Fish and Game. 2006. Annual Report to the National Marine Fisheries Service for Fisheries Restoration Grant Program Projects Conducted Under Department of the Army Regional General Permit NO. 12 (Corps File No. 27922N) within the U.S. Army Corps of Engineers, San Francisco District January 1, 2005 through December 31, 2005. CDFG Region 1, Fortuna Office. March 1

California Department of Fish and Game. 2007. Annual Report to the National Marine Fisheries Service for Fisheries Restoration Grant Program Projects Conducted under the Department of the Army Regional General Permit NO. 12 (Corps File No. 27922N) within the U.S. Army

Corps of Engineers, San Francisco District January 1, 2006 through December 31, 2006. Northern Region, Fortuna Office. March 1.

California Department of Fish and Game. 2008. Annual Report to the National Marine Fisheries Service for Fisheries Restoration Grant Program Projects Conducted under the Department of the Army Regional General Permit NO. 12 (Corps File No. 27922N) within the U.S. Army Corps of Engineers, San Francisco District January 1, 2007 through December 31, 2007. Northern Region, Fortuna Office. March 1.

California Department of Fish and Game. 2009. Annual Report to the National Marine Fisheries Service for Fisheries Restoration Grant Program Projects Conducted under the Department of the Army Regional General Permit NO. 12 (Corps File No. 27922N) within the U.S. Army Corps of Engineers, San Francisco District January 1, 2008 through December 31, 2008. Northern Region, Fortuna Office. March 1.

California Department of Fish and Game. 2010. Annual Report to the National Marine Fisheries Service for Fisheries Restoration Grant Program Projects Conducted under the Department of the Army Regional General Permit No. 12 (Corps File No. 27922N) within the U.S. Army Corps of Engineers, San Francisco District January 1, 2009 through December 31, 2009. Northern Region, Fortuna Office. March 1.

Calif. Dept. of Water Resources, 1958, Office Report On Preliminary Investigation of Mad River, March 1958, Appendix C, A Preliminary Evaluation Of The Effect Of The Ruth Dam Project On Fisheries Of The Mad River, CDFG, June, 1957 (Rvsd. February, 1958).

Campbell, R.N.B., and D. Scott. 1984. The determination of minimum discharge for 0+ brown trout (*Salmo trutta L.*) using a velocity response. New Zealand Journal of Marine and Freshwater Research. 18:1-11.

Canatta, S.T. and T. Hassler, 1995. Spatial and temporal distribution and utilization patterns of juvenile anadromous salmonids of the Eel River estuary, June 1994-September 1995. Salmon Restoration Conference, Santa Rosa, CA.

Cederholm, C.J., L.M. Reid and E.O. Salo. 1981. Cumulative effects of logging road sediment on salmonid populations of the Clearwater River , Jefferson County, Washington. In: Proceedings of Conference on Salmon Spawning Gravel: A Renewable Resource in the Pacific Northwest? Pages 38-74. Report 19. Wash. State University, Water Research Center, Pullman,WA.

Chamberlin, T.W., R.D. Harr, and F.H. Everest. 1991. Timber harvesting, silviculture, and watershed processes. In: W.R. Meehan (*ed.*), Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats, pgs. 181-206. American Fisheries Society Special Pub. 19. Bethesda, MD.

Chapman, D.W. 1962. Aggressive behavior in juvenile coho salmon as a cause of emigration. Journal of Fisheries Resource Board of Canada 19:1047-1080.

Chapman, D.W. 1966. Food and space as regulators of salmonid populations in streams. American Naturalist 100:345-357.

Chapman, D.W. and T.C. Bjornn. 1969. Distribution of salmon in streams, with special reference to food and feeding. Pp. 153-176 *In:* T. G. Northcote (*ed.*). Symposium on salmon and trout in streams. University of British Columbia, Vancouver, B.C.

Chavez, F. P., J. Ryan, S. E. Lluch-Cota, and M. Ñiquen C. 2003. From Anchovies to Sardines and Back: Multidecadal Change in the Pacific Ocean. Science 299 (5604), 217.

Chilcote, M. W. 2003. Relationship between natural productivity and the frequency of wild fish in mixed spawning populations of wild and hatchery steelhead (*Oncorhynchus mykiss*). Can. J. Fish. Aquat. Sci. 60: 1057–1067.

Clothier, W.D. 1953. Fish loss and movement in irrigation diversions from the west Gallatin River, Montana. Journal of Wildlife Management 17:144-158.

Clothier, W.D. 1954. Effects of water reductions on fish movement in irrigation diversions. Journal of Wildlife Management 18:150-160.

Collins, B.W. 2004. Report to the National Marine Fisheries Service for Instream Fish Relocation Activities associated with Fisheries Habitat Restoration Program Projects Conducted Under Department of the Army (Permit No. 22323N) within the United States Army Corps of Engineers, San Francisco District During 2002 and 2003. California Department of Fish and Game, Northern California and North Coast Region. March 24, 2004. Fortuna, California.

Collins, B.W. 2005. Annual Report to the National Marine Fisheries Service for Fisheries Restoration Grant Program Projects Conducted Under Department of the Army Regional General Permit NO. 12 (Corps File No. 27922N) within the U.S. Army Corps of Engineers, San Francisco District January 1, 2005 through December 31, 2005. March 1.

Cushman, R.M. 1985. Review of ecological effects of rapidly varying flows downstream from hydroelectric facilites. North American Journal of Fisheries Management 5:330-339.

Downie, S.T., and K.P. Lucey, 2005. Salt River Watershed Assessment. May 2005. Coastal Watershed Planning and Assessment Program. Department of Fish and Game.

Edmundson, E., F.E. Everest, and D.W. Chapman. 1968. Permanence of station in juvenile Chinook salmon and steelhead trout. Journal of Fisheries Resource Board of Canada 25(7):1453-1464, 1968.

Everest, F.H. and D.W. Chapman. 1972. Habitat selection and spatial interaction by juvenile chinook salmon and steelhead trout in two Idaho streams. Journal of the Fisheries Research Board of Canada 29:91-100.

Fausch, K.D., and Northcote, T.G. 1992. Large woody debris and salmonid habitat in a small coastal British Columbia stream. Can. J. Fish. Aquat. Sci. 49: 682.693.

Fausch, K.D., and R.J. White. 1986. Competition among juveniles of coho salmon, brook trout, and brown trout in a laboratory stream, and implications for Great Lakes tributaries. Transactions of the American Fisheries Society 115:363-381.

Fausch, K.D., and M.K. Young. 1995. Evolutionarily significant units and movement of resident stream fishes: a cautionary tale. American Fisheries Society Symposium 17:360-370.

Flagg, T. A., B. A. Berejikian, J. E. Colt, W. W. Dickhoff, L. W. Harrell, D. J. Maynard, C. E. Nash, M. S. Strom, R. N. Iwamoto, and C. V. W. Mahnken. 2000. Ecological and behavioral impacts of artificial production strategies on the abundance of wild salmon populations pp. 92. NOAA Technical Memorandum NMFS-NWFSC-41. Seattle, WA: Northwest Fisheries Science Center.

Ford, J. K. B. and G. M. Ellis. 2006. Selective foraging by fish-eating killer whales *Orcinus orca* in British Columbia. Marine Ecology Progress Series 316:185-199.

Ford, J. K. B., Ellis, G. M., and Olesiuk, P. F. 2005. Linking prey and population dynamics: did food limitation cause recent declines of "resident" killer whales (*Orcinus orca*) in British Columbia? Canadian Science Advisory Secretariat Research Document 2005/042.

Ford, J.K.B., G.M. Ellis and K.C. Balcomb. 2000. Killer whales: the natural history and genealogy of *Orcinus orca* in British Columbia and Washington State. 2nd ed. UBC Press, Vancouver, British Columbia.

Forest Ecosystem Management Assessment Team. 1993. Forest ecosystem management: an ecological, economic, and social assessment. U.S. Forest Service, National Marine Fisheries Service, Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Environmental Protection Agency. Portland, Oregon, and Washington D.C. 843 pp. plus appendices.

Fresh, K.L. 1997. The role of competition and predation in the decline of Pacific salmon and steelhead. *In* Pacific salmon and their ecosystems: status and future options. *Edited by* D.J. Stouder, P.A. Bisson, and R.J. Naiman. Chapman Hall, New York. pp. 245-275.

Furniss, M.J., T.D. Roelofs, and C.S. Yee. 1991. Road construction and maintenance. Pp. 297-323. *In:* W.R. Meehan (1991).

Gleick, P. H. and E. L. Chalecki. 1999. The impacts of climatic changes for water resources of the Colorado and Sacramento-San Joaquin river basins. Journal of the American Water Resources Association 35:1429-1441.

Godfrey, H. 1965. Coho salmon in offshore waters. Pp. 1-39 *In:* Salmon of the North Pacific Ocean. Part IX. International North Pacific Fisheries Commission Bulletin 16. *In:* Sandercock (1991).

Good, T. P., R. S. Waples, and P. Adams (editors). 2005. Updated status of federally listed ESUs of West Coast salmon and steelhead. U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-NWFSC-66. 597 p.

Gowan, C., Young, M.K., Fausch, K.D., and S.C. Riley. 1994. Restricted movement in resident stream salmonids: A paradigm lost? Canadian Journal of Fisheries and Aquatic Sciences 50:2626-2637.

Graybill, M.R. 1981. Haul out patterns and diet of harbor seals, *Phoca vitulina*, in Coos County, Oregon. Master's Thesis. University of Oregon, Eugene. 55 pp.

Green Diamond Resource Company. 2006. Aquatic habitat conservation plan and candidate conservation agreement with assurances. Volume 1–2, Final report. Prepared by Green Diamond Resource Company for National Marine Fisheries Service and U.S. Fish and Wildlife Service.

Greene, C. M. and T. J. Beechie. 2004. Consequences of potential density-dependent mechanisms on recovery of ocean-type chinook salmon (Oncorhynchus tshawytscha). Can. J. Fish. Aquat. Sci. 61(4): 590–602.

Gregory, R.S., and T.G. Northcote. 1993. Surface, planktonic, and benthic foraging by juvenile Chinook salmon (*Oncorhynchus tshawytcha*) in turbid laboratory conditions. Canadian Journal of Fisheries and Aquatic Sciences 50:233-240.

Gresh, T., J. Lichatowich, and P. Schoonmaker. 2000. An estimation of historic and current levels of salmon production in the northeast Pacific ecosystem. Fisheries 15(1):15-21.

Habera, J.W., R.J. Strange, B.D. Carter, and S.E. Moore. 1996. Short-term mortality and injury of rainbow trout caused by three-pass AC electrofishing in a southern Appalachian stream. North American Journal of Fisheries Management 11:192-200.

Habera, J.W., R.J. Strange, and A.M. Saxton. 1999. AC eletrofishing injury of large brown trout in low-conductivity stream. North American Journal of Fisheries Management 19:120-26.

Hagans, D.K., and W.E. Weaver. 1987. Magnitude, cause and basin response to fluvial erosion, Redwood Creek basin, northern California. In *Erosion and Sedimentation in the Pacific Rim*. Beschta, R.L., Blinn, T., Grant, G.E., Ice, G.G., and F.J. Swanson [Eds.]. IAHS Publication No. 165. International Assoc. of Scientific Hydrology: Wallingford, Oxfordshire. p. 419-428.

Hamlet, A. F., P. W. Mote, M. P. Clark, and D. P. Lettenmaier. 2005. Effects of temperature and precipitation variability on snowpack trends in the western United States. Journal of Climate 18:4545-4561.

Hamlet, A. F. and D. P. Lettenmaier. 1999. Columbia River Streamflow Forecasting Based on ENSO and PDO Climate Signals. Journal of Water Resources Planning and Management 125(6): 333-341.

Hankin, D.G. and M.C. Healey. 1986. Dependence of exploitation rates for maximum yield and stock collapse on age and sex structure of chinook salmon (*Oncorhynchus tshawytscha*) stocks. Canadian Journal of Fisheries and Aquatic Sciences 43:1746-1759.

Hankin, D.G. and R. McKelvey. 1985. Comment on fecundity of chinook salmon and its relevance to life history theory. Canadian Journal of Fisheries and Aquatic Sciences 42:393-394.

Hanrahan, T.P., D.B. Dauble, and D.R. Geist. An estimate of chinook salmon (*Oncorhynchus tshawytscha*) spawning habitat and redd capacity upstream of a migration barrierin the upper Columbia River. Canadian Journal of Fisheries and Aquatic Sciences 61:23-33.

Hanson, L.C. 1993. The foraging ecology of harbor seals, *Phoca vitulina*, and California sea lions, *Zalophus californianus*, at the mouth of the Russian River, California. Master's Thesis. Sonoma State University, Rohner Park, CA. 70 pp.

Hanson, M.B., R.W. Baird, C. Emmons, J. Hempelmann, G.S. Schorr, J. Sneva, and D.Van Doornik. 2007. Summer diet and prey stock identification of the fish-eating "southern resident" killer whales: Addressing a key recovery need using fish scales, fecal samples, and genetic techniques. Abstract from the 17th Biennial Conference on the Biology of Marine Mammals, Capetown, South Africa.

Hard, J. J., B. A. Berejikian, E. P. Tezak, S. L. Schroder, C. M. Knudsen and L. T. Parker. 2000. Evidence for morphometric differentiation of wild and captively reared adult coho salmon: a geometric analysis. Environ. Biol. Fish. 58:61-73.

Harr, R.D and R.A. Nichols. 1993. Stabilizing forest roads to help restore fish habitats: A northwest Washington example. Fisheries 18(4):18-22

Hartman, G.F. 1965. The role of behavior in the ecology and interaction of underyearling coho salmon and steelhead trout. Journal of the Fisheries Research Board of Canada 22: 1035-1081.

Harvey, B.C. 1986. Effects of suction gold dredging on fish and invertebrates in two California streams. North American Journal of Fisheries Management 6:401-409.

Haupt, H.F. 1959. Road and slope characteristics affecting sediment movement from logging roads. J. Forestry 57(5): 329-339.

Hayes, M.L. 1983. Active Capture Techniques. Pages 123-146 in L.A. Nielsen and K.L. Johnson, editors. Fisheries Techniques. American Fisheries Society. Bethesda, Maryland.

Healey, M.C. 1991. The life history of chinook salmon (*Oncorhynchus tshawytscha*). Pp. 213-393 *In:* Groot and Margolis (*1991*).

Healey, M.C. and W.R. Heard. 1984. Inter- and Intra-population variation in the fecundity of chinook salmon (*Oncorhynchus tshawytscha*) and its relevance to life history theory. Canadian Journal of Fisheries and Aquatic Sciences 41:476-483.

Hearn, W.E. 1987. Interspecific competition and habitat segregation among stream-dwelling trout and salmon: a review. Fisheries 12:24-31.

Hearn, W.E. and B.E. Kynard. 1986. Behavioral interactions and habitat utilization of juvenile rainbow trout and Atlantic salmon in tributaries of the White River of Vermont. Canadian Journal of Fisheries and Aquatic Sciences 43: 1988-1998.

Hicks B.J., Hall J.D., Bisson P.A. and J.R. Sedell. 1991. Responses of salmonids to habitat changes. Am Fish Soc Spec Publ 19: 483-518.

Higgins, P., S. Dobush, and D. Fuller. 1992. Factors in northern California threatening stocks with extinction. Unpublished manuscript, Humboldt Chapter American Fisheries Society. 24 pp. Available from Humboldt Chapter of the American Fisheries Society, P.O. Box 210, Arcata, CA 95521.

Hutson, S. S., N. L. Barber, J. F. Kenny, K. S. Linsey, D. S. Kumia, and M. A. Maupin. 2004. Estimated Use of Water in the United States in 2000. U.S. Geological Survey Circular 1268. Available at: http://pubs.usgs.gov/circ/2004/circ1268.

ISAB. 2002. Hatchery surpluses in the Pacific Northwest. Fisheries. 27(12): 16-27.

Jameson, R.J. and K.W. Kenyon. 1977. Prey of sea lions in the Rogue River. Oregon Journal of Mammalogy 58(4):672.

Jensen, A. 2000. Final Report, 1999 Fisheries monitoring program for gravel extraction operations on the Mad, Van Duzen, and Trinity rivers. Natural Resources Management Corporation, 1434 Third Street, Eureka, CA 95501. January 13. 42 pp. plus appendices.

Jonnson, B. 1997. A review of ecological and behavioural interactions between cultured and wild Atlantic salmon. ICES J. Mar. Sci. 54: 1031-1039.

Kahler, T.H., P. Roni, and T.P. Quinn. 2001. Summer movement and growth of juvenile anadromous salmonids in small western Washington streams. Canadian Journal of Fisheries and Aquatic Sciences 58:1947-2637

Kraft, M.E. 1972. Effects of controlled flow reduction on a trout stream. Journal of Fisheries Research Board of Canada 29:1405-1411.

Ketcheson, G.L. and H.A. Froehlich. 1978. Hydrology factors and environmental impacts of mass soil movements in the Oregon Coast Range. Report by the Water Resources Research Institute. Oregon State University. Corvallis, OR.

Keter, T. S. (1995). Environmental history and cultural ecology of the North Fork of the Eel River Basin, California. Technical Report USDA, Forest Service, Pacific Southwest Region, R5-EM-TP-002.

Knowles, N. and D. R. Cayan. 2004. Elevational dependence of projected hydrologic changes in the San Francisco estuary and watershed. Climate Change 62: 319-336.

Knuuti, K. 2003. Assessment of Changes in Channel Morphology and Bed Elevation in the Mad River, California, 1971-2000. Final Report. U.S. Army Corps of Engineers. Engineer Research and Development Center.

Kostow, K. E. 2004. Differences in juvenile phenotypes and survival between hatchery stocks and a natural population provide evidence for modified selection due to captive breeding. Can. J. Fish. Aquat. Sci. 61: 577–589.

Kostow, K. E. and S. Zhou. 2006. The Effect of an Introduced Summer Steelhead Hatchery Stock on the Productivity of a Wild Winter Steelhead Population. Trans. Am. Fish. Soc. 135: 825-841.

Kostow, K. E., A. R. Marshall and S. R. Phelps. 2003. Naturally spawning hatchery steelhead contribute to smolt production but experience low reproductive success. Trans. Am. Fish. Soc. 132: 780–790.

Lau, M.R. 1994. Habitat utilization, density, and growth of steelhead trout, coho salmon, and Pacific giant salamander in relation to habitat types in a small coastal redwood stream. Master of Science Thesis, University of California Davis. Davis, California.

Leider, S.A., M.W. Chilcote, and J.J. Loch. 1986. Movement and survival of presmolt steelhead in a tributary and the mainstem of a Washington river. North American Journal of Fisheries Management 6:526-531.

Levin, P. S., R. W. Zabel and J. G. Williams. 2001. The road to extinction is paved with good intentions: negative association of fish hatcheries with threatened salmon. Proc. R. Soc. Lond. B. 268: 1153–1158.

Liermann, M. and R. Hilborn. 2001. Depensation: evidence, models, and implications. Fish and Fisheries 2: 33-58.

MacFarlane, R. B., S. Hayes, and B. Wells. 2008. Coho and Chinook Salmon Decline in California during the Spawning Seasons of 2007/08. National Marine Fisheries Service. Southwest Region. Santa Cruz, CA.

MacKichan, K. A. 1951. Estimated Use of Water in the United States—1950. U.S. Geological Survey Circular 115. Available at: http://pubs.usgs.gov/circ/1951/circ115.

Mattole Salmon Group. 1997. Mattole Salmon Recovery Progress. Mattole Watershed Document #8. Mattole Salmon Group, Petrolia, CA.

Mayer, T. 2008. Analysis of trends and changes in Upper Klamath Lake hydroclimatology. United States Fish and Wildlife Service. Water Resources Branch. Portland, Oregon. 31 pp.

McElhany, P., M. H. Ruckelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt. 2000. Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units. NOAA Tech. Memo. NMFS-NWFSC-42. U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. National Marine Fisheries Service. 156 p.

McEwan, D. and T.A. Jackson. 1996. Steelhead Restoration and Management Plan for California. California Department of Fish and Game, 1416 Ninth Street, Sacramento, CA 95814. 234 pp. *In:* Busby *et al.* (1996).

McGinnity, P., P. Prodo, A. Ferguson, R. Hynes, N. O´ Maoile´idigh, N. Baker, D. Cotter, B. O'Hea1, D. Cooke, G. Rogan, J. Taggart and T. Cross. 2003. Fitness reduction and potential extinction of wild populations of Atlantic salmon, Salmo salar, as a result of interactions with escaped farm salmon. Proc. R. Soc. Lond. B. 270: 2443–2450

McMichael, G.A., C. S. Sharpe and T.N. Pearsons. 1997. Effects of Residual Hatchery-Reared Steelhead on Growth of Wild Rainbow Trout and Spring Chinook Salmon. Transactions of the American Fisheries Society 126(2): 230–239.

Megahan, W.F. and R.A. Nowlin. 1976. Sediment storage in channels draining small forested watersheds in the mountains of central Idaho. Third Federal Inter-agency Sedimentation Conference, Denver, CO.

Miles, E. L., A. K. Snover, A. F. Hamlet, B. Callahan, and D. Fluharty. 2000. Pacific Northwest regional assessment: the impacts of climate variability and climate change on the water resources of the Columbia River basin. Journal of the American Water Resources Association 36: 399-420.

Mote, P.W. 2006. Climate-driven variability and trends in mountain snowpack in western North America. Journal of Climate 19: 6209-6220.

Mote, P. W., A. F. Hamlet, M. P. Clark, and D. P. Lettenmaier. 2005. Declining snowpack in western North America. Bulletin of the American Meteorological Society. January 2005:39-49.

Moyle, P. B. 2002. *Inland Fishes of California*. Second Edition. University of California Press. Berkeley, CA.

Moyle, P.B., Israel, J.A., Purdy, S.E. 2008. Salmon, Steelhead, and Trout in California. Status of an Emblematic Fauna. A report commissioned by California Trout. Davis, CA.

M. Sparkman. California Department of Fish and Game. Personal communication. 2007.

Murphy, M.L. 1995. Forestry impacts on freshwater habitat of anadromous salmonids in the Pacific Northwest and Alaska -- requirements for protection and restoration. NOAA Coastal Ocean Program Decision Analysis Series No. 7. NOAA Coastal Ocean Office, Silver Spring, MD. 156 pp.

Murphy, M.L. and W.R. Meehan. 1991. Stream ecosystems. *In:* W.R. Meehan (*ed.*), Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats, pgs. 17-46. American Fisheries Society Special Publication 19. Bethesda, MD.

Murphy, G.I. and L. Shapovalov. 1951. A preliminary analysis of northern California salmon and steelhead runs. California Fish and Game 37:497-507. *In:* Busby *et al.* (1996).

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. Deptartment of Commerce. NOAA Technical Memorandum NMFS-NWFSC-35. Northwest Fisheries Science Center, Seattle, Washington. 443 pp.

National Marine Fisheries Service. 1997b. Investigations of Scientific Information on the Impacts of California Sea Lions and Pacific Harbor Seals on Salmonids and on the Coastal Ecosystems of Washington, Oregon, and California. U. S. Dept. of Commerce, NOAA Tech. Memo. NMFS-NWFSC-28. 172 pp.

National Marine Fisheries Service. 1999. Biological Opinion. Pacific Lumber Company Habitat Conservation Plan/Sustained Yield Plan for the Headwaters Forest Project. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Long Beach, CA. 465 pp plus app.

National Marine Fisheries Service. 2001. Status review update for coho salmon (*Oncorhynchus kisutch*) from the Central California Coast and the California Portion of the Southern Oregon/Northern California Coast Evolutionarily Significant Units. Southwest Fisheries Science Center, Santa Cruz Laboratory. April 12. 43 pp.

National Marine Fisheries Service. 2003. Preliminary conclusions regarding the updated status of listed ESUs of West Coast salmon and steelhead. Part C. Coho salmon. February 2003 Co-manager review draft.

National Marine Fisheries Service. 2003a. Preliminary conclusions regarding the updated status of listed ESUs of West Coast salmon and steelhead. Part B. Steelhead trout. February 2003 Co-manager review draft.

National Marine Fisheries Service. 2003b. Preliminary conclusions regarding the updated status of listed ESUs of West Coast salmon and steelhead. Part A. Chinook salmon. February 2003 Co-manager review draft.

National Marine Fisheries Service. 2005. Final Assessment of the National Marine Fisheries Service's Critical Habitat Analytical Review Teams (CHARTs) for Seven Salmon and Steelhead Evolutionarily Significant Units (ESUs) in California. NOAA Fisheries Protected Resource Division, Long Beach, CA.

National Marine Fisheries Service. 2007. 2007 Report to Congress. Pacific Coastal Salmon Recovery Fund FY 2000-2006.

National Marine Fisheries Service. 2011. Southern Oregon/Northern California Recovery Domain 5-Year Review: Summary and Evaluation of Southern Oregon/Northern California Coast Coho Salmon ESU. NMFS Southwest Region, Long Beach, CA.

National Marine Fisheries Service. 2011a. Status Review Update for Pacific Salmon and Steelhead Listed Under the Endangered Species Act: Southwest. NMFS Southwest Fisheries Science Center, Santa Cruz, CA.

National Marine Fisheries Service. 2011b. Southern North-Central California Recovery Domain 5-Year Review: Summary and Evaluation of California Coastal Chinook Salmon ESU and Central California Coast Coho Salmon ESU. NMFS Southwest Region, Long Beach, CA.

National Research Council (NRC). 2004. Endangered and Threatened Fishes in the Klamath River Basin: Causes of decline and strategies for recovery. National Academies Press. Washington, D.C.

Nakamura and Swanson. 1993. Effects of Course Woody Debris on Morphology and Sediment Storage of a Mountain Stream System in Western Oregon. Earth Surface Processes and Landforms. Vol. 18: 43-61

Nehlsen, W., J.E. Williams, and J.A. Lichatowich. 1991. Pacific salmon at the crossroads: Stocks at risk from California, Oregon, Idaho, and Washington. Fisheries 16(2):4-21.

Nielsen, J.L. 1998. Electrofishing California's endangered fish populations. Fisheries 23:6-12.

Nordwall, F. 1999. Movements of brown trout in a small stream: effects of electrofishing and consequences for population estimates. North American Journal of Fisheries Management 19:462-469.

Nichols, K., K. True, E. Wiseman, and J.S. Foot. 2007. FY 2005 Investigational Report: Incidense of *Ceratomyxa Shasta* and *Parvicapsula minibicornis* infections by QPCR and

histology in juvenile Klamath River Chinook salmon. U.S. Fish and Wildlife Service, CANV Fish Health Center. Anderson, CA.

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 Department of Fish and Wildlife, Research and Development Section, Corvallis, and Ocean Salmon Management, Newport. 83 pp.

Nielson, J.L., C. Gan, and W.K. Thomas. 1994. Differences in genetic diversity for mitochondrial DNA between hatchery and wild populations of Oncorhynchus. Can. J. Fish. Aquat. Sci. 51:290-297.

Pacific Fisheries Management Council. 2006. Preseason Report 1: Stock Abundance Analysis for 2006 Ocean Salmon Fisheries. Portland, OR

Pacific Fishery Management Council (PFMC). 2003. Pre-season Report I – Stock Abundance Analysis for 2003 Ocean Salmon Fisheries. Portland, OR. February.

Pacific Fishery Management Council (PFMC). 2000. Amendment 14 to Pacific Coast Management Plan (1997). Incorporating the regulatory impact review/initial regulatory flexibility analysis and final supplemental environmental impact statement. 23 pages.

Pacific Fishery Management Council (PFMC). 1999. Preseason Report III Analysis of Council Adopted Management Measures for 1999 Ocean Salmon Fisheries. May.

Pacific Watershed Associates. 1998. Sediment Source Investigation and Sediment Reduction Plan for the Bear Creek Watershed, Humboldt County, California. Report prepared for The Pacific Lumber Company. Pacific Watershed Associates, Arcata, CA. Arcata, CA.

Pascual, M. A., T. P. Quinn, and H. Fuss. 1995. Factors affecting the homing of fall Chinook salmon from Columbia River hatcheries. Transactions of the American Fisheries Society 124:308-320.

Pearse, P .E., C. J. Donohoe, and J. C. Garza. 2007. Population genetics of steelhead (Oncorhynchus mykiss) in the Klamath River. Environ Biol Fish (2007) 80:377–387.

Peterson, N. P. 1982. Population characteristics of juvenile coho salmon (*Oncorhynchus kisutch*) overwintering in riverine ponds. Canadian Journal of Fisheries and Aquatic Sciences 39: 1303- 1307.

Quinn, T. P. 2005. The Behavior and Ecology of Pacific Salmon and Trout. University of Washington Press, Seattle, WA.

Raleigh, R.F., T. Hickman, R.C. Solomon, and P.C. Nelson. 1984. Habitat suitability information: rainbow trout. U.S. Fish Wildl. Serv. FWS/OBS-82/10.60.

Reynolds, J.B. 1983. Electrofishing. Pages 147-164 in L.A. Nielsen and D.L. Johnson, editors. Fisheries Techniques. American Fisheries Society. Bethesda, Maryland.

Reeves, G.H., F.H. Everest, and J.D. Hall. 1987. Interactions between the redside shiner (*Richardsonius balteatus*) and the steelhead trout (*Salmo gairdneri*) in western Oregon: the influence of water temperature. Canadian Journal of Fisheries and Aquatic Sciences 44:1603-1613.

Regonda, S.K., B. Rajagoplan, M. Clark, and J. Pitlick. 2005. Seasonal shifts in hydroclimataology over the western United States. Journal of Climate 18: 372-384.

Reid, L.M. 1998. Review of the: Sustained yield plan/habitat conservation plan for the properties of the Pacific Lumber Company, Scotia Pacific Holding Company, and Salmon Creek Corporation. Unpublished report. USDA Forest Service. Pacific Southwest Research Station. Redwood Sciences Laboratory. Arcata, California. 63 pp.

Reid, L.M. and Dunne, T. 1984. Sediment production from forest road surfaces. Water Resources Research 20(11): 1753-1761.

Reisenbichler, R. R. and J.D. McIntyre. 1997. Genetic differences in growth and survival of juvenile hatchery and wild steelhead trout, *Salmo gairdneri*. J. Fish. Res. Board Can. 34: 123-128.

Reisenbichler, R. R. and S. P. Rubin. 1999. Genetic changes from artificial propagation of Pacific salmon affect the productivity and viability of supplemented populations. ICES J. Mar. Sci. 56: 459-466.

Ricker, W.E. 1980. Causes of the decrease in age and size of chinook salmon (*Oncorhynchus tshawytscha*). Canadian Technical Report on Fisheries and Aquatic Sciences 944. 25 pp.

Roffe, T.J. and B.R. Mate. 1984. Abundance and feeding behavior of pinnipeds in the Rogue River, Oregon. Journal of Wildlife Management 48(4):1262-1274.

Sandercock, F.K. 1991. Life history of coho salmon. Pp. 397-445 *In:* Groot and Margolis (1991).

Sanders, J.E., J.J. Long, C.K. Arakawa, J.L. Bartholomew, and J.S. Rohovec. 1992. Prevalence of *Renibacterium salmoninarum* among downstream-migrating salmonids in the Columbia River. Journal of Aquatic Animal Health 4:72-75.

Saulitis, E., C. Matkin, L. Barrett-Lennard, K. Heise, and G. Ellis. 2000. Foraging strategies of sympatric killer whale (*Orcinus orca*) populations in Prince William Sound, Alaska. Mar. Mamm. Sci. 16(1): 94-109.

Scheffer, V.B. and J.W. Slipp. 1948. The whales and dolphins of Washington State. Am. Midl. Nat. 39: 257-289.

Scheffer, T. H., and C.C. Sperry. 1931. Food habits of the Pacific harbor seal, *Phoca vitulina richardsi*. J. Mammal. 12(3):214-226.

Schiewe, M.H. 1997. Memorandum to W. Stelle and W. Hogarth. Conclusions regarding the Updated Status of Coho Salmon from Northern California and Oregon Coasts. National Marine Fisheries Service, Northwest Fisheries Science Center, 2725 Montlake Boulevard East, Seattle, Washington 98112-2097. 70 pp. plus appendices.

Scott Harris. California Department of Fish and Game. Personal Communication. 2009.

Shapovalov, L., and A.C. Taft. 1954. The Life Histories of the Steelhead Rainbow Trout *Salmogairdneri gairdneri*) and Silver Salmon (*Oncorhynchus kisutch*) with Special Reference toWaddell Creek, California, and Recommendations Regarding Their Management. California Department of Fish and Game, Fish Bulletin No. 98. 375 pp.

Shelton, J.M. 1955. The hatching of chinook salmon eggs under simulated natural conditions. Prog. Fish-Cult. 17:20-35.

Sheppard, D. 1972. The present status of the steelhead trout stocks along the Pacific coast. *In* D. H. Rosenberg (editor), A review of the oceanography and renewable resources of the northern Gulf of Alaska, p. 519-556. IMS Report R72-23, Sea Grant Report 73-3. Institute of Marine Science, University of Alaska, Fairbanks.

Sigler, J.W., T.C. Bjournn, and F.H. Everest. 1984. Effects of chronic turbidity on density and growth of steelhead and coho salmon. Transactions of the American Fisheries Society 113:142-150.

Simenstad, C.A., K.L. Fresh, and E.O. Solo. 1982. The role of Puget Sound and Washington coastal estuaries in the life history of Pacific salmon: An unappreciated function, PP. 343-363. *In:* V.S. Kennedy, (*ed*.). 1982. Estuarine Comparisons. Academic Press, New York, New York.

Simpson Resource Company. 2002. Draft Aquatic Habitat Conservation Plan and Candidate Conservation Agreement with Assurances. July. Simpson Resource Company. California Timberlands Division. Korbel, CA. 2 volumes.

Spalding, S., Peterson, N.P., and Quinn, T.P. 1995. Summer distribution, survival and growth of juvenile coho salmon, Oncorhynchus kisutch, under varying experimental conditions of brushy instream cover. Trans. Am. Fish. Soc. 124: 124.130.

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. 52pp.

Sparkman, M.D. 2003. Upper Redwood Creek Juvenile Salmonid Downstream Migration Study, 2000-2002. Project 2a5. 2002 Annual Report. California Department of Fish and Game. Steelhead Research and Monitoring Program. 62 pp.

Spence, B.C., G.A. Lomnicky, R.M. Hughes, and R.P. Noviztki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. Management Technology Environmental Research Services Corp., Corvallis, OR.

Spence, B., Bjorkstedt, E., Garza, J.C., Hankin, D., Smith, J., Fuller, D., Jones, W., Macedo, R., Williams, T., Mora, E. 2007. A Framework for Assessing the Viability of Threatened and Endangered Salmon and Steelhead in North-Central California Coast Recovery Domain. Public Review Draft for NOAA Fisheries.

State of California, Department of Finance, California County Population Estimates and Components of Change by Year, July 1, 2000-2008. Sacramento, California, December 2008.

Stewart, I. T., D. R. Cayan, and M. D. Dettinger. 2005. Changes toward earlier streamsflow timing across western North America. Journal of Climate 18: 1136-1155.

Stocking, R. W., R. A. Holt, J. S. Foott, and J. L. Bartholomew. 2006. Spatial and temporal occurrence of the salmonid parasite *Ceratomyxa shasta* (Myxozoa) in the Oregon-California Klamath River basin. Journal of Aquatic Animal Health 18**:** 194–202.

Sullivan, K., T.E. Lisle, C.A. Dolloff, G.E. Grant, and L.M. Reid. 1987. Stream channels: the link between forests and fishes. In E.O. Salo and T.W. Cundy (*eds.*), Streamside Management: Forestry and Fishery Interactions, pgs. 191-232. Contribution 57, University of Washington., Inst. of Forest Resources, Seattle.

Swanson, F.J. and Dryness C.T. 1975. Impact of clearcutting and road construction on soil erosion and landsliding in the Western Cascade Range, Oregon. Geology 3(7): 393-396.

Swanson, F.J. and G.W. Lienkaemper. 1978. Physical consequences of large organic debris in Pacific northwestern streams. USDA For. Serv. Gen. Tech. Rep. PNW-59. 12p.

Swanston, D.N. and F.J. Swanson. 1976. Timber harvesting, mass erosion, and steepland forest geomorphology in the Pacific Northwest. In Coates, D.R. ed., Geomorphology and Engineering. Dowden, Hutchison, and Ross, Inc., Pages 199-221. Stroudsburg, PA.

Swanston, D. N. 1991. Natural processes. pp. 139-179. In W. R. Meehan, editor. Influences of forest and rangeland management on salmonid fishes and their habitats. Amer. Fish. Soc. Spec. Publ. 19. 751 p.

Sweeting, R.M., R.J. Beamish, D.J. Noakes and C.M. Neville. 2003. Replacement of wild coho salmon by hatchery-reared coho salmon in the Strait of Georgia over the past three decades. Trans. Am. Fish. Soc. 23: 492-502.

Taniguchi, A.K. 1970. Interval of estuarine residence and out-migration of the juvenile chinook salmon in the Mad River, California. Master's Thesis. Humboldt State University. Arcata, California.

Taylor, R.N. 2000. Final Report: Humboldt County Culvert Inventory and Fish Passage Evaluation. CDFG contract # FG-7068 IF. 36 pp.

Thomas, V.G. 1985. Experimentally determined impacts of a small, suction gold dredge on a Montana stream. North American Journal of Fisheries Management 5: 480-488.

Thomas, J. W., M. G. Raphael, R. G. Anthony, E. D. Forsman, A. G. Gunderson, R. S. Holthausen, B. G. Marcot, G. H. Reeves, J. R. Sedell, and D. M. Solis. 1993. Viability assessments and management considerations for species associated with late-successional and old-growth forest of the Pacific Northwest. Research Report of the Scientific Analysis Team. U.S. Forest Service, Washington, D.C. 530 pp

Tschaplinski, P. J. 1988. The use of estuaries as rearing habitats by juvenile coho salmon. In Proceedings of a Workshop: Applying 15 Years of Carnation Creek Results. Edited by T.W. Chamberlin. Carnation Creek Steering Committee, Nanaimo, B.C. pp. 123–142.

Tschaplinski, P.J. and G.F. Hartman. 1983. Winter distribution of juvenile coho salmon (*Oncorhynchus kisutch*) before and after logging in Carnation Creek, British Columbia, and some implications for overwinter survival. Canadian Journal of Fisheries and Aquatic Sciences 40:452-461.

U.S. Army Corps of Engineers 1982. Russian River basing study northern California streams investigation final report. San Francisco District. San Francisco, CA

Van Den Berghe, E.P. and M.R. Gross. 1984. Female size and nest depth in coho salmon (*Oncorhynchus kisutch*). Canadian Journal of Fisheries and Aquatic Sciences 41:204-206.

Van Kirk, R. W., and S. W. Naman. 2008. Relative effects of climate and water use on base-low trends in the lower Klamath Basin. Journal of the American Water Resources Association. In Press.

Velagic, E. 1995. Turbidity study: a literature review. Prepared for Delta planning branch, California Department of Water Resources by Centers for Water and Wildland Resources, University of California, Davis.

Vicuna, S., E. P. Maurer, B. Joyce, J. A. Dracup, and D. Purkey. 2007. The sensitivity of California water resources to climate change scenarios. Journal of the American Water Resources Association 43:482-498.

Voight, H. and J. Waldvogel. 2002. Smith River Anadromous Fish Action Plan. Smith River Advisory Council. 78 p.

Wallace, M. 2010. Field Note: Martin Slough, thence Swain Slough, thence Elk river, thence Humboldt Bay. California Department of Fish and Game.

Waples, R.S. 1991. Definition of "species" under the Endangered Species Act: Application to Pacific salmon. U.S. Department of Commerce. NOAA Technical Memorandum. NMFS, F/NWC-194. 29 pp.

Waples R.S., Gustafson R.G., Weitkamp L.A., Myers J.M., Johnson O.W., Busby P.J., Hard J.J., Bryant G.J., Waknitz F.W., Neely K., Teel D., Grant W.S., Winans G.A., Phelps S., Marshall A., Baker B.M. 2001. Characterizing diversity in salmon from the Pacific Northwest. J. Fish Biol., 59, 1–41.

Ward, E.J., E.E. Holmes and K.C. Balcomb. 2009. Quantifying the effects of prey abundance on killer whale reproduction. J. App. Ecol. 46(3): 632-640.

Waters, T. F. 1995. Sediment in Streams: Sources, Biological Effects, and Control. American Fisheries Society Monograph 7.

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. Department of Commerce. NOAA Technical Memorandum NMFS-NWFSC-24, Northwest Fisheries Science Center, Seattle, Washington. 258 pp.

Wells, B. K., C. B. Grimes, J. C. Field and C. S. Reiss. 2006. Covariation between the average lengths of mature coho (Oncorhynchus kisutch) and Chinook salmon (O. tshawytscha) and the ocean environment. Fish. Oceanogr. 15:1, 67–79.

Wesche, T.A. 1974. Evaluation of trout cover in smaller streams. Paper presented to American Fisheries Society Western Division meetings, Albuquerque, New Mexico.

Williams, T. H., E. P. Borkstedt, W. G. Duffy, D. Hillemeier, G. Kautsky, T. E. Lisle, M. McCain, M. Rode, R. G. Szerlong, R. S. Schick, M. N. Goslin, and A. Agrawal. 2006. Historical population structure of coho salmon in the Southern Oregon/Northern California Coasts Evolutionarily Significant Unit. U.S. Dept. Commer. NOAA Tech. memo. NMFS-NWFSC-390. June. 71 p.

Williams, T. H., B. C. Spence, W. Duffy, D. Hillemeier, G. Kautsky, T. Lisle, M. McCain, T. Nickelson, G. Garman, E. Mora, and T. Pearson. 2007. Framework for assessing viability of threatened coho salmon in the Southern Oregon/Northern California Coast Evolutionarily Significant Unit. Oregon-California Technical Recovery Team external review draft. July 5. 88 p.

Zhu, T., M. W. Jenkins, and J. R. Lund. 2005. Estimated impacts of climate warming on California water availability under twelve future climate scenarios. J. Am. Water Res. Assoc. 41: 1027-1038.

Federal Register Notices Cited

64 FR 24049. National Marine Fisheries Service. Final Rule and Correction. Designated Critical Habitat; Central California Coast and Southern Oregon/Northern California Coasts Coho Salmon. May 5, 1999.

64 FR 50394. National Marine Fisheries Service. Endangered and Threatened Species: Threatened Status for Two Chinook Salmon Evolutionarily Significant Units (ESUs) in California. September 16, 1999.

65 FR 36074. National Marine Fisheries Service. Endangered and Threatened Species: Threatened Status for One Steelhead Evolutionarily Significant Unit (ESU) in California. June 7, 2000.

70 FR 37160. National Marine Fisheries Service. Final Rule. Endangered and Threatened Species: Final Listing Determinations for 16 ESUs of West Coast Salmon, and Final 4(d) Protective Regulations for Threatened Salmonid ESUs. June 28, 2005.

70 FR 52488. National Marine Fisheries Service. Final Rule. Endangered and Threatened Species: Designation of Critical Habitat for Seven Evolutionarily Significant Units of Pacific Salmon and Steelhead in California. September 2, 2005.

71 FR 17757. National Marine Fisheries Service. Final Rule. Endangered and Threatened Wildlife and Plants: Threatened Status for Southern Distinct Population Segment of North American Green Sturgeon. April 7, 2006.

72 FR 16284. Fish and Wildlife Service. Final Rule. Endangered and Threatened Wildlife and Plants: Adding Four Marine Taxa to the List of Endangered and Threatened Wildlife. April 4, 2007

73 FR 52084. National Marine Fisheries Service. Proposed Rule. Endangered and Threatened Wildlife and Plants: Proposed Rule Making to Designate Critical Habitat for the Southern Distinct Population Segment of North American Green Sturgeon. Sept 8, 2008.

Enclosure 2

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT CONSULTATION

I. INTRODUCTION

The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267, 16 U.S.C. 1801 *et seq*.), established new requirements for Essential Fish Habitat (EFH) descriptions in Federal fishery management plans and require Federal agencies to consult with the NOAA's National Marine Fisheries Service (NMFS) on activities that may adversely affect EFH. EFH for Pacific Coast salmon has been described in Appendix A, Amendment 14 to the Pacific Coast Salmon Fishery Management Plan (Pacific Fishery Management Council 2000). The U.S. Army Corps of Engineers' (Corps) permitting of the Humboldt County Resource Conservations District's Salt River and Riverside Ranch Restoration Project (project), which has been designated EFH for Pacific salmon.

Only species managed under a Federal fishery management plan are covered under the MSFCMA. Coho salmon and Chinook salmon are managed under Federal fishery management plans, whereas steelhead are not managed. Therefore, these EFH conservation recommendations address only coho salmon and Chinook salmon.

II. LIFE HISTORY AND HABITAT REQUIREMENTS

General life history information and Evolutionarily Significant Unit (ESU) status for Southern Oregon/Northern California Coast (SONCC) coho salmon and California Coastal (CC) Chinook are discussed in the associated biological opinion. Further detailed information on coho salmon ESUs is available in the NOAA Fisheries status review for coho salmon from Washington, Oregon, and California (Weitkamp *et al.* 1995). Detailed information on Chinook salmon ESUs is available in the NOAA Fisheries status review for Chinook salmon from Washington, Idaho, Oregon, and California (Myers *et al.* 1998).

III. PROPOSED ACTION

The proposed action is the ecological restoration of the Salt River, a tributary slough to the Eel River, and the 264-acre Riverside Ranch, in Humboldt County, California. A detailed description is provided in the associated biological opinion.

IV. EFFECTS OF THE PROPOSED ACTION

Effects of the proposed action on coho salmon and Chinook salmon EFH are those associated with short-term increased sedimentation and killing of salmonid prey species. These effects are described in the associated biological opinion.

V. CONCLUSION

After reviewing the effects of the project, NOAA Fisheries has determined that the proposed action would adversely affect coho salmon and Chinook salmon EFH.

VI. EFH CONSERVATION RECOMMENDATIONS

NOAA Fisheries has no conservation measures to recommend over what is currently proposed. The effects are primarily short-term and associated project mitigation including the construction of two wood structures and riparian planting is expected to result in long-term benefits to Chinook and coho salmon EFH.

VII. FEDERAL AGENCY STATUTORY REQUIREMENTS

The MSFCMA [section 305(b)(4)(B)] and Federal regulations [50 CFR § 600.920(j)] to implement the EFH provisions of the MSFCMA require Federal action agencies to provide a written response to EFH conservation recommendations within 30 days of their receipt. A preliminary response is acceptable if a final response cannot be completed within 30 days. The final response must include a description of measures proposed to avoid, mitigate, or offset the adverse effects of the activity on EFH. If your response is inconsistent with our EFH conservation recommendations, the Corps must provide an explanation for not implementing those recommendations.

VIII. LITERATURE CITED

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. United States Department of Commerce, National Oceanic and Atmospheric Administration Technical Memorandum NOAA Fisheries-NWFSC-35, Northwest Fisheries Science Center, Seattle, Washington. 443 pages.

Pacific Fishery Management Council (PFMC). 2000. Amendment 14 to Pacific Coast Management Plan (1997). Incorporating the regulatory impact review/initial regulatory flexibility analysis and final supplemental environmental impact statement. 23 pages.

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.

United States Department of Commerce, National Oceanic and Atmospheric Administration Technical Memorandum NOAA Fisheries-NWFSC-24, Northwest Fisheries Science Center, Seattle, WA. 258 pages.