NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7
BIOLOGICAL OPINION

Title:	Biological Opinion on Bureau of Land Management Vegetation Treatments Using Herbicides
Consultation Conducted By:	Endangered Species Act Interagency Cooperation Division, Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce
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NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7 BIOLOGICAL OPINION

Action Agencies: Bureau of Land Management

Activity Considered: Bureau of Land Management Vegetation Treatments using Aminopyralid, Fluroxypyr, and Rimsulfuron on Bureau of Land Management Lands in 17 Western States

Consultation Conducted By: Endangered Species Act Interagency Cooperation Division, Office of Protected Resources, National Marine Fisheries Service

Approved: Donna S Wieting

Donna S. Wieting
Director, Office of Protected Resources

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ACRONYMS AND ABBREVIATIONS

ac-acre
a.e.-Acid equivalent
AI-Active Ingredient
ALS-Acetolactase synthase
ANS- Aquatic nuisance species
BA-Biological Assessment
BLM-Bureau of Land Management
CFR-Code of Federal Regulations
DDT-Dichlorodiphenyltrichloroethane
DO-Dissolved oxygen
DPS-Distinct population segment
EPA-Environmental Protection Agency
ERA-Ecological Risk Assessment
ESA-Endangered Species Act
ESU-Ecologically Significant Unit
FIFRA-Federal Insecticide, Fungicide, and Rodencticide Act
FR-Federal Register
gal-gallon
GIS- Geographic Information System
ICBTRT-Interior Columbia Basin Technical Review Team
kg-kilogram
km-kilometerlbs-pounds
LCFRB-Lower Columbia Fish Recovery Board
LCR-Lower Columbia River
LUP-Land Use Plan
ms-millisecond
NMFS-National Marine Fisheries Service
NOAA-National Oceanic and Atmospheric Administration
PCEs-Primary Constituent Elements
PEIS-Programmatic Environmental Impact Statement

PUP-Pesticide Use Proposal
ROW-Rights of way
RQ-Risk quotients
SR-Snake River
SOP-Standard Operating Procedure
TEP-Threatened, Endangered, and Proposed [for listing]
UCR-Upper Columbia River
USFWS-U.S. Fish and Wildlife Service

1 INTRODUCTION

Section 7 (a)(2) of the Endangered Species Act (ESA) requires Federal agencies to insure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. When a Federal agency's action "may affect" a protected species, that agency is required to consult formally with National Oceanic and Atmospheric Administration (NOAA)'s National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS), depending upon the endangered species, threatened species, or designated critical habitat that may be affected by the action (50 CFR §402.14(a)). Federal agencies are exempt from this general requirement if they have concluded that an action "may affect, but is not likely to adversely affect" endangered species, threatened species, or designated critical habitat and NMFS or the USFWS concurs with that conclusion (50 CFR §402.14(b)).

Section 7 (b)(3) of the ESA requires that at the conclusion of consultation, NMFS and/or USFWS provide an opinion stating how the Federal agencies' actions will affect ESA-listed species and their critical habitat under their jurisdiction. If an incidental take is expected, section 7 (b)(4) requires the consulting agency to provide an incidental take statement that specifies the impact of any incidental taking and includes reasonable and prudent measures to minimize such impacts.

For the actions described in this document, the action agency is the Bureau of Land Management (BLM).

The biological opinion (opinion) was prepared by NMFS Endangered Species Act Interagency Cooperation Division in accordance with section 7(b) of the ESA and implementing regulations at 50 CFR §402. This document represents NMFS' opinion on the effects of these actions on endangered and threatened species and critical habitat that has been designated for those species. A complete record of this consultation is on file at NMFS Office of Protected Resources in Silver Spring, Maryland.

1.1 Background

The Bureau of Land Management has initiated formal consultation with the NMFS Office of Protected Resources on BLM's proposal to add three new active ingredients (aminopyralid, fluroxypyr, and rimsulfuron) to its list of approved active ingredients for use on BLM lands in 17 Western states.

This action follows the BLM's formal consultation in 2007, which examined the effects of vegetation treatments on ESA-listed species on BLM-administered lands in 17 Western states. These vegetation treatments included various methods proposed for use controlling unwanted and invasive vegetation on BLM lands, including fire, mechanical, manual, biological control agents, and herbicide treatments. The herbicide treatments included applying formulations containing 18 active ingredients (AIs) to treat vegetation on BLM lands in the western U.S. The 2007 consultation examined the BLM's national program under which vegetation treatments would be conducted, and did not address individual vegetation treatments that would be conducted by BLM field offices. Such site-specific treatments were to be addressed individually in subsequent section 7 consultations conducted by the NMFS Regions (NMFS 2007).

In the current action, the BLM is proposing to add three new AIs—aminopyralid, fluroxypyr, and rimsulfuron—to its list of approved AIs for use on herbicide treatments on BLM lands in Western states.

BLM engaged contacts at NMFS and USFWS throughout 2014 to develop its biological assessment (BA) on the three new AIs. BLM provided the draft BA for comment by NMFS and USFWS, as well as ecological risk assessments (ERAs) for each of the three AIs, information on the application rates, development of the buffer zones, and other relevant parts of the AI's proposed application. NMFS and USFWS provided technical assistance and recommendations on the draft BA and related documents.

1.2 Consultation History

This opinion is based on information provided in the March 20, 2015 biological assessment and other sources including:

- ERAs for aminopyralid, fluroxypyr, and rimsulfuron
- Data provided by BLM on developing the risk quotients (RQ) and buffer zones for the AIs
- Biological opinions written by the NMFS Regions for site-specific treatments following the 2007 Opinion
- Published and unpublished scientific information on endangered and threatened species and their surrogates
- Scientific and commercial information such as reports from government agencies and the peer-reviewed literature
- Biological opinions on similar activities, and
- Other sources of information.

On March 20, 2015, the NMFS' ESA Interagency Cooperation Division received a request for formal consultation under section 7 of the ESA from the BLM on its proposal to add three new herbicides to its list of approved AIs for use on public lands.

On June 2, 2015, the NMFS' ESA Interagency Cooperation Division and BLM had a meeting to discuss questions on the consultation package.

On July 14, and September 1, 2015 the NMFS' ESA Interagency Cooperation Division and BLM agreed to extensions on the consultation deadline.

2 DESCRIPTION OF THE PROPOSED ACTION

"Action" means all activities or programs authorized, funded, or carried out, in whole or in part, by federal agencies. The Federal action considered in this Opinion is the BLM's proposal to authorize three new AIs to its list of herbicides approved for use on BLM publicly-administered lands in 17 Western states.

2.1 Proposed Activities

The BLM proposes to use formulations containing three new AIs as part of its national vegetation treatment program—aminopryalid, floroxypyr, and rimsulfuron. If authorized, these three new AIs will add to the existing 18 AIs currently used in the vegetation treatment program; the 2007 opinion (NMFS 2007) evaluated these 18 AIs.

Herbicide treatment methods will include applying formulations containing aminopryalid, floroxypyr, and rimsulfuron. Herbicide formulations are a combination of the active ingredients and other inert ingredients called adjuvants. Adjuvants are chemicals added to the herbicide formulations to increase the efficiency of the herbicide (BLM 2015a).

Each of the three proposed AIs has been registered under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and by the U.S. Environmental Protection Agency (EPA) as general use pesticides. The application procedures for registered herbicides are explicitly stated; to comply with FIFRA, the application of all registered herbicides must follow herbicide label rates, uses and handling instructions. For use on public lands, applicators (i.e., individuals applying the herbicide, or those directly supervised by a certified applicator), must be certified with the EPA (BLM 2015a).

Besides restrictions on the terms of the label and approved applicators, other practical reasons like treatment objective, features of the application area, characteristics of the target species and the desired vegetation, equipment limitations, and proximity to ecologically sensitive areas all will influence the application of the proposed three AIs. Such considerations will be assessed by site in subsequent section 7 consultations at the Region.

2.1.1 Herbicide Descriptions

Aminopyralid is available in a soluble liquid formulation, and is categorized as a growth regulator herbicide (BLM 2015a). Its general mechanism of toxicity is to mimic the auxin plant growth hormone. Aminopyralid causes uncontrolled cell division and elongation in the vascular tissues of the plant, eventually causing the plant to starve.[1] Aminopyralid is registered under the EPA's reduced risk initiative, meaning that EPA considers aminopryalid to be less of a risk to

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[1] https://www.btny.purdue.edu/WeedScience/MOA/Auxin_Growth_Regulators/text.html

human health and the environment than other alternative herbicides, and can be used right up to the water's edge (BLM 2015a).

Fluroxypyr is also a growth regulator herbicide and works by mimicking auxin plant growth hormones, specifically, indoleacetic acid. It is a selective post-emergent systemic herbicide for the control of broadleaf weeds. Similarly to aminopryalid, fluroxypyr causes uncontrolled growth in the targeted plant. This stress eventually leads to the death of the plant (BLM 2015a).

Rimsulfuron is a sulfonylurea herbicide classified as a branched-chain amino acid inhibitor, specifically by inhibiting acetolactate synthase (ALS) enzyme. By inhibiting the enzyme, rimsulfuron causes stoppage of shoot growth, discoloration, necrosis of tissues and then plant death. These affects appear about 7-10 days after treatment.[2]

2.1.2 Herbicide Formulations Using the Proposed AIs

AIs are the ingredients in pesticide formulations, that is, the commercial products that can kill or otherwise harm the target pest. The three proposed AIs would be used in formulations for use on BLM-administered lands (Table 1). All formulations shown in Table 1 have been registered with EPA in accordance with FIFRA (BLM 2015a). The herbicide formulations containing the proposed AIs were evaluated in the ecological risk assessments (ERAs) (see section 2.1.7).

An AI may be combined with inert ingredients (any ingredient in the formulation that is not intended to affect the target organism, for example, a solvent) or adjuvants. An adjuvant is a chemical designed to enhance or prolong the activity of the AI or make the active ingredient easier to apply (BLM 2015a). Adjuvants can include surfactants, drift control agents, compatibility agents, and other materials which enable the AI to stick to target species or to spread during use of the formulation. Adjuvants may be incorporated into formulated products as inert ingredients or they may be sold separately and applied as a tank mixture[3] with pesticide products. Adjuvants that are sold as separate products are not under the same FIFRA registration guidelines that pesticides are; however an individual herbicide does contain lists of "label-approved" adjuvants which can be used in accordance with the specifications on the label. There are over 200 adjuvants approved for use on BLM lands (BLM 2015a).

Adjuvants have been identified for use with each of the AI formulations. Only nonionic surfactants have been identified for use with aminopyralid. Only methylated seed oil surfactants are used for fluroxypyr formulations. Several types of spray adjuvants are identified as

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[2] https://www.btny.purdue.edu/WeedScience/MOA/index.html

[3] When adjuvants and one or more AIs are combined in a tank or other container, it is referred to as a tank mixture Council, N. R. 2013. Assessing Risks to Endangered and Threatened Species from Pesticides. Pages 141 *in* C. o. E. R. A. u. F. a. E. B. o. E. S. a. T. D. o. E. a. L. S. N. R. Council, editor. The National Academies Press, Washington, D.C..

compatible for use with rimsulfuron, including nonionic surfactants, petroleum crop oil concentrate, modified seed oil, ammonium nitrogen fertilizer, and combination adjuvant products (BLM 2015a). In the ERAs for aminopyralid and rimsulfuron, the maximum predicted concentrations of the inert or adjuvant compounds were calculated. In the ERA for fluroxypyr, the maximum predicted concentrations of the adjuvants for fluroxypyr could not be mathematically calculated, so an ecotoxicological literature review was conducted instead to determine the level of risk (BLM 2014c). A more detailed discussion on the results of these analyses can be found in the Response Section (5.9.3).

Table 1 Herbicide formulations proposed for use on BLM-administered lands using the 3 new AIs. Table adapted from (BLM 2015a).

Active Ingredient	Trade Name	Concentration
Aminopyralid	Milestone	2.0 lb a.e./gal
	Milestone VM	2.0 lb a.e./gal
Aminopyralid + 2,4-D	GrazonNext	0.33+2.67 lb a.e./gal
	ForeFront HL	0.41+3.33 lb a.e./gal
	ForeFront R&P	0.33+2.67 lb a.e./gal
Aminopyralid + Mesulfuron Methyl	Opensight	0.525+9.45% a.i.
Aminopyralid + Triclopyr	Milestone VM Plus	0.1+1.0 lb a.e./gal
Rimsulfuron	Matrix	25% a.i.
	Matrix SG	25% a.i.
	Matrix FNV	25% a.i.
Fluroxypyr	Comet	1.5 lb a.e./gal
	Fluroxypyr Herbicide	2.8 lb a.e./gal
	Vista	1.5 lb a.e./gal
	Vista XRT	2.8 lb a.e./gal
Fluroxypyr + Clopyralid	Truslate	0.75+0.75 lb a.e./gal
Fluroxypyr + Picloram	Surmount	0.67+0.67 lb a.e./gal
	Trooper Pro	1.0+1.0 lb a.e./gal
Fluroxypyr + Triclopyr	PastureGard	0.5+1.5 lb a.e./gal
	PastureGard HL	1.0+3.0 lb a.e./gal

2.1.3 Tank Mixes Using the Proposed AIs

In a tank mix, two or more compatible herbicides can be combined in a spray tank and applied simultaneously, mostly for efficiency (e.g., equipment, personnel). Tank mixes have been used by the BLM to treat about 20% of public lands in the past (2001-2011) (BLM 2015a), and it is probable the three proposed AIs would be incorporated into tank mixes. There is some degree of uncertainty about the effects of herbicide interactions in tank mixes, and the potential risks to nontarget species. When using tank mixes, land managers must follow label instructions by the SOPs described in the 2007 BA (BLM 2007b).

2.1.4 Herbicide Application Procedures

Aminopryalid, fluroxypyr, and rimsulfuron (as well as tank mixes and herbicide formulations containing these AIs) would be applied by several methods, including:

- Aerial applications (i.e., fixed-wing aircraft or helicopter)
- Manual applications (i.e., spot treatments through herbicide injectors or backpack sprayers)
- Granular application (i.e., hand crank granular spreader)
- Use of mechanical equipment like a spray boom or wand attached to a vehicle

Each of the three proposed AIs are registered for use in rangeland, forestland, oil, gas and minerals, rights of way, and recreation and cultural resource areas. Aminopryalid, fluroxypyr and rimsulfuron are not registered for use in riparian or aquatic areas.

Application of aminopyralid, fluroxypyr, and rimsulfuron would be carried out through aerial and ground dispersal (Table 2). Ground applications are conducted on foot or on horseback with backpack sprayers or by vehicles, from all-terrain vehicles (ATVs), utility vehicles, or trucks equipped with spot or boom/broadcast sprayers. Ground applications at energy and mineral sites, along rights-of-way (ROW), and in recreation areas are solely carried out using ATVs or trucks (BLM 2014a; BLM 2014c; BLM 2014d).

Table 2 Characteristics of aminopyralid, fluroxypyr, and rimsulfuron, including application techniques and projected use frequency on BLM land. Modified from (BLM 2015a).

Herbicide	Herbicide Characteristics and Application Techniques	Projected Future Use (Percent)*
Aminopyralid	Selective herbicide; plant growth regulator Applied post-emergence, using aerial or ground application equipment	10
Fluroxypyr	Selective herbicide; plant growth regulator	1

Herbicide	Herbicide Characteristics and Application Techniques	Projected Future Use (Percent)*
	Applied to actively growing plants, using aerial or ground application equipment	
Rimsulfuron	Selective herbicide; ALS-inhibiting herbicide Applied pre- and post-emergence, using ground or aerial equipment	16

**Percent of all acres treated*

Application rates are divided into two general categories: typical and maximum. The typical application rate indicates the usual rate at which the AI would be used. In specified programs under certain circumstances, a higher, maximum rate is necessary, and it is specified as the amount which would not be exceeded (BLM 2015a). Aminopyraild and fluroxypyr have the same typical and maximum application rates across all programs; rimsulfuron has a lower typical application rate for the Rangeland and Public domain Forestland programs than for other programs (Table 3).

Table 3 Typical and Maximum Application Rates for aminopyralid, fluroxypyr, and rimsulfuron. Modified from (BLM 2015a).

Herbicide	Typical Application Rate (lbs a.e./ac)	Maximum Application Rate (lbs a.e./ac)
Aminopyralid	0.078	0.11
Fluroxypyr	0.26	0.5
Rimsulfuron	**Typical Application Rate (lbs a.i./ac)**	**Maximum Application Rate (lbs a.i./ac)**
Rangeland Public-domain Forestland	0.0469	0.0625
Energy and Mineral Sites ROW Recreation	0.0625	0.0625

2.1.5 Herbicide Treatment Standard Operating Procedures

BLM will follow standard operating procedures (SOPs) when implementing its herbicide treatment programs. These SOPs are being implemented as part of the existing programs, and would also apply to adding the three new AIs. The SOPs have several general aims, including protecting the native plant community, addressing safety concerns, and lessening risk to nontarget plants, animals and protected species and their habitat.

The SOPs contain numerous measures and guidance documents which would be applicable to herbicide treatment projects that involve aminopyralid, fluroxypyr, and rimsulfuron. The SOPs address the vegetation treatment process at several phases, allowing opportunity to evaluate risks and introduce protective measures at each step. The following describes the SOPs and is condensed from the 2015 BA and Appendix A (BLM 2015a):

- Project Planning, Development and Revegetation
    - Prevention measures are considered here to lessen risk of introducing or spreading invasive plants.
- Herbicide Treatment Planning
    - This stage evaluates the need for chemical treatments, and the potential impact on the environment.
    - Operational plans are developed. A plan could include herbicide buffers near water bodies, project specifications, personnel responsibilities, emergency procedures, safety measures, and spill response.
- Site Revegetation Procedures
    - These are procedures applied depending on site for the benefit and promotion of the native plant community after herbicides eliminate invasive plants.
- Precautions to Lessen Impacts to Protected Species
    - At this step, the project site is surveyed for threatened and endangered species and designated critical habitat (if present) is identified. BLM engages with NMFS and USFWS for section 7 consultations as necessary.
- Procedures for Herbicide Application
    - This step establishes the use of general and specific measures intended to protect threatened and endangered species and designated critical habitat.

2.1.6 Programmatic Conservation Measures for New AIs

While the SOPs described broadly address concerns about impacts to ESA-listed species and their critical habitat, these procedures are general. In its 2007 BA, BLM presented conservation measures for each species (or species group), which were developed using the ecological risk assessment (ERA) for each of the AIs (BLM 2007b). These national protective measures were intended to be tailored by the BLM field offices based on local conditions, depending upon the ESA-listed species present. The programmatic conservation recommendations below were developed for aminopyralid, fluroxypyr and rimsulfuron based on the recommendations in the ERAs, and are specific to aquatic animals[4] (BLM 2015a):

Programmatic Conservation Measures for Aquatic Animals

- For treatments occurring in watersheds with threatened, endangered, or proposed (TEP) species or designated or undesignated critical habitat (i.e., unoccupied habitat critical to species recovery):
  - Where feasible, access work site only on existing roads, and limit all travel on roads when damage to the road surface will result or is occurring.
  - Where TEP aquatic species occur, consider ground-disturbing activities on a case by case basis, and implement SOPs to ensure minimal erosion or impact to the aquatic habitat.
  - Within riparian areas, do not use vehicle equipment off established roads.
  - Outside riparian areas, allow driving off established roads only on slopes of 20 percent or less.
  - Except in emergencies, land helicopters outside riparian areas.
  - Within 150 feet of wetlands or riparian areas, do not fuel or refuel equipment, store fuel, or perform equipment maintenance (locate all fueling and fuel storage areas, as well as service landings outside protected riparian areas).
  - Before helicopter fueling operations prepare a transportation, storage, and emergency spill plan and obtain the appropriate approvals; for other heavy equipment fueling operations use a slip-tank not greater than 250 gallons. Prepare spill containment and cleanup provisions for maintenance operations.

Conservation Measures Related to Revegetation Treatments

- Outside riparian areas, avoid hydro-mulching within buffer zones established locally. This precaution will limit adding sediments and nutrients and increasing water turbidity.
- Within riparian areas, engage in consultation locally to ensure that revegetation activities incorporate knowledge of site-specific conditions and project design.
- Maintain equipment used for transportation, storage, or application of chemicals in a leak-proof condition.
- Do not store or mix herbicides, or conduct post-application cleaning within riparian areas.
- Ensure that trained personnel monitor the weather at spray times during application.
- Strictly enforce all herbicide labels.

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[4] Additional programmatic conservation measures were developed for other species groups (e.g., plants, insects, birds, etc.); see Appendix A, Table A-2 for a complete list (BLM. 2015a. Biological Assessment for Vegetation Treatments Using Aminopyralid, Fluroxypyr, and Rimsulfuron on Bureau on Land Management Lands in 17 Western States. U. S. D. o. I. B. o. L. Management, editor, Washington, D.C.).

- Do not broadcast spray within 100 feet of open water when wind velocity exceeds 5 mph.
- Do not broadcast spray when wind velocity exceeds 10 mph.
- Do not spray if precipitation is occurring or is imminent (within 24 hours).
- Do not spray if air turbulence is sufficient to affect the normal spray pattern.
- Do not broadcast spray herbicides in riparian areas that provide habitat for TEP aquatic species. Determine appropriate buffer distances locally to ensure that overhanging vegetation that provides habitat for TEP species is not removed from the site. Buffer distances provided as conservation measures in assessing effects to plants (Chapter 4 of the BA) and fish and aquatic invertebrates should be consulted as guidance (Table 5-5 of the BA).
- Follow all instructions and SOPs to avoid spill and direct spray situations into aquatic habitats.

2.1.7 Ecological Risk Assessments

Ecological risk assessments (ERAs) were prepared for each of the three AIs (BLM 2014a) (BLM 2014d) (BLM 2014c). The purpose of an ERA is to identify the potential risks of the herbicide to non-target plants and animals (and any associated risks to habitat) and to characterize exposure situations to develop generic risk estimates. The analyses in the ERAs evaluated the AIs and the herbicide formulations containing the AIs. Four potential exposure situations were evaluated for aquatic animals: direct spray of the water body, accidental spill into the water body, off-site drift of spray to the water body, and surface runoff from the application area to the water body (BLM 2015a). Both the typical and maximum application rates (Table 3) were considered for each situation, using ground and aerial equipment. (Exposure situations for manual spot treatments were not evaluated because such treatments occur on a small-scale, under controlled circumstances.) The computer models AgDRIFT®, GLEAMS, AERMOD, and CALPUFF were used to predict herbicide transport in the environment (i.e., spray drift, runoff, etc.). The results of the modeling will be discussed in further detail in the effects section (5.9).

A degradate is the physical or biological components that remain once a complex compound (like an herbicide) breaks down. Degradates were not discussed in the ERAs because a lack of data on the toxicity of degradates of the herbicides (BLM 2015a). The issue toxicity of degradates was discussed in the 2007 Programmatic Environmental Impact Statement (PEIS), which acknowledged the uncertainty surrounding the issue and how the physical and chemical attributes of degradates are still poorly understood, despite conducting additional studies (BLM 2007a).

2.1.8 Local BLM Field Office Procedures to Protect ESA-listed Species

The ERAs were used to inform the guidance to be used later by the local BLM field offices while planning their site-specific vegetation treatment programs, and to develop the conservation measures presented in the BA and discussed in Section 2.1.6 (BLM 2015a). The conservation measures described in this opinion and in the BA are starting points. Conservation measures can be expanded upon or modified as appropriate during local BLM field office consultations.

Using the information from the ERAs and BA, the BLM developed a set of procedures that would be followed by the local BLM field offices to insure that any site-specific vegetation treatment programs would provide sufficient consideration of the effects on ESA-listed species and designated critical habitat. These procedures include:

- Before any site-specific projects would occur, local BLM field offices will consult with the appropriate NMFS or USFWS office on any action that may affect ESA-listed species or designated critical habitat.
- The BLM will follow the herbicide label instructions, identify the appropriate application methods and rates (see Table 3), and incorporate mitigation and conservation measures from the ERAs and BA to reduce risks to ESA-listed resources.
- The BLM will analyze exposure levels of ESA-listed species based on modeling.
- Protective measures for ESA-listed species will be agreed upon by the local BLM field office and the Services and be included in the Pesticide Use Proposal (PUP).
- The Pesticide Use Proposal will contain protective measures for ESA-listed species, and the BLM will be required to follow those measures once the PUP is signed.

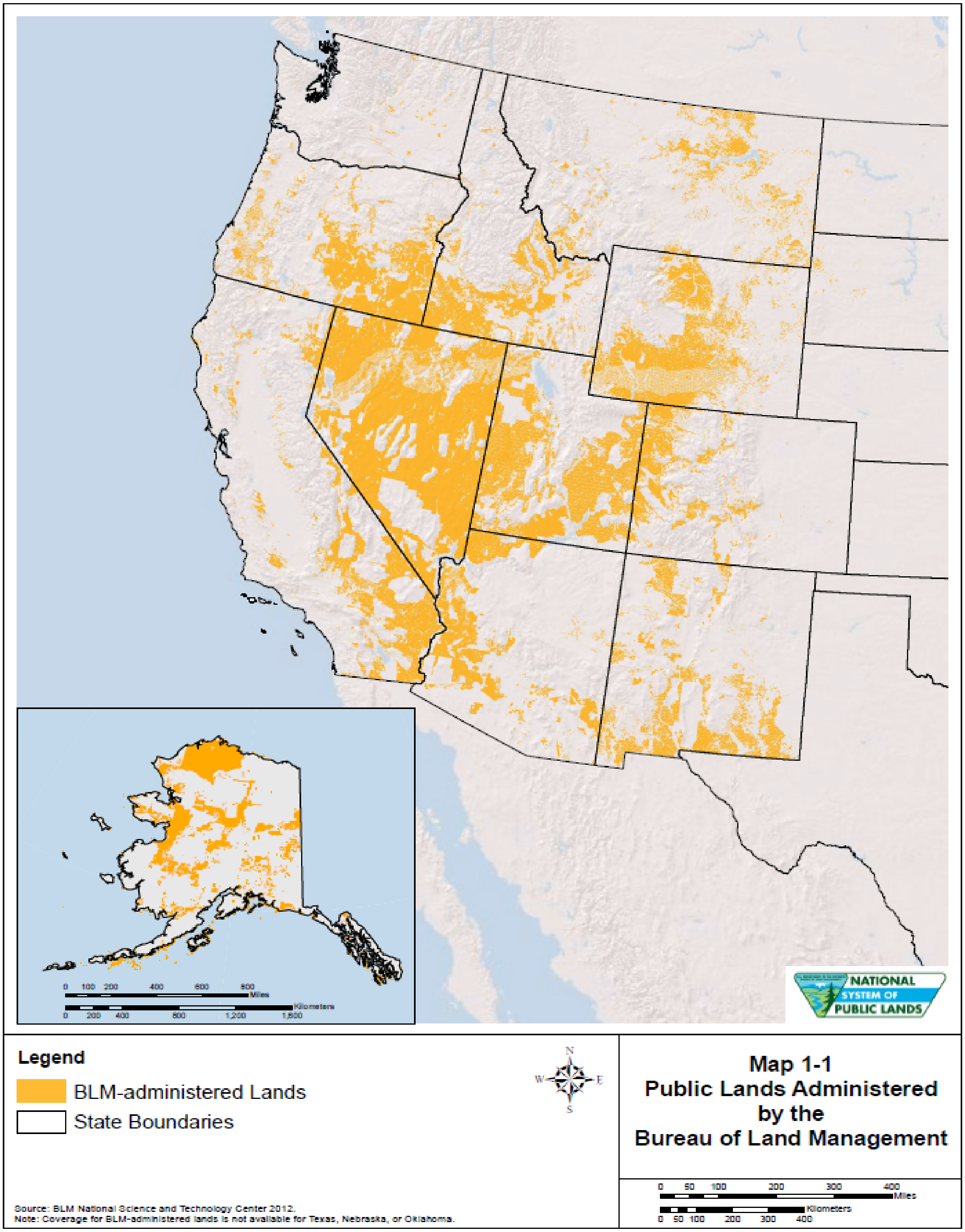
2.1.9 Local BLM Field Office section 7 Consultations

Local level section 7 consultations will be tracked. After seeking response from the Services, BLM developed a series of questions that will be entered in the PUP into the National Invasive Species Information Management System, the tracking system used by BLM to track pesticide use on BLM lands. These questions record whether ESA-listed resources are present in the proposed treatment area, whether the BLM field office sought section 7 consultation with the Services, and the result of the consultation. The National Invasive Species Information Management System generates an annual report, and this information on site-specific consultations will be provided.

2.2 Action Area

Action area means all areas affected directly, or indirectly, by the Federal action, and not just the immediate area involved in the action (50 CFR 402.02).

For the proposed action, the action area is approximately 932,000 acres of BLM-administered lands in 17 Western states (Figure 1). The total acreage of land treated using the three new AIs would be the same as evaluated in the 2007 opinion. BLM does not propose to treat lands adjacent to the coast (BLM 2015a).



Source: BLM National Science and Technology Center 2012.
Note: Coverage for BLM-administered lands is not available for Texas, Nebraska, or Oklahoma.

Figure 1: Map depicting the public lands administered by the BLM in 17 Western states where the proposed herbicide treatments could be applied.

Annually, up to about 932,000 acres of BLM-administered lands would be treated with the three new herbicides. These treatments could occur anywhere on the 247 million acres of BLM lands in the western U.S. (making the acreage exposed to the herbicides approximately 0.4% of BLM lands). The vegetation treatments carried out every year changes based on funding, and has varied since 2006 to 2012 from 260,000-436,000 acres (average: 315,000 acres) (BLM 2015a).

2.3 Interrelated and Interdependent Actions

Interrelated actions are those that are part of a larger action and depend on that action for their justification. *Interdependent* actions are those that do not have independent use, apart from the action under consideration.

BLM's proposed action to add 3 new AIs to its list of approved herbicides for the vegetation treatment program does not contain any interrelated or interdependent effects. If approved, the 3 AIs will be incorporated into the BLM's existing vegetation treatment program, the program having been analyzed in the 2007 opinion (NMFS 2007), and subject to all the same processes and standards that were examined in that consultation. This on-going Federal action will be considered as part of the Environmental Baseline.

3 OVERVIEW OF NMFS' ASSESSMENT FRAMEWORK

Section 7 (a)(2) of the ESA requires Federal agencies, in consultation with NMFS, to insure that their actions either are not likely to jeopardize the continued existence of endangered or threatened species; or adversely modify or destroy their designated critical habitat.

"To jeopardize the continued existence of an ESA-listed species" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of an ESA-listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02). The jeopardy analysis considers both survival and recovery of the species.

Section 7 assessment involves the following steps:

1. We identify the proposed action and those aspects (or stressors) of the proposed action that are likely to have direct or indirect effects on the physical, chemical, and biotic environment within the action area, including the spatial and temporal extent of those stressors.
2. We identify the ESA-listed species and designated critical habitat that are likely to co-occur with those stressors in space and time.
3. We describe the environmental baseline in the action area including:
   a. Past and present impacts of Federal, state, or private actions and other human activities in the action area;
   b. Anticipated impacts of proposed Federal projects that have already undergone formal or early section 7 consultation,

   c. Impacts of state or private actions that are contemporaneous with the consultation in process.

4. We identify the number, age (or life stage), and sex of ESA-listed individuals that are likely to be exposed to the stressors and the populations or subpopulations to which those individuals belong. This is our exposure analysis.
5. We evaluate the available evidence to determine how those ESA-listed species are likely to respond given their probable exposure. This is our response analyses.
6. We assess the consequences of these responses to the individuals that have been exposed, the populations those individuals represent, and the species those populations comprise. This is our risk analysis.
7. The adverse modification analysis considers the impacts of the proposed action on the critical habitat features and conservation value of designated critical habitat. This 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 regarding critical habitat.[5]
8. We describe any cumulative effects of the proposed action in the action area.

   Cumulative effects, as defined in our implementing regulations (50 CFR §402.02), are the effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area. Future Federal actions that are unrelated to the proposed action are not considered because they require separate section 7 consultation.

9. We integrate and synthesize these steps by considering the effects of the action to the environmental baseline and the cumulative effects to determine whether the action could reasonably be expected to:

   d. Reduce appreciably the likelihood of both survival and recovery of the ESA-listed species in the wild by reducing its numbers, reproduction, or distribution; or
   e. Reduce the conservation value of designated or proposed critical habitat. These assessments are made in full consideration of the status of the species and critical habitat.

10. We state our conclusions regarding jeopardy and the destruction or adverse modification of critical habitat.

If, in completing the last step in the analysis, we determine the action under consultation is likely to jeopardize the continued existence of ESA-listed species or destroy or adversely modify designated critical habitat, we must identify a reasonable and prudent alternative (RPA) to the

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[5] Memorandum from William T. Hogarth to Regional Administrators, Office of Protected Resources, NMFS (Application of the “Destruction or Adverse Modification” Standard Under Section 7(a)(2) of the Endangered Species Act) (November 7, 2005).

action. The RPA must not be likely to jeopardize the continued existence of ESA-listed species nor adversely modify their designated critical habitat and it must meet other regulatory requirements.

To comply with our obligation to use the best scientific and commercial data available, we conducted electronic and manual searches of the available literature. These searches helped to identify information relevant to the potential stressors and responses of ESA-listed species may be affected by the proposed action to draw conclusions about the likely risks to the continued existence of these species and the conservation value of their critical habitat.

The BLM's current vegetation treatment program includes the use of prescribed fire, mechanical, manual, and biological control methods, with a list of 18 approved herbicide AIs on BLM-administered lands in 17 Western states. The BLM's treatment program contains measures within it to protect threatened and endangered species and their designated critical habitat. The 2007 programmatic consultation considered this vegetation treatment program, which found the action would not jeopardize any ESA-listed species, or adversely modify and designated critical habitat (NMFS 2007). This Opinion represents NMFS' evaluation of whether the process in place to evaluate and implement the proposed use of the three new AIs satisfies BLM's obligations under section 7(a)(2) of the Endangered Species Act, as amended.

At a site-specific level, the actual treatment methods used, acres treated, timing and location of treatments are determined by the local BLM field offices. The typical site-specific assessment is impossible for this programmatic consultation to evaluate, because the actual treatment methods used would vary based on local circumstances which cannot be predicted at such a specific level. Therefore, this consultation on the proposed action to add three new AIs to the list of approved herbicides will assess BLM's treatment program and how it protects threatened and endangered species and their designated critical habitat. Subsequent section 7 consultations taking place at the Regional level would examine the effects of using herbicides containing the three new AIs on a site by site basis.

At a program level, the processes BLM employs to carry out its existing vegetation treatment program protecting ESA-listed species and designated critical habitat should be effective, and should prevent exposure of ESA-listed resources to potential adverse effects from vegetation treatments using the three proposed AIs. However, subsequent section 7 consultations on site-specific vegetation treatment programs would evaluate the actions individually, and consider local conditions and circumstances that we are unable to consider at the program level. Subsequent NMFS Regional section 7 consultations with BLM on site-specific actions would also ask if the conclusion of this national consultation is true for specific vegetation management decisions by BLM.

4 STATUS OF ESA-LISTED SPECIES

This section identifies the ESA-listed species that potentially occur within the action area (Figure 1) that may be affected by BLM's proposal to add three AIs to its list of approved herbicides in the vegetation treatment program. It then summarizes the biology and ecology of those species and what is known about their life histories in the action area. The species potentially occurring within the action area are ESA-listed in Table 4, with their regulatory status.

ESA-listed fishes like chinook, coho, chum, steelhead, eulachon, and green sturgeon are of particular concern in the proposed action because these species occur in various habitats throughout their life history. They can be found in freshwater environments, occurring in areas that overlap with the action area. Habitat alterations associated with the removal of plants with herbicides may be either beneficial or detrimental to species. Additionally, herbicides can be directly toxic to species depending on the level of exposure and the species' sensitivity. The three AIs may affect these species because the action area overlaps with the species' range, suggesting exposure to the species and their habitat is likely. Critical habitat has also been designated or proposed for nearly all the ESA-listed species found in Table 4; these critical habitat designations occur in many locations, most notably rivers and fresh water environments which could overlap with the action area.

Table 4. Threatened and endangered species that may be affected by BLM's proposed action adding 3 new AIs to its list of approved herbicides

Species	ESA Status	Critical Habitat	Recovery Plan
Marine Fish			
Eulachon (*Thaleichthys pacificus*)	T – 75 FR 13012	76 FR 65323	-- --
Sturgeon			
Green sturgeon (*Acipenser medirostris*)	T – 71 FR 17757	74 FR 52300	-- --
Marine Mammals -- Cetaceans			
Killer Whale (*Orcinus orca*)	E – 70 FR 69903	E – 71 FR 69054	73 FR 4176
Salmonids			
salmon, Chinook (*Oncorhynchus tshawytscha*)			
- California coastal	T – 64 FR 50393	70 FR 52488	
- Central Valley spring-run	T – 64 FR 50393	70 FR 52488	79FR42504
- Lower Columbia River	T – 64 FR 14308	70 FR 52630	78FR41911
- Upper Columbia River (UCR) spring-run	E – 64 FR 14308	70 FR 52630	72 FR 57303
- Puget Sound	T – 64 FR 14308	70 FR 52630	72 FR 2493
- Sacramento River winter-run	E – 59 FR 440	58 FR 33212	79FR42504

Species	ESA Status	Critical Habitat	Recovery Plan
- Snake River fall-run	T – 59 FR 42529	58 FR 68543	
- Snake River spring/summer-run	T – 59 FR 42529	64 FR 57399	
- Upper Willamette River	T – 64 FR 14308	70 FR 52630	76 FR 52317b
salmon, chum (*Oncorhynchus keta*)			
- Columbia River	T – 64 FR 14507	70 FR 52630	78FR41911
- Hood Canal summer-run	T – 64 FR 14507	70 FR 52630	72 FR 29121
salmon, coho (*Oncorhynchus kisutch*)			
- Central California coast	E – 61 FR 56138	65 FR 7764	
- Oregon coast	T – 63 FR 42587	64 FR 24049	78FR41911
- Southern Oregon & Northern California coasts	T – 62 FR 24588		
- Lower Columbia River	T – 70 FR 37160	78 FR 2725 (proposed)	78FR41911
salmon, sockeye (*Oncorhynchus nerka*)			
- Ozette Lake	T – 64 FR 14528	70 FR 52630	74 FR 24706
- Snake River	E – 56 FR 58619	58 FR 68543	
trout, steelhead (*Oncorhynchus mykiss*)			
- California Central Valley	T – 71 FR 834	70 FR 52488	79FR42504
- Central California coast	T – 71 FR 834	70 FR 52488	
- South-central California coast	T – 71 FR 834	70 FR 52488	
- Southern California	E – 71 FR 834	70 FR 52488	
- Northern California	T – 71 FR 834	70 FR 52488	
- Lower Columbia River	T – 71 FR 834	70 FR 52630	74 FR 50165
- Middle Columbia River	T – 71 FR 834	70 FR 52630	
- Upper Columbia River	T – 74 FR 42605	70 FR 52630	72 FR 57303
- Upper Willamette River	T – 71 FR 834	70 FR 52630	76 FR 52317b
- Snake River Basin	T – 71 FR 834	70 FR 52630	
- Puget Sound	T – 72 FR 26722	78 FR 2725 (proposed)	

4.1 ESA-listed Species and Critical Habitat Not Likely to be Adversely Affected

NMFS uses two measures to identify the ESA-listed or critical habitat that are not likely to be adversely affected by the proposed action, as well as the effects of activities that are interrelated to or interdependent with the Federal agency's proposed action. The first measure is exposure, or some reasonable expectation of a co-occurrence, between one or more potential stressors associated with the proposed activities and ESA-listed species or designated critical habitat. If we conclude that an ESA-listed species or designated critical habitat is not likely to be exposed to the proposed activities, we must also conclude the species or critical habitat is not likely to be adversely affected by those activities.

The second measure is the probability of a response given exposure. ESA-listed species or designated critical habitat that is exposed to a potential stressor but is likely to be unaffected by the exposure is also not likely to be adversely affected by the proposed action. We applied these measures to the species ESA-listed in Table 4 and we summarize our results below.

An action warrants a "may affect, not likely to be adversely affected" finding when its effects are *beneficial, insignificant* or *discountable. Beneficial* effects have an immediate positive effect without any adverse effects to the species or habitat. Beneficial effects are usually discussed when the project has a clear link to the ESA-listed species or its specific habitat needs and consultation is required because the species may be affected.

Insignificant effects connect the size or severity of the impact and include those effects that are undetectable, not measurable, or so minor that they cannot be meaningfully evaluated. Insignificant is the appropriate effect conclusion when plausible effects are going to happen, but will not rise to constituting an adverse effect resulting in a decrease in individual fitness. That means the ESA-listed species may be expected to be affected, but not harmed or harassed.

Discountable effects are those that are unlikely to occur. For an effect to be discountable, there must be a plausible adverse effect (i.e., a credible effect that could result from the action and that would be an adverse effect if it did impact a listed species), but it is unlikely to occur.

ESA-listed species including cetaceans, sea turtles, invertebrates, and pinnipeds and their designated critical habitat can be present in the coastal waters and areas of 4 out of the 17 western states of the action area—California, Oregon, Washington, and Alaska.

- Pinniped species include ringed seal Arctic Distinct population segment (DPS), Steller sea lion Western DPS
- Cetacean species include sei, fin, sperm, blue, humpback, Cook Inlet beluga and North Pacific right whales
- Invertebrate species include white and black abalone
- Sea turtles species include green, loggerhead, Kemp's ridley, Olive ridley and leatherback sea turtles

Herbicides containing the three proposed AIs will not be used in coastal areas, and they are not approved for use in riparian or aquatic areas, and the herbicides must be used in a manner consistent with the label instructions (BLM 2015a). While some exposure through long range transport mechanisms is possible, the magnitude of exposure with these pathways will be very low and any effects to ESA-listed cetaceans[6], sea turtles, invertebrates or pinnipeds are expected to be insignificant or discountable.

Critical habitat has been designated in California, Oregon, Washington and Alaska for black abalone, leatherback sea turtles, Cook Inlet beluga whales, Southern Resident killer whales, North Pacific right whales, and Steller sea lions. In evaluating the effects of the proposed action to critical habitat, we must assess the potential effects to the primary constituent elements (PCEs). Of the PCEs for these designated critical habitats (Table 5), the potential effects of the herbicide use possibly impacting the quantity or presence of prey species or food resources is most probable. However, herbicides containing the three proposed AIs will not be used in coastal areas, making it extremely unlikely that exposure will occur in designated critical habitat for these species. Therefore, the effects of the proposed action on these critical habitat units are discountable, and will not be considered further.

There are three rockfish species listed as threatened in Puget Sound, Washington: yelloweye, canary rockfish, and boccacio Puget Sound/Georgia Basin DPS. Critical habitat was designated for the rockfishes in Puget Sound in 2014 (79 FR 68041); the PCEs can be found in Table 5. There are a few small (>0.5 km^2) parcels of BLM-administered lands near Puget Sound, but herbicides containing the three proposed AIs will not be used in coastal areas, making exposure unlikely to occur. Therefore, the effects of the proposed action on Puget Sound/Georgia Basin DPS rockfishes and their critical habitat are discountable, and will not be considered further.

Notably, the proposed action includes mechanisms in its program so site-specific consultations would occur as necessary in the future. Any potential exposure and effects to all listed resources within a site-specific action area would be considered during those consultations conducted at a Regional level.

Table 5 Table of designated critical habitat in California, Oregon, Washington and Alaska not likely to be adversely effected by the proposed action.

Species	Critical Habitat FR Notice/Date	General Location	Primary Constituent Elements (PCEs)
Black Abalone *Haliotis cracherodii*	76 FR 66806 10/27/2011	Coastal CA	Rocky substrate: Benches, crevices, large boulders Food resources: Bacterial and diatom films, algae Juvenile settlement habitat: Rocky habitat with coralline algae and/or crevices, cryptic biogenic structures Suitable water quality Suitable nearshore circulation patterns

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[6] Excluding Southern Resident killer whales; see section 4.2.

Species	Critical Habitat FR Notice/Date	General Location	Primary Constituent Elements (PCEs)
Leatherback sea turtle *Dermochelys coriacea*	77 FR 4170 01/26/2012	Coastal CA, OR, WA	Occurrence of prey species (Jellyfish species) Migratory pathway conditions to allow for safe and timely passage and access to/from/within high use foraging areas
Beluga Whale *Delphinapterus leucas:* Cook Inlet	76 FR 20180 04/11/2011	AK (Cook Inlet; Anchorage, Homer)	Intertidal and subtidal waters of Cook Inlet with depths less than 30 feet (Mean Lower Low Water)(9.1 m) and within 5 miles (8 km) of high and medium flow anadromous fish streams. Primary prey species consisting of four species of Pacific salmon (Chinook, sockeye, chum, and coho), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole. Waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales. Unrestricted passage within or between the critical habitat areas. Waters with in-water noise below levels resulting in Cook Inlet beluga whales abandoning critical habitat areas.
Right Whale *Eubalaena glacialis* North Pacific	73 FR 19000 04/08/2008	AK (Gulf of Alaska, Bering Sea)	Copepods in areas of the North Pacific Ocean in which northern right whales are known or believed to feed
Stellar Sea Lion *Eumetopias jubatus:* Eastern (species delisted but CH still in effect)	58 FR 45269 8/27/1993 In effect. See 78 FR 66139.	CA, OR	Physical and biological habitat features that support reproduction, foraging, rest, and refuge. Includes terrestrial, air, and aquatic areas

Species	Critical Habitat FR Notice/Date	General Location	Primary Constituent Elements (PCEs)
Puget Sound / Georgia Basin Rockfish species Yelloweye *Sebastes ruberrimus* Canary *Sebastes pinniger* Boccacio *Sebastes paucispinis*	78 FR 47635 8/6/2013	WA (Salish Sea/Puget Sound)	Adults Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities, water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities, and the type and amount of structure and rugosity that supports feeding opportunities and predator avoidance Juvenile canary and boccacio Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities; and Water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities.

4.2 ESA-listed Species and Critical Habitat Likely to be Adversely Affected

This opinion examines the status of each species that would be affected by the proposed action. The status is determined by the risk the ESA-listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. The species status section helps to inform by describing the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. More details on the status and trends of these ESA-listed species, and their biology and ecology can be found in the listing regulations and critical habitat designations published in the Federal Register, status reviews, recovery plans, and on these NMFS Web sites: [http://www.nmfs.noaa.gov/pr/species/index.htm].

The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential physical and biological features that help to form that conservation value.

One factor affecting the range wide status of anadromous fishes, Southern Resident killer whales and aquatic habitat at large is climate change. This factor will be discussed in further detail in the Environmental Baseline section.

The following section focuses primarily on anadromous fishes. However, Southern Resident killer whales could also be adversely affected by the proposed action owing to the fact that individuals of this DPS show a strong preference for consuming Chinook salmon (NMFS 2008b). If Chinook salmon are exposed to any of the proposed AIs, and Southern Resident killer whales eat those exposed Chinook salmon, the Southern Resident killer whales could in turn be exposed to the proposed AIs. Furthermore, designated critical habitat for Southern Resident killer whales includes a primary constituent element requiring prey of sufficient quantity and quality to support Southern Resident killer whales (Table 5). If exposure to the proposed action affects the Chinook salmon population, it would also constitute an effect to the designated critical habitat for Southern Resident killer whale.

4.2.1 Southern Resident Killer Whale

Species description and distribution

Killer whales (or orcas) are distributed worldwide, but populations are isolated by region and ecotype (i.e., different morphology, ecology, and behavior). Southern Resident killer whales occur in the inland waterways of Puget Sound, Strait of Juan de Fuca, and Southern Georgia Strait during the spring, summer and fall. During the winter, they move to coastal waters primarily off Oregon, Washington, California, and British Columbia. The DPS was listed as endangered under the ESA on November 18, 2005 (70 FR 69903). We used information available in the final rule, the 2012 Status Review (NMFS 2012) and the 2011 Stock Assessment Report (http://www.nmfs.noaa.gov/pr/pdfs/sars/po2011whki-pensr.pdf) to summarize the status of this species, as follows.

Life history

Southern Resident killer whales are geographically, matrilineally, and behaviorally distinct from other killer whale populations (70 FR 69903). The DPS includes three large, stable pods (J, K, and L), which occasionally interact (Parsons et al. 2009). Most mating occurs outside natal pods, during temporary associations of pods, or as a result of the temporary dispersal of males (Pilot et al. 2010). Males become sexually mature at 10 – 17 years of age. Females reach maturity at 12 – 16 years of age and produce an average of 5.4 surviving calves during a reproductive life span of approximately 25 years. Mothers and offspring maintain highly stable, life-long social bonds, and this natal relationship is the basis for a matrilineal social structure. They prey upon salmonids, especially Chinook salmon (Hanson et al. 2010).

Population dynamics

The 2012 abundance estimate for the Southern Resident DPS is 87 whales. This represents an average increase of 0.4 percent annually since 1982 when there were 78 whales. Population abundance has fluctuated during this time with a maximum of approximately 100 whales in 1995 (http://www.nmfs.noaa.gov/pr/pdfs/sars/po2011whki-pensr.pdf). As compared to stable or growing populations, the DPS reflects a smaller percentage of juveniles and lower fecundity (NMFS 2011) and has demonstrated weak growth in recent decades.

Status

The Southern Resident killer whale DPS was listed as endangered in 2005 in response to the population decline from 1996 – 2001, small population size, and reproductive limitations (i.e., few reproductive males and delayed calving). Current threats to its survival and recovery include: contaminants, vessel traffic, and reduction in prey availability. Chinook salmon populations have declined due to degradation of habitat, hydrology issues, harvest, and hatchery introgression; such reductions may require an increase in foraging effort. In addition, these prey contain environmental pollutants (e.g., flame retardants; PCBs; and DDT). These contaminants become concentrated at higher trophic levels and may lead to immune suppression or reproductive impairment (70 FR 69903). The inland waters of Washington and British Columbia support a large whale watch industry, commercial shipping, and recreational boating; these activities generate underwater noise, which may mask whales' communication or interrupt foraging. The factors that originally endangered the species persist throughout its habitat: contaminants, vessel traffic, and reduced prey. The DPS's resilience to future perturbation is reduced as a result of its small population size (N = 86); however, it has demonstrated the ability to recover from smaller population sizes in the past and has shown an increasing trend over the last several years. NOAA Fisheries is currently conducting a status review prompted by a petition to delist the DPS based on new information, which indicates that there may be more paternal gene flow among populations than originally detected (Pilot et al. 2010).

Critical habitat
On November 29, 2006, NMFS designated critical habitat for the Southern Resident killer whale (71 FR 69054). The critical habitat consists of approximately 6,630 km^2 in three areas: the Summer Core Area in Haro Strait and waters around the San Juan Islands; Puget Sound; and the Strait of Juan de Fuca. It provides the following physical and biological features: water quality to support growth and development; prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth; and inter-area passage conditions to allow for migration, resting, and foraging.

4.2.2 Chinook Salmon

We discuss the distribution, life history, population dynamics, status, and critical habitats of the nine species (here we use the word "species" to apply to distinct population segments (DPSs), and evolutionary significant units (ESUs) separately; however, because listed Chinook salmon species are indistinguishable in the wild and comprise the same biological species, we begin this section describing characteristics common across ESUs. We used information available in the 2005 West Coast salmon and steelhead status review (Good et al. 2005), various salmon evolutionarily significant unit (ESU) listing documents, and biological opinions (notably NMFS 2012a) to summarize the status of the species.

Species description and distribution
Chinook salmon are the largest of the Pacific salmon and historically ranged from the Ventura River in California to Point Hope, Alaska in North America, and in northeastern Asia from Hokkaido, Japan to the Anadyr River in Russia in both fresh and saltwater habitats (Healey

1991). In freshwater, Chinook salmon prefer streams that are deeper and larger than those used by other Pacific salmon species.

Life history

Chinook salmon exhibit varied and complex life history strategies and can be described as one of two types: “stream-type” or “ocean type”. Stream-type Chinook salmon ESUs reside in fresh water for a year or more following emergence before migrating to salt water; ocean-type Chinook salmon ESUs migrate to the ocean within their first year and typifies populations north of 56ºN (Healey 1991). Stream-type ESUs normally return in late winter and early spring (spring-run) as immature adults and reside in deep pools during summer before spawning in fall. Ocean-type ESUs migrate to the ocean within their first year (sub-yearlings) and usually return as full mature adults in fall (fall-run) and spawn soon after river entry. Temperature and stream flow can significantly influence the timing of migrations and spawning, as well as selecting spawning habitat (Geist et al. 2009; Hatten and Tiffan. 2009). All Chinook salmon are semelparous (i.e. they die after spawning).

The timing of return to freshwater, and ultimately spawning, often provides a temporal isolating mechanism for populations with different life histories. Return timing is often related to spawning location. Thus, differences in the timing of spawning migration also serve as a geographic isolating mechanism. Fall-run Chinook salmon spawn in the mainstem of larger rivers and are less dependent on flow, although early autumn rains and a drop in water temperature often provide cues for movements to spawning areas. Spring-run Chinook salmon take advantage of high flows from snowmelt to access the upper reaches of rivers.

Chinook salmon out-migrants (smolts) are about 2 to 5 inches long when they enter saline (often brackish) waters. The process of smoltification enables salmon to adapt to the ocean environment. Several factors can affect smoltification process, not only at the interface between fresh water and salt water, but higher in the watershed as the process of transformation begins long before fish enter salt waters. These factors include exposure to chemicals such as heavy metals and elevated water temperatures (Wedemeyer et al. 1980).

Chinook salmon feed on various prey organisms depending upon life stage. In fresh water and brackish waters Chinook salmon primarily feed on small invertebrates and vertebrates. The diet of adult oceanic Chinook salmon is comprised primarily of fish.

Status

On June 28, 2005, as part of the final listing determinations for 16 ESUs of West Coast salmon, NMFS amended and streamlined the 4(d) protective regulations for threatened salmon and steelhead (70 FR 37160) as described in the Protective Regulations for Threatened Salmonid Species section of this document. Under this change, the section 4(d) protections apply to natural and hatchery fish with an intact adipose fin, but not to listed hatchery fish that have had their adipose fin removed before release into the wild.

Critical habitat

Areas designated as critical habitat are important for the species' overall conservation by protecting quality growth, reproduction, and feeding. At designation, primary constituent elements (PCEs) are identified and include sites necessary to support one or more Chinook salmon life stages. These PCEs will be identified for each ESU below, but in general they may include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, nearshore marine habitat, and estuarine areas. Physical or biological features that characterize these sites will also be discussed for each ESU separately, but they may include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. The critical habitat designation identified for each ESU contains additional details on the areas included as part of the designation, and the areas that were excluded from designation.

4.2.2.1 California Coastal Chinook salmon

Species description and distribution

The California Coastal Chinook salmon ESU includes all naturally spawned populations of Chinook salmon from rivers and streams south of the Klamath River to the Russian River, California. Seven artificial propagation programs were included in the ESU, however on June 26, 2013, NMFS proposed to remove the artificial propagation programs from the ESU because the artificial propagation programs have been terminated (78 FR 38270). We used information available in the 2005 West Coast salmon and steelhead status review (Good et al. 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" (Bjorkstedt et al. 2005), "A framework for assessing the viability of Threatened and Endangered Salmon and Steelhead in the North-central California coast Recovery Domain" (Spence et al. 2008), listing documents (64 FR 50393; 70 FR 37160), and previously issued biological opinions (notably NMFS 2008a and 2012a) to summarize the status of the species.

Life history

California Coastal Chinook salmon are a fall-run, ocean-type salmon. A spring-run (river-type) component existed historically, but is now considered extinct (Bjorkstedt et al. 2005)(Bjorkstedt et al. 2005)(Bjorkstedt et al. 2005)(Bjorkstedt et al. 2005)(Bjorkstedt et al. 2005)(Bjorkstedt et al. 2005)(Bjorkstedt et al. 2005)(Bjorkstedt et al. 2005)(Bjorkstedt et al. 2005)(Bjorkstedt et al. 2005). The different populations vary in run timing depending on latitude and hydrological differences between watersheds. Entry of California Coastal Chinook salmon into the Russian River depends on increased flow from fall storms, usually in November to January. Juveniles of this ESU migrate downstream from April through June and may reside in the estuary for a time before entering the ocean.

Population dynamics

Historical estimates of escapement, based on professional opinion and evaluation of habitat conditions, suggest abundance was roughly 73,000 in the early 1960s with most fish spawning in the Eel River (Good et al. 2005)(Good et al. 2005)(Good et al. 2005)(Good et al. 2005)(Good et al. 2005)(Good et al. 2005)(Good et al. 2005)(Good et al. 2005)(Good et al. 2005)(Good et al.(Good et al. 2005). Comparison of historical and current abundance information indicates that independent populations of Chinook salmon are depressed in many basins (Bennet 2005). All spring-run populations once occupying the North Mountain Interior are considered extinct or nearly so. Redd counts in Mattole River in the northern portion of the ESU indicate a small but consistent population; the cooler northern climate likely provides for favorable conditions for these populations. The Eel River interior fall-run populations are severely depressed. Two functionally independent populations are believed to have existed along the southern coastal portion of the ESU; of these two, only the Russian River currently has a run of any significance. This is also the only population with abundance time series. The 2000 to 2007 median observed (at Mirabel Dam) Russian River Chinook salmon run size is 2,991 with a maximum of 6,103 (2003) and a minimum of 1,125 (2008) adults (Cook 2008; Sonoma County Water Agency 2008). The number of spawners has steadily decreased since its high returns in 2003 with 1,963 fish observed in 2007 and 1,125 observed by December 22, 2008.

Status

NMFS listed California Coastal Chinook salmon as threatened on September 16, 1999 (64 FR 50393) and reaffirmed their threatened status on June 28, 2005 (70 FR 37160). California Coastal Chinook salmon was listed due to the combined effect of dams that prevent them from reaching spawning habitat, logging, agricultural activities, urbanization, and water withdrawals in the river drainages that support them. This ESU is at considerable risk from population fragmentation and reduced spatial diversity. There is little connectivity between the southern and northern portions of their range. At the southern portion of the ESU, only the Russian River population has had a constant run that exceeded 1,000 adult spawning fish over the last 10 years. This places the ESU at risk from random catastrophic events, chronic stressors, and long-term environmental change. Life history diversity has been significantly reduced by loss of the spring-run race and reduction in coastal populations. Based on these factors, this ESU would likely have a low resilience to additional distress.

Critical habitat

NMFS designated critical habitat for California Coastal Chinook salmon on September 2, 2005 (70 FR 52488). Specific geographic areas designated include the California Water Service's hydrological units: Redwood Creek, Trinidad, Mad River, Eureka Plain, Eel River, Cape Mendocino, Mendocino Coast and the Russian River. PCEs include freshwater spawning sites, freshwater rearing sites, fresh water migration corridors, nearshore marine habitat and estuarine areas. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. The spawning Primary Constituent Element (PCE) in coastal streams is degraded by years of timber harvest that has produced large amounts of sand and silt in spawning gravel and reduced water quality by increased turbidity. Agriculture and urban areas have impacted rearing and migration PCEs in the Russian River by degrading water quality and by disconnecting the river from it floodplains by constructing levees. Water management from dams within the Russian and Eel

River watersheds maintain high flows and warm water during summer which benefits the introduced predatory Sacramento pikeminnow, which has resulted in excessive predation along migration corridors. Breaches of the sandbar at the mouth of the Russian River result in periodic mixing of salt water which degrades the estuary PCE by altering water quality and salinity conditions that support juvenile physiological transitions between fresh- and salt water. The current condition of PCEs for this ESU indicates that they are not currently functioning or are degraded; these conditions are likely to maintain low population abundances across the ESU.

4.2.2.2 Central Valley Spring-Run Chinook salmon

Species description and distribution

The Central Valley spring-run Chinook salmon ESU includes all naturally spawned populations of spring-run Chinook salmon in the Sacramento River and its tributaries in California. Central Valley spring-run Chinook salmon have been eliminated from the San Joaquin River and its tributaries and the American River due to constructing Friant and Folsom dams, respectively. Naturally spawning populations of Central Valley spring-run Chinook salmon currently are restricted to accessible reaches of the upper Sacramento River, and its tributaries Butte, Deer, and Mill Creeks and limited spawning occurs in the basins of smaller tributaries (CDFG 1998). This ESU includes one artificial propagation program. We used information available in the 2005 West Coast salmon and steelhead status review (Good et al. 2005), listing documents (64 FR 50393; 70 FR 37160), the draft recovery plan (NMFS 2009a) and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

The Chinook Central Valley ESU is a spring-run, ocean-type salmon. This ESU returns to the Sacramento River between March and July and spawning occurs from late August to early October, with a peak in September. Juveniles of this ESU require cool freshwater while they mature over the summer.

Population dynamics

The Central Valley drainage as a whole is estimated to have supported spring-run Chinook salmon runs as large as 700,000 fish between the late 1880s and the 1940s (Fisher 1994), although these estimates may reflect an already declining population, in part from the commercial gillnet fishery that occurred for this ESU. Median natural production of spring-run Chinook salmon from 1970 to 1989 was 30,220 fish. In the 1990s, the population experienced a substantial production failure with an estimated natural production ranging between 3,863 and 7,806 fish (except 1995, which had a natural production of an estimated 35,640 adults) during the years between 1991 and 1997. Numbers of naturally produced fish increased significantly in 1998 to an estimated 48,755 adults and estimated natural production has remained above 10,000 fish since then (USFWS 2007).

The Sacramento River trends show long- and short- term negative trend and negative population growth. Meanwhile, the median production of Sacramento River tributary populations increased from a low of 4,248 with only one year exceeding 10,000 fish before 1998 to a combined natural production of more than 10,000 spring-run Chinook in all years after 1998 (data from USFWS 2007). Time series data for Mill, Deer, Butte, and Big Chico Creeks spring-run Chinook salmon (through 2006) indicate that all three tributary spring-run Chinook populations experienced population growth. Although the populations are small, Central Valley spring-run Chinook salmon have some of the highest population growth rates of Chinook salmon in the Central Valley.

Status
NMFS originally listed Central Valley spring-run Chinook salmon as threatened on September 16, 1999 (64 FR 50393), and reaffirmed their status on June 28, 2005 (70 FR 37160). This species was listed due to loss of historical spawning habitat, degradation of remaining habitat, and threats to genetic diversity from hatchery salmon. Risks persist to the spatial structure and diversity of the ESU. Only three extant independent populations exist, and they are especially vulnerable to disease or catastrophic events because they are near. In addition, until there are means to spatially the spring-run and fall-run populations in the lower basin of the Feather River, some genetic introgression of the races is expected to continue. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

Critical habitat
NMFS designated critical habitat for Central Valley spring-run Chinook salmon on September 2, 2005 (70 FR 52488). In total, Central Valley spring-run Chinook salmon occupy 37 watersheds (freshwater and estuarine). The total area of habitat designated as critical includes about 1,100 miles of stream habitat and about 250 square miles of estuarine habitat in the San Francisco-San Pablo-Suisun Bay complex. PCEs include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, nearshore marine habitat and estuarine areas. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. Spawning and rearing PCEs are degraded by high water temperature caused by the loss of access to historic spawning areas in the upper watersheds which maintained cool and clean water throughout the summer. The rearing PCE is degraded by floodplain habitat being disconnected from the mainstem of larger rivers throughout the Sacramento River watershed, by reducing effective foraging. The migration PCE is degraded by lack of natural cover along the migration corridors. Juvenile migration is obstructed by water diversions along Sacramento River and by two large state and federal water-export facilities in the Sacramento-San Joaquin Delta. Contaminants from agriculture and urban areas have degraded rearing and migration PCEs while they have lost their functions necessary to serve their intended role to conserve the species. Water quality impairments in the designated critical habitat of this ESU include fertilizers, insecticides, fungicides, herbicides, surfactants, heavy metals, petroleum products, animal and human sewage, sediment in the form of turbidity, and other anthropogenic pollutants. Pollutants enter the surface waters and riverine sediments as contaminated stormwater runoff, aerial drift and deposition, and by point source discharges. The current condition of PCEs for this ESU indicates they are not currently functioning or are degraded; these conditions are likely to maintain low population abundances across the ESU.

4.2.2.3 Lower Columbia River Chinook salmon

Species description and distribution

This Chinook salmon ESU includes all naturally spawned populations of Chinook salmon from the Columbia River and its tributaries from its mouth at the Pacific Ocean upstream to a transitional point between Washington and Oregon, east of the Hood River and the White Salmon River, and includes the Willamette River to Willamette Falls, Oregon, exclusive of spring-run Chinook salmon in the Clackamas River. Twenty artificial propagation programs are included in the ESU (70 FR 37160; 76 FR 50448). We used information available in the 2005 West Coast salmon and steelhead status review (Good et al. 2005), "Historical population structure of Pacific salmonids in the Willamette River and Lower Columbia River Basins" (Myers et al. 2006), the recovery plan (NMFS 2013a), the 5-year review (NMFS 2011a), listing documents (64 FR 14308; 70 FR 37160), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

Lower Columbia River Chinook salmon have three life history types: early fall run, ocean-type ("tule" salmon); late fall run, stream-type ("bright" salmon); and spring-run, stream-type. Presently, the fall-runs are the predominant life history types, though spring-run Lower Columbia River Chinook salmon were numerous historically.

Both fall-runs of Lower Columbia River Chinook salmon enter fresh water between August through October to spawn in large river mainstems; however, the bright salmon has a delayed entry to spawning grounds and resides in the river for a longer time between river entry and spawning. Tule salmon spawn from late September to November, with peak spawning activity in mid-October and brights spawn from November to January, with peak spawning in mid-November. Most tule salmon remain at sea from 1 to 5 years (more commonly three to five years) and return to spawn at two to six years old. Brights return to freshwater predominately as three- and four-year-olds.

Spring-run Chinook salmon enter freshwater in March through June to spawn in upstream tributaries in August and September. The spring-run Chinook salmon migrates to the sea as yearlings, typically in spring, though some may over-winter in the mainstem Columbia River before out-migrating (Lower Columbia Fish Recovery Board [LCFRB] 2010). The natural timing of Lower Columbia River spring-run Chinook salmon emigration is obscured by hatchery releases. Most remain at sea from one to five years (more commonly two to four years) and return to spawn at three to six years old (LCFRB 2010).

Population dynamics

It is estimated that 31 independent Chinook salmon populations (22 fall- and late fall-runs and 9 spring- runs) are estimated to have existed historically in the Lower Columbia River. Of those 31 populations, it is estimated that 8-10 historic populations have been extirpated, most of them spring-run populations. Historically, the number of spring-run Chinook salmon returning to the Lower Columbia River may have almost equaled that of fall-run Chinook salmon. However, most of spring-run Lower Columbia River (LCR) Chinook salmon populations are now extirpated and total returns are substantially lower for the fall-run component in recent years.

Historical records of Chinook salmon abundance are sparse. However, cannery records suggest a peak run of 4.6 million fish (43 million lbs) in 1883 (Lichatowich 1999). Recent trend indicators for most populations are negative. Most populations for which data are available have a long-term trend of less than one 1; indicating the population is not replacing itself and is in decline (Bennet 2005). Only the late-fall run population in Lewis River has an abundance and population trend that may be considered viable. The Sandy River is the only stream system supporting a natural production of spring-run Chinook salmon of any amount; however, the population is at risk from low abundance and negative to low population growth rates (McElhany 2007).

Status

NMFS listed Lower Columbia River Chinook salmon as threatened on March 24, 1999 (64 FR 14308) and reaffirmed their threatened status on June 28, 2005 (70 FR 37160). This ESU was listed due to the combined effect of dams that prevent them from reaching spawning habitat, logging, agricultural activities, urbanization, threats to genetic diversity from hatchery salmon, and overexploitation. Though the basin wide spatial structure has remained intact, the loss of about 35 percent of historic habitat has affected distribution within several Columbia River subbasins. The ESU is at risk from low abundances in all but one population, combined with most populations having a negative or stagnant long-term population growth. Though fish from conservation hatcheries do help to sustain several LCR Chinook salmon runs in the short-term, it is unlikely to result in sustainable wild populations in the long-term. Further, the genetic diversity of all populations (except the late fall-run) has been eroded by large hatchery influences. Having only one population that may be viable puts the ESU at considerable risk from environmental stochasticity and random catastrophic events. The near-loss of the spring-run life history type limits the ESU’s ability to maintain its fitness in the face of environmental change. Based on these factors, this ESU would likely have a moderate (late fall-run salmon in Lewis River) to low (all other populations) resilience to additional perturbations.

Critical habitat

NMFS designated critical habitat for LCR Chinook salmon on September 2, 2005 (70 FR 52630). It includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Hood Rivers as well as specific stream reaches some tributary subbasins. PCEs include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, nearshore marine habitat and estuarine areas. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. Timber harvest, agriculture, and urbanization have degraded spawning and rearing PCEs by reducing floodplain connectivity and water quality, and by removing natural cover in several rivers. Hydropower development projects have reduced timing and magnitude of water flows, by altering the water quantity needed to form and maintain physical habitat conditions and support juvenile growth and mobility. Adult and juvenile migration PCEs are affected by several dams along the migration route.

4.2.2.4 Upper Columbia River Spring-run Chinook salmon

Species description and distribution
The Upper Columbia River spring-run Chinook salmon ESU includes all naturally spawned populations of Chinook salmon in all river reaches accessible to Chinook salmon in Columbia River tributaries upstream of Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River. Six artificial propagation programs are part of this ESU. We used information available in status reviews (Good et al. 2005; NMFS 2011n), listing documents (63 FR 11482; 64 FR 14308; 70 FR 37160), the recovery plan (Upper Columbia Salmon Recovery Board 2007), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history
Upper Columbia River spring-run salmon are a stream-type salmon. Salmon in this ESU return to the upper Columbia tributaries from April through July, with the run peaking in mid-May. Spawning occurs in the late summer, peaking in mid- to late August. Juvenile spring-run Chinook salmon spend a year in fresh water before emigrating to salt water in the spring of their second year. Most returning adults are four- and five-year-old fish that have spent two and three years at sea, respectively.

Population dynamics
The ESU historically consisted of four populations; of these, one is now extinct. Spawning escapements have declined within all extant populations (in Wenatchee, Entiat, and Methow rivers) since 1958. In the most recent 5-year geometric mean (1997 to 2001), spawning escapement for naturally produced fish was 273 for the Wenatchee population, 65 for the Entiat population, and 282 for the Methow population, only 8% to 15% of the minimum abundance thresholds. Escapement did increase substantially in 2000 and 2001 in all three river systems. Based on 1980 to 2004 returns, the average annual growth rate for this ESU is estimated at 0.93 (meaning the population is not replacing itself; Fisher and Hinrichsen 2006). If population growth rates were to continue at 1980 to 2004 levels, Upper Columbia River spring-run Chinook salmon populations are projected to have high probabilities of decline within 50 years.

Status
NMFS listed UCR Spring-run Chinook salmon as endangered on March 24, 1999 (64 FR 14308), and reaffirmed their endangered status on June 28, 2005 (70 FR 37160). The ESU was listed due to the combined effect of dams that prevent them from reaching spawning habitat; habitat degradation from irrigation diversions, hydroelectric development, livestock grazing, and urbanization; and reduced genetic diversity from artificial propagation efforts. The Interior Columbia Basin Technical Review Team (ICBTRT) characterizes the spatial structure risk to UCR Spring-run Chinook populations as “low” or “moderate” and the diversity risk as “high” (Interior Columbia Technical Review Team 2008a; 2008b; 2008c). The high risk is a

result of reduced genetic diversity from homogenization of populations that occurred under the Grand Coulee Fish Maintenance Project in 1939-1943. Abundance data showed an increase in spawner returns in 2000 and 2001, though this increase was not sustained in subsequent years. Population viability analyses for this species (using the Dennis Model) suggest that these Chinook salmon face a significant risk of extinction: a 75 to 100% probability of extinction within 100 years (given return rates for 1980 to present). Based on these factors, this ESU would likely have a low resilience to additional perturbations.

Critical habitat

NMFS designated critical habitat for Upper Columbia River spring-run Chinook salmon on September 2, 2005 (70 FR 52630). The designation includes all Columbia River estuaries and river reaches upstream to Chief Joseph Dam and several tributary subbasins. PCEs include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, nearshore marine habitat and estuarine areas. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. Spawning and rearing PCEs are degraded in tributary systems by urbanization, grazing, irrigation, and diversion. These activities have resulted in excess erosion of fine sediment and silt that smother spawning gravel and reduction in flow necessary for successful incubation, formation of physical rearing conditions, and juvenile mobility. Moreover siltation further affects critical habitat by reducing water quality through contaminated agricultural runoff; and removing natural cover. Adult and juvenile migration PCEs are heavily degraded by Columbia River Federal dam projects and some mid-Columbia River Public Utility District dam projects also obstruct the migration corridor.

4.2.2.5 Puget Sound Chinook salmon

Species description and distribution

The Puget Sound Chinook salmon ESU includes all naturally spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound from the North Fork Nooksack River to the Elwha River on the Olympic Peninsula in Washington. Thirty-six hatchery populations were included as part of the ESU and five were considered essential for recovery and listed (spring-run salmon from Kendall Creek, North Fork Stillaguamish River, White River, and Dungeness River, and fall-run salmon from the Elwha River). On June 26, 2013, NMFS proposed to change the number of artificial propagation considered to be part of the ESU to 27 (78 FR 38270). We used information available in the 2005 West Coast salmon and steelhead status review (Good et al. 2005), “Independent populations of Chinook salmon in Puget Sound” (Ruckelshaus et al. 2006), listing documents (63 FR 11482; 64 FR 14308; 70 FR 37160), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

Chinook salmon in this area Puget Sound populations include both early-returning (August) and late-returning (mid-September to October) Chinook salmon spawners (1991). However, within these generalized life histories, significant variation occurs in residence time in freshwater and estuarine environments. For example, Hayman et al. (1996) described three juvenile Chinook salmon life histories with varying residency times in the Skagit River system in northern Puget Sound. return to freshwater habitats as three- to four-year-olds.

Population dynamics
generally have an “ocean-type” life history. Puget Sound populations include both early-returning (August) and late-returning (mid-September to October) Chinook salmon spawners (1991). However, within these generalized life histories, significant variation occurs in residence time in freshwater and estuarine environments. For example, Hayman et al. (1996) described three juvenile Chinook salmon life histories with varying residency times in the Skagit River system in northern Puget Sound. Puget Sound Chinook salmon return to freshwater habitats as three- to four-year-olds.

Status
NMFS listed Puget Sound Chinook salmon as threatened in 1999 (64 FR 14308) and reaffirmed its status as threatened on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of damming, forest practices, agricultural practices, and urbanization; reduced genetic diversity from artificial propagation efforts; and overharvest. The spatial structure of the ESU is compromised by extinct and weak populations being disproportionably distributed to the mid- to southern Puget Sound and the Strait of Juan de Fuca. A large portion (at least 11) of the extant runs is sustained, in part, through artificial propagation. Of the populations with greater than 1,000 natural spawners, only two have a low fraction of hatchery fish. This places the ESU at risk from random catastrophic events, chronic stressors, and long-term environmental change. Life history diversity has been significantly reduced by the disproportionate loss of the early fall-run life history. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

Critical habitat
NMFS designated critical habitat for Puget Sound Chinook salmon on September 2, 2005 (70 FR 52630). Specific geographic area include portions of the Nooksack River, Skagit River, Sauk River, Stillaguamish River, Skykomish River, Snoqualmie River, Lake Washington, Green River, Puyallup River, White River, Nisqually River, Hamma Hamma River and other Hood Canal watersheds, the Dungeness/Elwha Watersheds, and nearshore marine areas of the Strait of Georgia, Puget Sound, Hood Canal and the Strait of Juan de Fuca. PCEs include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, nearshore marine habitat, and estuarine areas. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. Forestry practices have heavily impacted migration, spawning, and rearing PCEs in the upper watersheds of most rivers systems within critical habitat designated for the Puget Sound Chinook salmon. Degraded PCEs include reduced conditions of substrate supporting spawning, incubation and larval development caused by siltation of gravel; and

degraded rearing habitat by removal of cover and reduction in channel complexity. Urbanization and agriculture in the lower alluvial valleys of mid- to southern Puget Sound and the Strait of Juan de Fuca have reduced channel function and connectivity, reduced available floodplain habitat, and affected water quality. Thus, these areas have degraded spawning, rearing, and migration PCEs. Hydroelectric development and flood control also obstruct Puget Sound Chinook salmon migration in several basins. The most functional PCEs are found in northwest Puget Sound: the Skagit River basin, parts of the Stillaguamish River basin, and the Snohomish River basin where federal land overlap with critical habitat designated for the Puget Sound Chinook salmon. However, estuary PCEs are degraded in these areas by reduction in the water quality from contaminants, altered salinity conditions, lack of natural cover, and modification and lack of access to tidal marshes and their channels.

4.2.2.6 Sacramento River Winter-Run Chinook salmon

Species description and distribution

The Sacramento River winter-run Chinook salmon ESU includes all naturally spawned populations of winter-run Chinook salmon entering and using the Sacramento River system in the Central Valley, California. The ESU now consists of a single spawning population. Two hatchery populations were included as part of the ESU, however on June 26, 2013, NMFS proposed that one artificial propagation program be removed from the ESU, as the program has been terminated (78 FR 38270). We used information available in the 2005 West Coast salmon and steelhead status review (Good et al. 2005), listing documents (54 FR 32085, 55 FR 10260, 69 FR 33102, 70 FR 37160), the draft recovery plan (NMFS 2009a), the 5-year status review (NMFS 2011b), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

The winter-run Chinook salmon have characteristics of both stream- and ocean-type life histories. Adults enter freshwater in winter or early spring but delay spawning until late spring (May to June). Fry emerge from the gravel in late June to early July and continue through October (Fisher 1994). Young winter-run Chinook salmon start migrating to sea as early as mid-July with a peak movement over the Red Bluff Diversion Dam in September. Some offspring move downstream as fry while other rear in the upper Sacramento River and move down as smolt. Normally fry have passed the Red Bluff Diversion Dam by October while smolts may pass over the dam until March. Juvenile winter-runs occur in the Delta primarily from November through early May. Winter-run juveniles remain in the Delta until they are from 5 to 10 months of age, and then begin emigrating to the ocean as early as November and continue through May (Fisher 1994). Returning adults can be between two to six years old, but the majority return as three-year olds.

Population dynamics

Construction of Shasta Dams in the 1940s eliminated access to historic spawning habitat for winter-run Chinook salmon. As a result the ESU has been reduced to a single spawning population that is dependent on the availability of suitably cool water from Shasta Reservoir during periods of spawning, incubation and rearing. Winter-runs may have been as large as 200,000 fish based upon commercial fishery records from the 1870s (Fisher 1994). During the first three years of operation of the counting facility at the Red Bluff Diversion Dam (1967 to 1969), an average of 86,500 winter-run Chinook salmon were counted (CDFG 2008). Critically low levels were reached during the drought of 1987 to 1992 with a low point of 191 fish counted. The three-year average run size for the period of 1989 to 1991 was 388 fish. The population grew rapidly from the early 1990s to mid-2005; mean run size increased from 1,363 adults before 2000 to 8,470 adults between 2000 and 2006 (USFWS 2007). Abundance has declined in subsequent years (4,461 adults estimated for 2007 and a preliminary estimate between 2,600 to 2,950 adults for 2008 [USFWS 2008]) and the 10-year trend in abundance is negative.

Status

The Snake River (SR) winter-run Chinook salmon ESU was first listed as threatened on August 4, 1989 under an emergency rule (54 FR 32085). On January 4, 1994, NMFS reclassified the ESU as an endangered species because of several factors, including: (1) the continued decline and increased variability of run sizes since its listing as a threatened species in 1989; (2) the expected weak returns in coming years as the result of two small year classes (1991 and 1993); and (3) continuing threats to the species (59 FR 440). On June 14, 2004, NMFS proposed to reclassify the ESU as threatened (69 FR 33102), but its status as endangered was upheld in the final listing determination on June 28, 2005 (70 FR 37160). Good et al. (2005) found the SR winter-run Chinook salmon ESU was in danger of extinction. The major concerns of the Biological Review Team (BRT) were there was only one extant population, and it was spawning outside its historical range in artificially-maintained habitat that is vulnerable to drought and other catastrophes. Also, the ESU was expected to have lost some genetic diversity through bottleneck effects in the late 1980s and early 1990s, and hatchery releases may also have affected population genetics. Abundance data showed an increase in spawner returns from 1990s to mid-2005, though this increase was not sustained in subsequent years. The population growth rate for this ESU is negative, indicating the population has been declining and is not self-sustaining. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

Critical habitat

NMFS designated critical habitat for this species on June 16, 1993 (58 FR 33212). The designation includes: the Sacramento River from Keswick Dam, Shasta County (river mile 302) to Chipps Island (river mile 0) at the westward margin of the Sacramento-San Joaquin Delta, and other specified estuarine waters. PCEs include specific water temperature, minimum instream flow, and water quality standards. In addition, biological features vital for the ESU include unimpeded adult upstream migration routes, spawning habitat, egg incubation and fry emergence areas, rearing areas for juveniles, and unimpeded downstream migration routes for juveniles. As there is overlap in designated critical habitat for both the Sacramento River Winter-run Chinook salmon and the spring-run Chinook salmon, the conditions of PCEs for both ESUs are similar. Spawning and rearing PCEs are degraded by high water temperature caused by the loss of access to historic spawning areas in the upper watersheds where water maintain lower temperatures. The rearing PCE is further degraded by floodplain habitat disconnected from the mainstems of larger rivers throughout the Sacramento River watershed. The migration PCE is also degraded by the lack of natural cover along the migration corridors. Rearing and migration PCEs are further affected by pollutants entering the surface waters and river sediments as contaminated stormwater runoff, aerial drift and deposition, and by point source discharges. Juvenile migration is obstructed by water diversions along Sacramento River and by two large state and federal water-export facilities in the Sacramento-San Joaquin Delta. The current condition of PCEs for the Sacramento River Winter-run Chinook salmon indicates that they are not currently functioning or are degraded. Their conditions are likely to maintain low population abundances across the ESU.

4.2.2.7 Snake River Fall-Run Chinook salmon

Species description

The SR Fall-run Chinook salmon ESU includes all naturally spawned populations of fall-run Chinook salmon in the mainstem Snake River below Hells Canyon Dam; and in the Tucannon River, Grande Ronde River, Imnaha River, Salmon River, and Clearwater River subbasins. Four artificial propagation programs are included in the ESU. We used information available in the 2005 West Coast salmon and steelhead status review (Good et al. 2005), listing documents (57 FR 14653, 70 FR 37160), the 5-year status review (NMFS 2011c), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

Before dam construction, fall Chinook salmon were primarily ocean-type; however, today both an ocean-type and reservoir-type occur (Connor et al. 2005). Adult ocean-type salmon in the ESU enter the Columbia River in July and August and spawn from October to November. Juveniles emerge from the gravels in March and April of the following year, moving downstream from natal spawning and early rearing areas from June through early autumn. Reservoir-type juveniles overwinter in pools created by dams before migrating to sea; this response is likely because of early development in cooler temperatures, which prevents rapid growth. Phenotypic characteristics have shifted in apparent response to environmental changes from hydroelectric dams (Connor et al. 2005).

Population dynamics

The SR Fall-run Chinook salmon ESU consists of one extant population that is confined to a small fraction (15 percent) of its historic range. Two populations have been extirpated. Estimated annual returns for the period 1938 to 1949 were at 72,000 fish. By the 1950s, numbers had declined to an annual average of 29,000 fish (Bjornn and Horner 1980). Numbers of SR Fall-run Chinook salmon continued to decline during the 1960s and 1970s as approximately 80% of their historic habitat were eliminated or severely degraded by constructing the Hells Canyon complex (1958 to 1967) and the lower Snake River dams (1961 to 1975). Natural-origin spawners of the ESU for 2001 (2,652 adults) exceeded 1,000 fish for the first time since counts began at the

Lower Granite Dam in 1975. The recent five-year mean abundance of 871 naturally produced spawners during the 2011 status review generated concern that despite recent improvements, the abundance level is low for an entire ESU. However, during the years from 1975 to 2000, the ESU fluctuated between 500 to 1,000 natural spawners, which suggests a higher degree of stability in growth rate at low population levels than is seen in other salmonid populations. Further, numbers of natural-origin salmon in the ESU have increased over the last few years, with estimates at Lower Granite Dam of 2,652 fish in 2001, 2,095 fish in 2002, and 3,895 fish in 2003.

Status

NMFS listed Snake River fall-run Chinook salmon as endangered in 1992 (57 FR 14653), but reclassified their status as threatened on June 28, 2005 (70 FR 37160). The ESU was listed because of habitat loss and degradation from the combined effects of damming; forest, agricultural, mining and wastewater management practices; and overharvest. Both long- and short-term trends in natural returns are positive. Productivity is likely sustained largely by a system of small artificial rearing facilities in the lower Snake River Basin. Depending upon the assumptions made regarding the reproductive contribution of hatchery fish, long- and short-term trends in productivity are at or above replacement. Low abundances in the 1990s combined with many hatchery derived spawners likely have reduced genetic diversity from historic levels; however, the salmon in this ESU remain genetically distinct from similar fish in other basins. Because the ESU's single population spawning activities are limited to a relatively short reach of the free flowing mainstem Snake River, it is at considerable risk from environmental variability and random events. The population remains at a moderate risk of becoming extinct (probability between 5 and 25 percent in 100 years). Based on these factors, this ESU would likely have a moderate resilience to additional perturbations.

Critical habitat

NMFS designated critical habitat for Snake River fall-run Chinook salmon on December 28, 1993 (58 FR 68543). This critical habitat encompasses the waters, waterway bottoms, and adjacent riparian zones of specified lakes and river reaches in the Columbia River that are or were accessible to listed Snake River salmon (except reaches above impassable natural falls, and Dworshak and Hells Canyon dams. Specific PCEs were not designated in the critical habitat final rule; instead four "essential habitat" categories were described: 1) spawning and juvenile rearing areas, 2) juvenile migration corridors, 3) areas for growth and development to adulthood, and 4) adult migration corridors. The "essential features" that characterize these sites include substrate and spawning gravel; water quality, quantity, temperature, velocity; cover or shelter; food; riparian vegetation; space; and safe passage conditions. Hydropower operations and flow management practices have impacted spawning and rearing habitat and migration corridors throughout the ESU's range. The major degraded essential habitat and features include: safe passage for juvenile migration; rearing habitat water quality; and spawning areas with gravel, water quality, cover or shelter, riparian vegetation, and space to support egg incubation and larval growth and development. Water quality impairments in the designated critical habitat are common within the range of this ESU. Pollutants such as petroleum products, pesticides, fertilizers, and sediment in the form of turbidity enter the surface waters and river sediments from the headwaters of the Snake, Salmon, and Clearwater Rivers to the Columbia River estuary. These pollutants combine and travel with contaminated stormwater runoff, aerial drift and deposition, and by point source discharges.

4.2.2.8 Snake River Spring/Summer-Run Chinook salmon

Species description

The SR Spring/Summer-run Chinook ESU includes all naturally spawned populations of spring/summer-run Chinook salmon in the mainstem Snake River and the Tucannon River, Grande Ronde River, Imnaha River, and Salmon River subbasins. Fifteen artificial propagation programs are included in the ESU, however on June 26, 2013, NMFS proposed the number of artificial propagation programs included in the ESU be changed to 11 (78 FR 38270). We used information available in status reviews (Matthews and Waples 1991; Good et al. 2005), Interior Columbia Basin Technical Recovery Team reports (ICBTRT 2003), listing documents (57 FR 14653, 70 FR 37160), the 5-year status review (NMFS 2011c), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

Snake River spring/summer-run Chinook salmon have a stream-type life history. Spring-run salmon of this ESU pass Bonneville Dam beginning in early March to mid-June and spawn from mid- to late August. Summer-run salmon return to the Columbia River from June through August and spawn approximately one month later than spring-run salmon. Summer-run salmon spawn lower in the Snake River drainages than spring-run fish; however, an overlap of summer-run and spring-run spawning areas does occur. In both run types eggs incubate over the winter, and hatch in late winter and early spring of the following year. Juvenile fish mature in freshwater for one year before they migrate to the ocean in the spring of their second year of life. Depending on the tributary and the specific habitat conditions, juveniles may migrate extensively from natal reaches into alternative summer-rearing or overwintering areas. Salmon of this ESU return from the ocean to spawn primarily as four and five year-old fish, after two to three years in the ocean.

Population dynamics

The Interior Columbia Basin Technical Recovery Team has identified 32 populations in five major population groups (Upper Salmon River, South Fork Salmon River, Middle Fork Salmon River, Grande Ronde/Imnaha, Lower Snake Mainstem Tributaries) for this species. Historic populations above Hells Canyon Dam are considered extinct. The status review reports that total annual salmon production of this ESU may have exceeded 1.5 million adults in the late 1800s. Total (natural plus hatchery origin) returns fell to roughly 100,000 spawners by the late 1960s (Fulton 1968). Abundance of summer run Chinook salmon have increased since low returns in the mid-1990s (lowest run size was 692 fish in 1995). The 1997 to 2008 geometric mean total return for the summer run component at Lower Granite Dam was slightly more than 8,700 fish, compared to the geometric mean of 3,076 fish for the years 1987 to 1996 (Data from the

Columbia Basin Fisheries Agencies and Tribes http://www.fpc.org/). However, over 80 percent of the 2001 return and over 60 percent of the 2002 return originated from hatcheries.

Status

NMFS listed Snake River spring/summer-run Chinook salmon as threatened on April 22, 1992 (57 FR 14653), and reaffirmed their status on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of damming; forest, agricultural, mining, and wastewater management practices; overharvest; and artificial propagation. There is no obvious long-term positive trend, though recent trends are approaching 1, indicating the population is nearly replacing itself. Risks to individual populations within the ESU may be greater than the extinction risk for the entire ESU due to low levels of annual abundance of individual populations. Multiple spawning sites are accessible and natural spawning and rearing are well distributed within the ESU. However, many spawning aggregates have also been extirpated, which has increased the spatial separation of some populations. The South Fork and Middle Fork Salmon Rivers currently support most natural production in the drainage. There is no evidence of wide-scale genetic introgression by hatchery populations. The high variability in life history traits indicates sufficient genetic variability within the ESU to maintain distinct subpopulations adapted to local environments. Based on these factors, this ESU would likely have a moderate resilience to additional perturbations.

Critical habitat

NMFS designated critical habitat for Snake River spring/summer-run Chinook salmon on December 28, 1993 (58 FR 68543). This critical habitat encompasses the waters, waterway bottoms, and adjacent riparian zones of specified lakes and river reaches in the Columbia River that are or were accessible to listed Snake River salmon (except reaches above impassable natural falls, and Dworshak and Hells Canyon dams). Specific PCEs were not designated in the critical habitat final rule; instead four "essential habitat" categories were described: 1) spawning and juvenile rearing areas, 2) juvenile migration corridors, 3) areas for growth and development to adulthood, and 4) adult migration corridors. The "essential features" that characterize these sites include substrate and spawning gravel; water quality, quantity, temperature, velocity; cover or shelter; food; riparian vegetation; space; and safe passage conditions. Hydropower operations and flow management practices have impacted spawning and rearing habitat and migration corridors in some regions. The ICBTRT reports the Panther Creek population was extirpated because of legacy and modern mining-related pollutants that created a chemical barrier to fish passage. Water quality impairments are common in the range of the critical habitat designated for this ESU. Pollutants such as petroleum products, pesticides, fertilizers, and sediment in the form of turbidity enter the surface waters and river bottom substrate from the headwaters of the Snake, Salmon, and Clearwater Rivers to the Columbia River estuary as contaminated stormwater runoff, aerial drift and deposition, and by point source discharges.

4.2.2.9 Upper Willamette River Chinook salmon

Species description

The Upper Willamette River Chinook salmon ESU includes all naturally spawned populations of spring-run Chinook salmon in the Clackamas River and in the Willamette River, and its tributaries, above Willamette Falls, Oregon. Seven artificial propagation programs are included in the ESU, however on June 26, 2013, NMFS proposed to change the number of artificial propagation programs included in the ESU to six (78 FR 38270). We used information available in status reviews (Good et al. 2005; NMFS 2011d), the recovery plan (Oregon Department of Fish and Wildlife and NMFS 2011), "Historical population structure of Pacific salmonids in the Willamette River and Lower Columbia River Basins" (Myers et al. 2006), listing documents (64 FR 14308, 70 FR 37160), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

Upper Willamette River Chinook salmon are a spring-run, stream-type salmon. Adults appear in the lower Willamette River in February, but most of the run ascends Willamette Falls in April and May, with a peak in mid- to late May. Present-day salmon ascend the Willamette Falls by a fish ladder. Migrating spring Chinook salmon over Willamette Falls extends into July and August and overlaps with the beginning of the introduced fall-run of Chinook salmon. The adults hold in deep pools over summer and spawn between August to October, with a peak in September. Fry emerge from December to March and juvenile migration varies among three distinct emigration "runs": fry migration in late winter and early spring; sub-yearling (0 yr +) migration in fall to early winter; and yearlings (1 yr +) migrating in late winter to spring. Sub-yearlings and yearlings rear in the mainstem Willamette River where they also use floodplain wetlands in the lower Willamette River during the winter-spring floodplain inundation period. Fall-run Chinook salmon spawn in the Upper Willamette but are not considered part of the ESU because they are not native. Salmon of this ESU return from the ocean to spawn primarily as four and five year-old fish, after two to three years in the ocean.

Population dynamics

Historically, this ESU included sizable numbers of spawning salmon in the Santiam River, the middle fork of the Willamette River, and the McKenzie River, as well as smaller numbers in the Molalla River, Calapooia River, and Albiqua Creek. Most natural spring-run Chinook salmon populations of this ESU are likely extirpated or nearly so; the spring-run in the McKenzie River is the only known remaining naturally reproducing population in this ESU. The total abundance of adult spring-run Chinook salmon (hatchery-origin + natural-origin fish) passing Willamette Falls has remained fairly steady over the past 50 years (ranging from approximately 20,000 to 70,000 fish). However, the current abundance is an order of magnitude below the peak abundance levels observed in the 1920s (approximately 300,000 adults). Total number of fish increased during the period from 1996 to 2004 when it peaked at more than 96,000 adult spring-run Chinook salmon passing Willamette Falls. Since then, the run has steadily decreased with only about 14,000 fish counted in 2008, the lowest number since 1960. ESU abundance increased again to about 25,000 adult spring-run Chinook salmon in 2009. Runs consist of a high, but uncertain, fraction of hatchery-produced fish.

Status

NMFS listed Upper Willamette River Chinook salmon as threatened on March 24, 1999 (64 FR 14308) and reaffirmed their status on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of damming; agricultural practices; urbanization; overharvest; and artificial propagation. The McKenzie River population is the only remaining self-sustaining naturally reproducing independent population. The other natural-origin populations in this ESU have low current abundances, and long- and short-term population trends are negative. The spatial distribution of the species has been reduced by the loss of 30 to 40 percent of the total historic habitat. This loss has restricted spawning to a few areas below dams. Access of fall-run Chinook salmon to the upper Willamette River and the mixing of hatchery stocks within the ESU have threatened the genetic integrity and diversity of the species. Much of the genetic diversity that existed between populations has been homogenized. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

Critical habitat

NMFS designated critical habitat for this species on September 2, 2005 (70 FR 52630). Designated critical habitat includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Willamette River as well as specific stream reaches in some sub-basins. PCEs include freshwater spawning and rearing sites, freshwater migration corridors. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. The migration PCE is degraded by dams altering migration timing and water management altering the water quantity necessary for mobility and survival. Migration, rearing, and estuary PCEs are also degraded by loss of riparian vegetation and in-stream cover. Pollutants such as petroleum products, fertilizers, pesticides, and fine sediment enter the stream through runoff, point source discharge, drift during application, and non-point discharge where agricultural and urban development occurs. Degraded water quality in the lower Willamette River where important floodplain rearing habitat is present affects the ability of this habitat to sustain its role to conserve the species. The current condition of PCEs identified in this critical habitat indicates that migration and rearing PCEs are not currently functioning or are degraded and impact their ability to serve their intended role for species conservation.

4.2.3 Chum salmon

We discuss the distribution, life history, population dynamics, status, and critical habitats of the two species (here we use the word “species” to apply to distinct population segments, DPSs, and evolutionary significant units, ESUs) separately; however, because listed chum salmon species are indistinguishable in the wild and comprise the same biological species, we begin this section describing characteristics common across ESUs. We used information available in status reviews

(Johnson et al. 1997; Good et al. 2005), various listing documents, and biological opinions (notably NMFS 2012a) to summarize the status of the species.

Species description and distribution
Because their range extends farther along the shores of the Arctic Ocean than other Pacific salmonid, chum salmon have the widest natural geographic and spawning distribution of the Pacific salmonids. Chum salmon have been documented to spawn from Korea and the Japanese island of Honshu, east around the rim of the North Pacific Ocean to Monterey Bay, California.

Historically, chum salmon were distributed throughout the coastal regions of western Canada and the U.S. Presently, major spawning populations occur as far south as Tillamook Bay on the northern Oregon coast.

Life history
In general, North American chum salmon migrate north along the coast in a narrow coastal band that broadens in southeastern Alaska. Chum salmon usually spawn in the lower reaches of rivers during summer and fall. Redds are dug in the mainstem or in side channels of rivers from just above tidal influence to nearly 100 km from the sea. The time to hatching and emergence from the gravel redds are influenced by dissolved oxygen (DO), gravel size, salinity, nutritional conditions, behavior of alevins in the gravel, and incubation temperature (Bakkala 1970; Salo 1991; Schroder 1977). Chum salmon juveniles use shallow, low flow habitats for rearing that include inundated mudflats, tidal wetlands and their channels, and sloughs. The duration of estuarine residence for chum salmon juveniles are known for only a few estuaries. Observed residence time ranged from 4 to 32 days, with about 24 days as the most common.

Immature salmon distribute themselves widely over the North Pacific Ocean and maturing adults return to the home streams at various ages, usually at two to five years old, and sometimes up to seven years (Bigler, 1985). This ocean-type migratory behavior contrasts with the stream-type behavior of some other species in the genus Oncorhynchus (e.g., steelhead, coho, and most types of Chinook and sockeye salmon). Stream-type salmonids usually migrate to sea at a larger size, after months or years of freshwater rearing. Thus, survival and growth for juvenile chum salmon depend less on freshwater conditions than on favorable estuarine conditions. Another behavioral difference between chum salmon and other salmonid species is that chum salmon form schools. Presumably, this behavior reduces predation (Pitcher 1986) especially if fish movements are coordinated to swamp predators (Miller and Brannon 1982). All chum salmon are semelparous (i.e., they die after spawning) and exhibit obligatory anadromy (i.e., there are no recorded landlocked or naturalized freshwater populations; they must spend portions of their lives in both salt and freshwater habitats).

Chum salmon feed on various prey organisms depending upon life stage and size. In freshwater Chum salmon feed primarily on small invertebrates; in saltwater, their diet consists of copepods, tunicates, mollusks, and fish.

Status
On June 28, 2005, as part of the final listing determinations for 16 ESUs of West Coast salmon, NMFS amended and streamlined the 4(d) protective regulations for threatened salmon and steelhead (70 FR 37160) as described in the Protective Regulations for Threatened Salmonid Species section of this document. Under this change, the section 4(d) protections apply to natural and hatchery fish with an intact adipose fin, but not to listed hatchery fish that have had their adipose fin removed before release into the wild.

Critical habitat
Areas designated as critical habitat are important for the species' overall conservation by protecting quality growth, reproduction, and feeding. At designation, primary constituent elements (PCEs) are identified and include sites necessary to support one or more chum salmon life stages. For both ESUs discussed below, PCEs include freshwater spawning, rearing, and migration areas; estuarine and nearshore marine areas free of obstructions; and offshore marine areas with good water quality. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. The critical habitat designation identified for each ESU contains additional details on the areas included as part of the designation, and the areas that were excluded from designation.

4.2.3.1 Columbia River Chum Salmon

Species description and distribution
The Columbia River chum salmon ESU includes all naturally spawned populations of chum salmon in the Columbia River and its tributaries in Washington and Oregon. Three artificial propagation programs are part of the ESU. We used information available in status reviews (Good et al. 2005; Ford 2011; NMFS 2011a), listing documents (63 FR 11774, 64 FR 14508, 70 FR 37160), recovery plans (LCFRB 2010; Oregon Department of Fish and Wildlife 2010; NMFS 2013a), "Historical population structure of Pacific salmonids in the Willamette River and Lower Columbia River Basins" (Myers et al. 2006), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history
Salmon of this ESU return to the Columbia River from mid-October to November and spawning occurs from early November to late December. Adults spawn in the lower reaches of rivers, digging redds along the edges of the mainstem and in tributaries or side channels. Some spawning sites are located in areas where geothermally-warmed groundwater or mainstem flow upwells through the gravel. Chum salmon fry emigrate to estuaries from March through May shortly after emergence. Like ocean-type Chinook salmon, juvenile chum salmon rear in estuaries for weeks to months before beginning their long-distance oceanic migration, primarily from February to June. The period of estuarine residence is a critical life history phase and plays a major role in determining the size of the subsequent adult run back to freshwater. Chum

salmon remain in the North Pacific and Bering Sea for 2 to 6 years, with most adults returning to the Columbia River as 4-year-olds.

Population dynamics

Historically, the ESU was composed of 17 populations in Oregon and Washington between the mouth of the Columbia River and the Cascade crest. Of these populations, 15 of them (six in Oregon and nine in Washington) are so depleted that either their baseline probability of persistence is low or they are extirpated or nearly so. An extensive 2000 survey in Oregon streams supports that chum salmon are extirpated from the Oregon portion of this ESU. Over the last century, Columbia River chum salmon returns have collapsed from hundreds of thousands to just a few thousand a year. Only two populations (Grays River and the Lower Gorge) with any significant spawning remain today, both in Washington. The estimated size of the Lower Gorge population is at 400-500 individuals, down from a historical level of greater than 8,900. A significant increase in spawner abundance occurred in 2001 and 2002 to around 10,000 adults. However, spawner surveys indicate the abundance again decreased to low levels during 2003 through 2008 though the spawner surveys may underestimate abundance since the proportion of tributary and mainstem spawning differ between years and the surveys do not include spawners in the Columbia River mainstem. In the 1980s, estimates of the Grays River population ranged from 331 to 812 individuals. However, the population increased in 2002 to as many as 10,000 individuals. Based on data for number of spawners by river mile, this increase continued through 2003 and 2004. However, fish abundance fell again to less than 5,000 fish during the years 2005 through 2008.

Status

NMFS listed Columbia River chum salmon as threatened on March 25, 1999 (64 FR 14508) and reaffirmed their status on June 28, 2005 (71 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of water withdrawal, conveyance, storage, and flood control; logging and agriculture; mining; urbanization; and overharvest. Much of the historical spatial structure has been lost on both the population and the ESU levels by extirpation (or near-extirpation) of many local stocks and the widespread loss of estuary habitats. Estimates of abundance and trends are available only for the Grays River and Lower Gorge populations, both of which have long- and short-term productivity trends at or below replacement. Limited distribution also increases risk to the ESU from local disturbances. Although hatchery production of chum salmon has been limited and hatchery effects on diversity are thought to have been fairly small, diversity has been reduced at the ESU level because of presumed extirpations and the low abundance in the remaining populations (fewer than 100 spawners by year for most populations). Based on these factors, this ESU would likely have a low resilience to additional perturbations.

Critical habitat

NMFS originally designated critical habitat for Columbia River chum salmon on February 16, 2000 (65 FR 7764); critical habitat was redesignated on September 2, 2005 (70 FR 52630).

Designated critical habitat includes areas in the following subbasins: Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Lower Cowlitz, and Lower Columbia subbasin and river corridor. PCEs for this ESU and physical or biological features that characterize them are described in Section 3.0.4. Limited information exists on the quality of essential habitat characteristics for this ESU. However, it is apparent that the migration PCE has been significantly impacted by dams obstructing adult migration and access to historic spawning locations. Water quality and cover for estuary and rearing PCEs have decreased in quality to the extent the PCEs are not likely to maintain their intended function to conserve the species.

4.2.3.2 Hood Canal Summer-Run chum salmon

Species description and distribution

The Hood Canal summer-run chum salmon ESU includes all naturally spawned populations in Hood Canal and its tributaries as well as populations in Olympic Peninsula rivers between Hood Canal and Dungeness Bay, Washington. Eight artificial propagation programs are included in the ESU, however on June 26, 2013, NMFS proposed to change the number of artificial propagation programs included in the ESU to four (78 FR 38270). We used information available in status reviews (Good et al. 2005; NMFS 2011e), listing documents (63 FR 11774, 64 FR 14508, 70 FR 37160), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

Salmon of this ESU enter natal rivers from late August until October (Washington Department of Fisheries and Wildlife and Western Washington Treaty Indian Tribes 1993) and spawning occurs from mid-September through mid-October. Adults spawn in low gradient, lower mainstem reaches of natal streams, typically in center channel areas due to the low flows encountered in the late summer and early fall and fry emerge between January and May. After hatching, fry move rapidly downstream to subestuarine habitats where they rear for an average of 23 days before entering the ocean. Summer-run chum salmon have a longer incubation time than fall-run chum salmon in the same streams. Consequently, offspring of summer-run chum salmon have lower average weight and less lipid content than offspring of fall-run chum salmon. Thus, prey availability during their early life history is important for fry survival. Most adult salmon of this ESU return from the ocean to spawn as three- and four-year old fish.

Population dynamics

Historically, this ESU consisted of two independent populations (the Strait of Juan de Fuca and Hood Canal populations) that, together, contained an estimated 16 stocks (Sands et al. 2007). Of the 16 historic stocks, seven are considered extirpated, primarily from the eastern side of Hood Canal. Of the extant Strait of Juan de Fuca stocks, three spawn in rivers and streams entering the eastern Strait of Juan de Fuca and Admiralty Inlet. The Hood Canal population consists of six extant stocks within the Hood Canal watershed. HC Summer-run chum salmon are part of an extensive rebuilding program developed and implemented in 1992 by state and tribal co-managers. The largest supplemental program occurs at the Big Quilcene River fish hatchery.

Reintroduction programs occur in Big Beef (Hood Canal population) and Chimacum (Strait of Juan de Fuca population) creeks. Adult returns for some of the HC summer-run chum salmon stocks showed modest improvements in 2000, with upward trends continuing in 2001 and 2002. The recent five-year mean abundance is variable among stocks, ranging from one fish to nearly 4,500 fish. Productivity in the last 5-year period (2005-2009) has been low, especially compared to the high productivity observed during the 5-10 previous years (1994-2004).

Status

NMFS listed Hood Canal summer-run chum salmon as threatened on March 25, 1999 (64 FR 14508), and reaffirmed their status on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of water withdrawal, conveyance, storage, and flood control; logging and agriculture; mining; urbanization; overharvest; and artificial propagation. Much of the historical spatial structure and connectivity has been lost on both the population and the ESU levels by extirpation of many local stocks and the widespread loss of estuary and lower floodplain habitats. Long-term trends in productivity are above replacement only for the Quilcene and Union River stocks; however, most stocks remain depressed. The overall trend in spawning abundance is stable (meaning adults are replacing themselves) for the Hood Canal population (all natural spawners and natural-origin only spawners) and for the Strait of Juan de Fuca population (all natural spawners). Only the Strait of Juan de Fuca population's natural-origin only spawners shows a significant positive trend. Estimates of the fraction of naturally spawning hatchery fish exceed 60 percent for some stocks, which indicates that reintroduction programs are supplementing the numbers of total fish spawning naturally in streams. There is also concern the Quilcene hatchery stock has high rates of straying, and may represent a risk to historical population structure and diversity. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

Critical habitat

NMFS designated critical habitat for Hood Canal summer-run chum salmon on September 2, 2005 (70 FR 52630). Designated critical habitat includes the Skokomish River, Hood Canal subbasin, which includes the Hamma Hamma and Dosewallips rivers and others, the Puget Sound subbasin, Dungeness/Elwha subbasin, and nearshore marine areas of Hood Canal and the Strait of Juan de Fuca. This includes a narrow nearshore zone within several Navy security and restricted zones and approximately eight miles of habitat that was unoccupied at the designation (including Finch, Anderson and Chimacum creeks), but has been reseeded. PCEs for this ESU and physical or biological features that characterize them are described in Section 3.0.4. The spawning PCE is degraded by excessive fine sediment in the gravel and the rearing PCE is degraded by loss of access to sloughs in the estuary and nearshore areas and excessive predation. Low flow in several rivers also adversely affects most PCEs. In estuarine areas, both migration and rearing PCEs of juveniles are impaired by loss of functional floodplain areas necessary for growth and development of juvenile chum salmon. These degraded conditions likely maintain low population abundances across the ESU.

4.2.4 Coho salmon

We discuss the distribution, life history, population dynamics, status, and critical habitats of the four species (here we use the word “species” to apply to distinct population segments, DPSs, and evolutionary significant units, ESUs) separately; however, because listed coho salmon species are indistinguishable in the wild and comprise the same biological species, we begin this section describing characteristics common across ESUs. We used information available in status reviews (notably Good et al. 2005), various listing documents, and biological opinions (notably NMFS 2012a) to summarize the status of the species.

Species description and distribution
The species was historically distributed throughout the North Pacific Ocean from central California to Point Hope, Alaska, through the Aleutian Islands, and from the Anadyr River, Russia, south to Hokkaido, Japan.

Life history
Coho salmon exhibit a stream-type life history. Most coho salmon enter rivers between September and February. In many systems, coho salmon wait to enter until fall rainstorms have provided the river with sufficiently strong flows and depth. Coho salmon spawn from November to January, and occasionally into February and March. Some spawning occurs in third-order streams, but most spawning activity occurs in fourth- and fifth-order streams with gradients of 3% or less. After fry emerge in spring, they disperse upstream and downstream to establish and defend territories with weak water currents such as backwaters and shallow areas near stream banks. Juveniles rear in these areas during the spring and summer. In early fall juveniles move to river margins, backwater, and pools. During winter juveniles typically reduce feeding activity and growth rates slow down or stop. By March of their second spring, juveniles feed heavily on insects and crustaceans and grow rapidly before smoltification and outmigration (Olegario 2006). Coho salmon smolts usually spend a short time (one to three days) in the estuary with little feeding (Thorpe 1994; Miller and Sadro 2003). After entering the ocean, immature coho salmon initially remain in nearshore waters close to the parent stream. North American coho salmon will migrate north along the coast in a narrow coastal band that broadens in southeastern Alaska. During this migration, juvenile coho salmon occur in both coastal and offshore waters.

Along the Oregon/California coast, coho salmon primarily return to rivers to spawn as three-year olds, having spent approximately 18 months rearing in freshwater and 18 months in salt water. In some streams, a smaller proportion of males may return as two-year olds. The presence of two-year old males can allow for substantial genetic exchange between brood years. The rather fixed three-year life cycle exhibited by female coho salmon limits demographic interactions between brood years. This makes coho salmon more vulnerable to environmental perturbations than other salmonids that exhibit overlapping generations, i.e., the loss of a coho salmon brood year in a stream is less likely than for other Pacific salmon to be reestablished by females from other brood years. All coho salmon are semelparous and anadromous.

Coho salmon feed on various prey organisms depending upon life stage and size. While at sea, coho salmon eat fish including herring, sand lance, sticklebacks, sardines, shrimp and surf smelt. While in estuaries and in freshwater coho salmon are significant predators of Chinook, pink, and chum salmon, as well as aquatic and terrestrial insects. Smaller fish, such as fry, eat chironomids, plecoptera and other larval insects, and typically use visual cues to find their prey.

Status

On June 28, 2005, as part of the final listing determinations for 16 ESUs of West Coast salmon, NMFS amended and streamlined the 4(d) protective regulations for threatened salmon and steelhead (70 FR 37160) as described in the Protective Regulations for Threatened Salmonid Species section of this document. Under this change, the section 4(d) protections apply to natural and hatchery fish with an intact adipose fin, but not to listed hatchery fish that have had their adipose fin removed before release into the wild.

4.2.4.1 Central California coast coho salmon

Species description and distribution

The central California coast coho salmon ESU includes all naturally spawned populations of coho salmon from Punta Gorda in northern California south to and including the San Lorenzo River in central California, as well as populations in tributaries to San Francisco Bay, excluding the Sacramento-San Joaquin River system. The ESU also includes four artificial propagation programs. We used information available in status reviews (Weitkamp et al. 1995; Good et al. 2005; NMFS 2011f; Spence and Williams 2011), "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" (Bjorkstedt et al. 2005), listing documents (60 FR 38011; 61 FR 56138; 70 FR 37160), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

Both run and spawn timing of coho salmon in this region are late (both peaking in January) northern populations, with little time spent in freshwater between river entry and spawning. Spawning runs coincide with the brief peaks of river flow during the fall and winter. Most juveniles of this ESU undergo smoltification and start their seaward migration one year after emergence from the redd. Juveniles spending two winters in freshwater have, however, been observed in at least one coastal stream within the range of the ESU. Smolt outmigration peaks in April and May (Shapovalov and Taft 1954). In general, coho salmon within California exhibit a three-year life cycle. However, two-year old males commonly occur in some streams.

Population dynamics

The ESU consisted historically of 11 functionally independent populations and a larger number of dependent populations. One of the two historically independent populations in the Santa Cruz mountains (i.e., south of the Golden Gate Bridge) is extirpated. Coho salmon are considered effectively extirpated from the San Francisco Bay. The Russian River population, once the largest and most dominant source population in the ESU, is now at high risk of extinction because of low abundance and failed productivity. The Lost Coast to Navarro Point to the north contains most coho salmon remaining in the ESU.

Limited information exists on abundance of coho salmon for this ESU. About 200,000 to 500,000 coho salmon were produced statewide in the 1940s. This escapement declined to about 99,000 by the 1960s with approximately 56,000 (56 percent) originating from streams within this ESU. The estimated number of coho salmon produced within the ESU in the late 1980s had further declined to 6,160 (46 percent of the estimated statewide production). Additionally, information on the abundance and productivity trends for the naturally spawning component of this ESU is limited. There are no long-term time series of spawner abundance for individual river systems. Returns increased in 2001 in streams within the northern portion of the ESU; however, returns in 2006/07 and 2007/08 were low (McFarlane et al. 2008) and about 500 fish returned in 2010 across the entire range. Hatchery raised smolt have been released infrequently but occasionally in large numbers in rivers throughout the ESU. Releases have included transfer of stocks within California and between California and other Pacific states as well as smolt raised from eggs collected from native stocks.

Status

NMFS listed the central California coast coho salmon ESU as threatened on October 31, 1996 (61 FR 56138) and later reclassified their status as endangered on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of logging, agricultural, and mining activities; urbanization; stream channelization; damming; wetland loss; overharvest; artificial propagation; and prolonged drought and poor ocean conditions. ESU spatial structure has been substantially modified due to lack of viable source populations and loss of dependent populations. Limited information exists on abundance for central California coast coho salmon; therefore, the best data available are presence-absence surveys used as a proxy for abundance changes. As of the 1996 listing, coho salmon occurred in 47 percent of streams (62) and were considered extirpated from 53 percent (71) of streams that historically harbored coho salmon within the ESU (Brown et al. 1994). Later reviews have concluded the number of occupied streams relative to historic has not changed and may have declined. Additionally, the low rates of return from 2006 to 2010 suggest that all three year classes are faring poorly across the species' range. Though hatchery salmon have been released, genetic studies show little homogenization of populations (i.e., transfer of stocks between basins) has had little effect on the geographic genetic structure of the ESU (SCWA 2002). Salmon in this ESU likely have considerable diversity in local adaptations given the ESU spans a large latitudinal diversity in geology and ecoregions, and include both coastal and inland river basins. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

Critical habitat

NMFS designated critical habitat for central California coast coho salmon on May 5, 1999 (64 FR 24049). Designated critical habitat includes accessible reaches of all rivers (including estuarine areas and tributaries) between Punta Gorda and the San Lorenzo River (inclusive) in

California. Critical habitat for this species also includes two streams entering San Francisco Bay: Arroyo Corte Madera Del Presidio and Corte Madera Creek. Specific PCEs were not designated in the critical habitat final rule; instead five "essential habitat" categories were described: 1) juvenile summer and winter rearing areas; 2) juvenile migration corridors; 3) areas for growth and development to adulthood; 4) adult migration corridors; and 5) spawning areas. The "essential features" that characterize these sites include adequate 1) substrate; 2) water quality; 3) water quantity; 4) water temperature; 5) water velocity; 6) cover or shelter; 7) food; 8) riparian vegetation; 9) space; and 10) safe passage conditions. NMFS (2008a) evaluated the condition of each habitat feature at its current condition relative to its role and function in conserving the species. Assessing the habitat showed a distinct trend of increasing degradation in quality and quantity of all essential features as the habitat progresses south through the species range, with the area from the Lost Coast to the Navarro Point supporting the most favorable habitats and the Santa Cruz Mountains supporting the least. However, all populations are degraded regarding spawning and incubation substrate, and juvenile rearing habitat. Elevated water temperatures occur in many streams across the entire ESU.

4.2.4.2 Lower Columbia River coho salmon

Species description and distribution

The lower Columbia River coho salmon ESU includes all naturally spawned populations of coho salmon in the Columbia River and its tributaries in Oregon and Washington, from the mouth of the Columbia up to and including the Big White Salmon and Hood Rivers, Washington; and the Willamette River to Willamette Falls, Oregon. This ESU includes 25 artificial propagation programs, however on June 26, 2013, NMFS proposed the number of artificial propagation programs included in the ESU be changed to 23 (78 FR 38270). We used information available in status reviews (Johnson et al. 1991; Good et al. 2005; Ford 2011; NMFS 2011a), recovery plans (LCFRB 2010; Oregon Department of Fish and Wildlife 2010; NMFS 2013a), "Viability status of Oregon salmon and steelhead populations in the Willamette and lower Columbia basins (McElhany et al. 2007), listing documents (70 FR 37160; 78 FR 2725), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

Most of the Lower Columbia River coho salmon are of hatchery origin. Hatchery runs are managed for two distinct runs: early-returning and late-returning. Early-returning coho salmon return to the Columbia River in mid-August and to spawning tributaries in early September, with peak spawning from mid- October to early November. Late-returning coho salmon return from late September through December and enter spawning tributaries from October through January. Most late-returning spawning occurs from November through January. Fry emerge from redds during a three-week period between early March and late July. Juveniles rear in freshwater for a year and smolt outmigration occurs from April through June with a peak in May. Juvenile coho are present in the Columbia River estuary from March to August. In general, salmon of this ESU return to freshwater as three-year-olds.

Analysis of run timing of coho salmon suggests the Clackamas River population is composed of one late returning population and one early returning population. The late-returning population is believed to be descended from the native Clackamas River population and the early-returning population is believed to descend from hatchery fish introduced from Columbia River populations outside the Clackamas River basin. The naturally produced coho salmon return to spawn between December and March.

Population dynamics
The ESU historically consisted of 24 independent populations. The vast majority (over 90 percent) of these are either extirpated or nearly so. Of the 24 populations, only two have significant natural production: the Sandy and Clackamas Rivers. Wild coho salmon reappeared in two additional basins (Scappoose and Clatskanie) after a 10-year period during the 1980s and 1990s when they were largely absent. Before 1900, the Columbia River had an estimated annual run of more than 600,000 adults with about 400,000 spawning in the lower Columbia River. By the 1950s, the estimated number of coho salmon returning to the Columbia River had decreased to 25,000 adults (about five percent of historic levels). Massive hatchery releases since 1960 have increased the Columbia River run size. Between 1980 and 1989, the run varied from 138,000 adults to a historic high of 1,553,000 adults. However, only a small portion of these spawned naturally, and available information indicates the naturally produced portion has continuously declined since the 1950s. The current number of naturally spawning fish during October and late November ranges from 3,000 to 5,500 fish. Most of these are of hatchery origin. The 1996 to 1999 geometric mean for the late run in the Clackamas River, the only-run which is considered consisting mainly of native coho salmon, was 35 fish. Both long- and short-term trends and median population growth rate for the natural origin (late-run) portion of the Clackamas River coho salmon are negative but with large confidence intervals. The short-term trend for the Sandy River population is close to 1, indicating a relatively stable population during the years 1990 to 2002. The long-term trend for this same population shows the population has been decreasing (trend = 0.54) and there is a 43 percent probability the median population growth rate was less than one.

Status
NMFS listed Lower Columbia River coho salmon as threatened on June 28, 2005 (70 FR 37160). Lower Columbia River coho salmon have been—and continue to be—affected by habitat degradation, hydropower impacts, harvest, and hatchery production. Out of the 24 populations that make up this ESU, 21 are considered to have a low probability of persisting for the next 100 years, and none is considered viable. The low persistence probability for most Lower Columbia River coho salmon populations is related to low abundance and productivity, loss of spatial structure, and reduced diversity. Though data quality has been poor because of inadequate spawning surveys and, until recently, the presence of unmarked hatchery-origin spawners, most populations are believed to have low abundance of natural-origin spawners (50 fish or fewer). The spatial structure of some populations is constrained by migration barriers (such as tributary dams) and development in lowland areas. Low abundance, past stock transfers, other legacy

hatchery effects, and ongoing hatchery straying may have reduced genetic diversity within and among coho salmon populations. It is likely that hatchery effects have also decreased population productivity. The poor baseline population status of coho salmon reflects long-term trends: natural-origin coho salmon in the Columbia Basin have been in decline for the last 50 years. Based on these factors, this ESU would likely have low resilience to additional perturbations.

Critical habitat

NMFS proposed critical habitat designation of approximately 2,288 miles of freshwater and estuarine habitat in Oregon and Washington on January 14, 2013 (78 FR 2725). A final designation has not been made.

4.2.4.3 Southern Oregon/Northern California Coast coho salmon

Species description

The Southern Oregon/Northern California Coast coho salmon ESU consists of all naturally spawning populations of coho salmon that reside below long-term, naturally impassible barriers in streams between Punta Gorda, California and Cape Blanco, Oregon. This ESU also includes three artificial propagation programs. We used information available in status reviews (Good et al. 2005; NMFS 2011h; Williams et al. 2011), the draft recovery plan (NMFS 2012b), listing documents (62 FR 24588; 70 FR 37160), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

In this ESU, river entry occurs earlier in the north and later in the south. In Oregon, salmon of this ESU enter rivers in September or October; south of the Klamath River Basin to the Mattole River, California salmon entry occurs in November and December; and river entry occurs from mid-December to mid-February in rivers farther south. Because coho salmon enter rivers late and spawn late south of the Mattole River, they spend much less time in the river before spawning compared to populations farther north. Juveniles emerge from the gravel in spring, and typically spend a summer and winter in freshwater before migrating to the ocean as smolts in their second spring. Coho salmon adults spawn at age three, spending about a year and a half in the ocean.

Population dynamics

Data on population abundance and trends are limited for this ESU. Historical point estimates of coho salmon abundance for the early 1960s and mid-1980s suggest that California statewide coho spawning escapement in the 1940s ranged between 200,000 and 500,000 fish. Numbers declined to about 100,000 fish by the mid-1960s with about 43 percent originating from this ESU. In 1994, Brown et al. estimated that about 7,000 wild and naturalized coho salmon were produced in the California portion of this ESU. Though long-term data on salmon abundance are rare, the available monitoring data indicate that spawner abundance has declined for populations in this ESU. The Shasta River population has declined in abundance by almost 50 percent from one generation to the next. Two partial counts from Prairie Creek, a tributary of Redwood Creek, and Freshwater Creek, a tributary of Humboldt Bay show negative trends, and data from the Rogue River basin also show recent negative trends. Estimates from Huntley Park in the Rogue

River basin show a strong return year of approximately 25,000 spawners in 2004, followed by a decline to 2,566 fish in 2009. The 12-year average estimated wild adult coho salmon in the Rogue River basin between 1998 and 2009 (excluding 2008)[7] is 8,050 fish. Based on extrapolations from cannery pack, the Rogue River had an estimated adult coho salmon abundance of 114,000 in the late 1800s (Meengs and Lackey 2005).

Status

NMFS listed the Southern Oregon/Northern California coast coho salmon as threatened on May 7, 1997 (62 FR 24588), and reaffirmed their status on June 28, 2005 (70 FR 37160). The ESU was listed because of habitat loss and degradation from the combined effects of logging, agricultural, and mining activities; road building; urbanization; stream channelization; damming; wetland loss; beaver trapping, water withdrawals; overharvest; drought; flooding; poor ocean conditions and El Niño; and artificial propagation. Though distribution has been reduced and fragmented within the ESU, extant populations can still be found in all major river basins within the ESU. Presence-absence data indicate a disproportionate loss of southern populations compared to the northern portion of the ESU. Though long-term data on salmon abundance are scarce, the available monitoring data indicate that spawner abundance has declined for populations in this ESU. Many populations have been extirpated, are near extirpation, or are severely depressed. Based on available data, the draft recovery plan (NMFS 2012b) concluded that this ESU is at high risk of extinction and is not viable. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

Critical habitat

NMFS designated critical habitat for Southern Oregon/Northern California Coast coho salmon on May 5, 1999 (64 FR 24049). Designated critical habitat includes all accessible river reaches between Cape Blanco, Oregon, and Punta Gorda, California and consists of the water, substrate, and river reaches (including off-channel habitats) in specified areas. Accessible reaches are those within the historical range of the ESU that can still be occupied by any life stage of coho salmon. Specific PCEs were not designated in the critical habitat final rule; instead five “essential habitat” categories were described: 1) juvenile summer and winter rearing areas; 2) juvenile migration corridors; 3) areas for growth and development to adulthood; 4) adult migration corridors; and 5) spawning areas. The “essential features” that characterize these sites include adequate: 1) substrate; 2) water quality; 3) water quantity; 4) water temperature; 5) water velocity; 6) cover or shelter; 7) food; 8) riparian vegetation; 9) space; and 10) safe passage conditions. Critical habitat designated for this ESU is of good quality in northern coastal streams. Spawning essential habitats have been degraded throughout the ESU by logging activities that

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[7] 2008 data were excluded from the average because the extremely low numbers were not consistent with that seen upstream at Gold Ray Dam, suggesting other reasons (sampling issues, data errors, etc.) for the dramatic drop in fish numbers from 2007 to 2008.

have increased fine particles in spawning gravel. Rearing essential habitats have been degraded in many inland watersheds from the loss of riparian vegetation resulting in unsuitably high water temperatures. Rearing and juvenile migration essential habitat quality has been reduced from the disconnection of floodplains and off-channel habitat in low gradient reaches of streams, consequently reducing winter rearing capacity.

4.2.4.4 Oregon Coast coho salmon

Species description

The Oregon Coast coho salmon ESU includes all naturally spawned populations of coho salmon in Oregon coastal streams south of the Columbia River and north of Cape Blanco (63 FR 42587). One hatchery population, the Cow Creek hatchery coho salmon, is considered part of the ESU. We used information available in the status review (Good et al. 2005), “Scientific conclusions of the status review for Oregon coast coho salmon (Oncorhynchus kisutch)” (Stout et al. 2012). “Identification of historical populations of coho salmon (Oncorhynchus kisutch) in the Oregon Coast Evolutionarily Significant Unit” (Lawson et al. 2007), listing documents (63 FR 42587; 73 FR 7816), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

In general, adults begin to migrate into rivers at the first fall freshet, usually in late October or early November, though there is some variation in run timing among watersheds. A delay in rain can delay river entry. Some coho may spend up to two months in freshwater before spawning. Spawning usually occurs from November through January and may continue into February. Juveniles emerge from the gravel in spring and typically spend a summer and winter in freshwater before migrating to the ocean as smolts, usually in April or May of their second spring. Timing varies between years, among river systems, and based on small-scale habitat variability. Salmon in this ESU exhibit a three-year life cycle, though two- year-old males commonly occur in some streams and on average make up 20 percent of spawning males.

Population dynamics

Lawson et al. (2007) considered the ESU to have historically consisted of 13 functionally independent populations and eight potentially dependent populations. Historical escapement in the 10 largest basins has been estimated to about 2.4 to 2.9 million spawners. The estimated median population of native spawners during the years 1990 to 1999 was 46,291 (min. 21,139, max. 82,661) spawners. After 1999, total ESU abundance increased. A median of 186,769 native spawners was estimated for the period 2000 through 2012 (min. 66,271, max. 356,243) (Oregon Department of Fish and Wildlife 2013). The encouraging increases in spawner abundance in 2000–2002 were preceded by three consecutive brood years (the 1994–1996 brood years returning in 1997–1999, respectively) exhibiting recruitment failure.[8] As of the 2005 status report, these three years of recruitment failure were the only such instances observed in the abundance time series since 1950. The increases in natural spawner abundance from 2000-2002 increases were primarily observed in populations in the northern portion of the ESU. Despite the increase in spawner abundance in 2000–2002, the long-term trends in ESU productivity remained negative because of the low abundances observed during the 1990s. Recent data indicate the total abundance of natural spawners in the Oregon coast coho salmon ESU again steadily decreased until 2007 with an estimated spawner abundance of 66,271 fish or approximately 25 percent of the 2002 peak abundance (258,418 spawners) (Oregon Department of Fish and Wildlife 2013). Thus, recruitment failed during the five years from 2002 through 2007. Abundance increased each year from 179,686 native spawners in 2008 to the highest recorded abundance of native spawners in the time series: 356,243 native spawners in 2012; however, abundance in 2012 was estimated at 99,142 native spawners, indicating another recruitment failure.

Status

NMFS listed the Oregon coast coho salmon as a threatened species on February 11, 2008 (73 FR 7816). The ESU was listed because its biological status had not improved since NMFS's January 19, 2006 determination the ESU's listing was not warranted (71 FR 3033) and current efforts being made to protect the species did not provide sufficient certainty of implementation or effectiveness to mitigate the assessed extinction risk. Current coho salmon coastal distribution has not changed markedly compared to historical distribution; however, river alterations and habitat destruction have significantly modified use and distribution within several river basins. Genetic diversity has been reduced by legacy effects of freshwater and tidal habitat loss, low spawner returns within the past 20 years, and past high levels of hatchery releases; however, with recent reductions in hatchery releases, diversity should improve. Based on these factors, this ESU would likely have a moderate resilience to additional perturbations.

Critical habitat

NMFS designated critical habitat for Oregon Coast coho salmon on February 11, 2008 (73 FR 7816). The designation includes 72 of 80 watersheds within the range of the ESU, totals approximately 6,600 stream miles, and includes all or portions of the Nehalem, Nestucca/Trask, Yaquina, Alsea, Umpqua, and Coquille basins. PCEs include: spawning sites with water and substrate quantity to support spawning, incubation, and larval development; freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth, foraging, behavioral development (e.g., predator avoidance, competition), and mobility; freshwater migratory corridors free of obstruction with

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[8] Recruitment failure is when a given year class of natural spawners fails to replace itself when its offspring return to the spawning grounds three years later.

adequate water quantity and quality conditions; and estuarine, nearshore and offshore areas free of obstruction with adequate water quantity, quality and salinity conditions that support physiological transitions between fresh- and saltwater, predator avoidance, foraging and other life history behaviors.

PCEs vary widely throughout the critical habitat area designated the ESU; many watersheds have been heavily altered and support low quality PCEs, while habitat in other watersheds have sufficient quality for supporting the conservation purpose of designated critical habitat. In many watersheds fine sediment into spawning gravel, created from timber harvest and forestry related activities, agriculture, and grazing, affects the spawning PCE. These activities have also diminished the channels' rearing and overwintering capacity by reducing large woody debris in stream channels, removing riparian vegetation, disconnecting floodplains from stream channels, and changing the quantity and dynamics of stream flows. The rearing PCE has been degraded by elevated water temperatures in 29 of the watersheds within the Nehalem, North Umpqua, and the inland watersheds of the Umpqua subbasins. Contaminants from agriculture and urban areas affect water quality in low-lying areas in the Umpqua subbasin, and in coastal watersheds within the Siletz/Yaquina, Siltcoos, and Coos subbasins. Reductions in water quality have been observed in 12 watersheds because of contaminants and excessive nutrition. Throughout the ESU, culverts and road crossings restrict passage, affecting PCE migration.

4.2.5 Sockeye salmon

We discuss the distribution, life history, population dynamics, status, and critical habitats of the two species (here we use the word "species" to apply to distinct population segments, DPSs, and evolutionary significant units, ESUs) separately. However, because listed sockeye salmon species are indistinguishable in the wild and comprise the same biological species, we begin this section describing characteristics common across ESUs. We used information available in the status review (Good et al. 2005), various listing documents, and biological opinions (notably NMFS 2012a) to summarize the status of the species.

Species description

Sockeye salmon occur in the North Pacific and Arctic oceans and associated freshwater systems. In North America, the species ranges north from the Klamath River in California to Bathurst Inlet in the Canadian Arctic. In Asia sockeye salmon range from northern Hokkaido in Japan north to the Anadyr River in Siberia. The largest populations occur north of the Columbia River.

Life history

Most sockeye salmon exhibit a lake-type life history (i.e., they spawn and rear in or near lakes), though some salmon exhibit a river-type life history. Spawning occurs in late summer and fall, but timing can vary among populations. In lakes, salmon commonly spawn along "beaches" where underground seepage provides fresh oxygenated water. Incubation is part of water temperature, but lasts between 100 to 200 days (Burgner 1991). Sockeye salmon fry primarily rear in lakes; river-emerged and stream-emerged fry migrate into lakes to rear. Juvenile sockeye salmon rear in lakes from one to three years after emergence, though some river-spawned salmon may migrate to sea in their first year. Juvenile sockeye salmon feeding behaviors change as they transition through life stages after emergence to the time of smoltification. In the early fry stage from spring to early summer, juveniles forage exclusively in the warmer littoral (i.e., shoreline) zone where they depend mostly on fly larvae and pupae, copepods, and water fleas. In summer, very young sockeye salmon move from the littoral habitat to a pelagic (i.e., open water) existence where they feed on larger zooplankton; however, flies may still make up a substantial portion of their diet. Older and larger fish may also prey on fish larvae. Distribution in lakes and prey preference is a dynamic process that changes daily and yearly depending on many reasons, including: water temperature; prey abundance; presence of predators and competitors; and size of the juvenile. Peak emigration to the ocean occurs in mid-April to early May in southern sockeye populations (<52ºN latitude) and as late as early July in northern populations (62ºN latitude) (Burgner 1991). Adult sockeye salmon return to their natal lakes to spawn after spending one to four years at sea. The diet of adult salmon consists of amphipods, copepods, squid, and other fish.

Certain populations of O. nerka become resident in the lake environment and are referred to as "kokanee". Kokanee and sockeye often co-occur in many interior lakes, where access to the sea is possible but energetically costly; kokanee are rarely found in coastal lakes, where the migration to sea is short and energetic costs are minimal. At times, a single population will result in both the anadromous and freshwater life history form. Both sockeye and kokanee are semelparous.

Status

On June 28, 2005, as part of the final listing determinations for 16 ESUs of West Coast salmon, NMFS amended and streamlined the 4(d) protective regulations for threatened salmon and steelhead (70 FR 37160) as described in the Protective Regulations for Threatened Salmonid Species section of this document. Under this change, the section 4(d) protections apply to natural and hatchery fish with an intact adipose fin, but not to listed hatchery fish that have had their adipose fin removed before release into the wild.

4.2.5.1 Ozette Lake sockeye salmon

Species description

The Ozette Lake sockeye salmon ESU includes all naturally spawned anadromous populations of sockeye salmon that migrate into and rear in Ozette Lake, Ozette River, Coal Creek, and other tributaries flowing into Ozette Lake, near the northwest tip of the Olympic Peninsula in Olympic National Park, Washington. Composed of only one population, the Ozette Lake sockeye salmon ESU consists of five spawning aggregations or subpopulations, grouped according to their spawning locations: Umbrella and Crooked creeks, Big Rive, and Olsen's and Allen's beaches. Two artificial populations are also considered part of this ESU. Sockeye salmon stock reared at the Makah Tribe's Umbrella Creek Hatchery were included in the ESU, but were not considered essential for recovery of the ESU. However, after the hatchery fish return and spawn in the wild, their progeny we consider them listed under the ESA. We used information available in status reviews (Good et al. 2005; NMFS 2011g), the recovery plan (NMFS 2009b), "Viability Criteria for the Lake Ozette Sockeye Salmon Evolutionarily Significant Unit" (Rawson et al. 2009), listing documents (63 FR 11750, 64 FR 14528), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

Salmon of this ESU enter Ozette Lake through the Ozette River from April to early August and they delay spawning is until late October to February. Spawning occurs primarily in lakeshore upwelling areas of the lake, though minor spawning may occur below the lake in the Ozette River or its tributary, Coal Creek. Native sockeye salmon do not presently spawn in tributary streams to Ozette Lake, though spawning may have occurred there historically. Hatchery salmon, however, do spawn in the Ozette Lake tributaries of Umbrella Creek and Big River. Fry in Ozette Lake and the tributaries emerge from late-February through May and disperse to open areas of the lake to rear. Juveniles rear for one year in the lake and emigrate seaward in their second spring. At emigration, smolts are relatively large, averaging 4 ½ to 5 inches in length. Most adult salmon of this ESU return from the ocean to spawn as four-year old fish. Ozette Lake also supports a population of kokanee which is not listed under the ESA.

Population dynamics

The Ozette Lake sockeye salmon ESU is composed of one historical population with multiple spawning aggregations. Historically at least four beaches in the lake were used for spawning; today only two beach spawning locations, Allen's and Olsen's beaches, are used. The historical abundance of Ozette Lake sockeye salmon is poorly documented, but may have been as high as 50,000 individuals (Blum, 1988). Declines began to be reported in the 1920s. Escapement estimates (run size minus broodstock take) from 1996 to 2006 are variable and range from a low of 1,404 individuals in 1997 to a high of 6,461 individuals in 2004, with a median of approximately 3,800 sockeye per year (geometric mean: 3,353). No statistical estimation of trends for this ESU are reported. However, comparing four year averages (to include four brood years in the average because the species primarily spawn as four-year olds) shows an increase during the period 2000 to 2006. For return years 1996 to 1999 the run size averaged 2,460 sockeye salmon; for years 2000 to 2003 the run size averaged just over 4,420 fish; and for years 2004 to 2006, the average abundance estimate was 4,167 sockeye. The supplemental hatchery program began with out-of-basin stocks and make up an average of 10 percent of the run. The proportion of beach spawners originating from the hatchery is unknown, but it is likely that straying is low. Based on estimates of habitat carrying capacity, a viable sockeye salmon population in the Lake Ozette watershed would range between 35,500 to 121,000 spawners.

Status

NMFS listed the Ozette Lake sockeye salmon ESU as threatened on March 25, 1999 (64 FR 14528), and reaffirmed their threatened status on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of logging; road building; predation; invasive plant species; and overharvest. Ozette Lake sockeye salmon have not been commercially harvested since 1982 and only minimally harvested by the Makah Tribe since 1982 (0 to 84 fish per year); there are also no known marine area harvest impacts to fish of this ESU. Overall abundance is substantially below historical levels and it is not known if this decrease in abundance is a result of fewer spawning aggregations, lower abundances at each aggregation, or a combination of both factors. The proportion of beach spawners is assumed to be low; therefore, hatchery originated fish are not believed to have had a major effect on the genetics of the naturally spawned population. However, Ozette Lake sockeye have a relatively low genetic diversity compared to other *O. nerka* populations examined in Washington State (Crewson et al. 2001). Genetic differences do occur between age cohorts, but as different age groups do not spawn with each other, the population may be more vulnerable to significant reductions in population structure due to catastrophic events or unfavorable conditions affecting one year class. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

Critical habitat

NMFS designated critical habitat for Ozette Lake sockeye salmon on September 2, 2005 (70 FR 52630). It encompasses areas within the Hoh/Quillayute subbasin, Ozette Lake, and the Ozette Lake watershed. The entire occupied habitat for this ESU is within the single watershed for Ozette Lake. PCEs identified for Lake Ozette sockeye salmon are areas for spawning, freshwater rearing and migration, estuarine areas free of obstruction, nearshore marine areas free of obstructions, and offshore marine areas with good water quality. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, and adequate passage conditions. Spawning habitat has been affected by loss of tributary spawning areas and exposure of much of the available beach spawning habitat due to low water levels in summer. Further, native and non-native vegetation as well as sediment have reduced the quantity and suitability of beaches for spawning. The rearing PCE is degraded by excessive predation and competition with introduced non-native species, and by loss of tributary rearing habitat. Migration habitat may be adversely affected by high water temperatures and low water flows in summer which causes a thermal block to migration (La Riviere 1991).

4.2.5.2 Snake River sockeye salmon

Species description

The Snake River sockeye salmon ESU includes all anadromous and residual sockeye from the Snake River basin, Idaho, as well as artificially propagated sockeye salmon from the Redfish Lake Captive Broodstock Program. Redfish Lake is located in the Salmon River basin, a subbasin within the larger Snake River basin. We used information available in status reviews (Gustafson et al. 1997; Good et al. 2005; NMFS 2011c), listing documents (58 FR 68543, 70 FR 37160), and previously issued biological opinions (notably NMFS 2008b and NMFS 2012a) to summarize the status of the species.

Life history

Snake River sockeye salmon are unique compared to other sockeye salmon populations. Sockeye salmon returning to Redfish Lake travel a greater distance from the sea (approximately 900 miles) to a higher elevation (6,500 ft) than any other sockeye salmon population and are the southern-most population of sockeye salmon in the world (Bjornn et al. 1968). Salmon of this ESU are separated by 700 or more river miles from two other extant upper Columbia River populations in the Wenatchee River and Okanogan River drainages. These latter populations return to lakes at substantially lower elevations (Wenatchee at 1,870 ft, Okanagon at 912 ft) and occupy different ecoregions.

No natural origin anadromous adults have returned since 1998 and the species is currently entirely supported by adults produced through a captive propagation program. Historically, salmon of this ESU entered the Columbia River system in June and July, and arrived at Redfish Lake between August and September. Spawning occurred in lakeshore gravel and generally peaked in October. Fry emerged in the spring (generally April and May) then migrated to open waters of the lake to feed. Juvenile sockeye remained in the lake for one to three years before migrating through the Snake and Columbia Rivers to the ocean. While pre-dam reports indicate that sockeye salmon smolts migrate in May and June, passive integrated transponder (PIT) -tagged sockeye smolts from Redfish Lake pass Lower Granite Dam from mid-May to mid-July. Adult anadromous sockeye spent two or three years in the open ocean before returning to Redfish Lake to spawn. A resident form of Snake River sockeye salmon also occurs in Redfish Lake. The residuals are nonanadromous (i.e. they complete their entire life cycle in freshwater); however, studies have shown that some ocean migrating juveniles are progeny of resident females (Rieman et al. 1994). The resident salmon spawn at the same time and in the same location as anadromous sockeye salmon.

Population dynamics

The only extant sockeye salmon population in the Snake River basin at the time of listing occurred in Redfish Lake. Other lakes in the Salmon River basin that historically supported sockeye salmon include Alturas Lake above Redfish Lake which was extirpated in the early 1900s as a result of irrigation diversions, though residual sockeye may still exist in the lake. From 1955 to 1965, the Idaho Department of Fish and Game eradicated sockeye salmon from Pettit, Stanley, and Yellowbelly lakes, and built permanent structures on each of the lake outlets that prevented re-entry of anadromous sockeye salmon (Chapman and Witty 1993). Other historic sockeye salmon populations within the Snake River basin now considered extinct include Wallowa Lake (Grande Ronde River drainage, Oregon), Payette Lake (Payette River drainage, Idaho), and Warm Lake (South Fork Salmon River drainage, Idaho).

Adult returns to Redfish Lake during the period 1954 through 1966 ranged from 11 to 4,361 fish (Bjornn et al. 1968). In 1985, 1986, and 1987, 11, 29, and 16 sockeye, respectively, were counted at the Redfish Lake weir. Only 18 natural origin sockeye salmon have returned to the Stanley Basin since 1987. The first adult returns from the captive brood stock program returned to the Stanley Basin in 1999. From 1999 through 2005, a total of 345 captive brood adults that had migrated to the ocean returned to the Stanley Basin. Recent years have seen an increase in returns to over 600 in 2008 and more than 700 returning adults in 2009.

Status

NMFS listed Snake River sockeye salmon as endangered on November 20, 1991 (56 FR 58619), and reaffirmed their status on June 28, 2005 (70 FR 37160). Subsequent to the 1991 listing, the residual form of sockeye residing in Redfish Lake was identified and in 1993, NMFS determined that residual sockeye salmon in Redfish Lake was part of the ESU. The ESU was listed due to habitat loss and degradation from the combined effects of damming and hydropower development; overexploitation; fisheries management practices; and poor ocean conditions. Recent annual abundances of natural origin sockeye salmon in the Stanley Basin have been extremely low. This species is currently entirely supported by adults produced through the captive propagation program. No natural origin anadromous adults have returned since 1998 and the abundance of residual sockeye salmon in Redfish Lake is unknown. Current smolt-to-adult survival of sockeye originating from the Stanley Basin lakes is rarely greater than 0.3% (Hebdon et al. 2004). Based on these factors, this ESU would likely have a very low resilience to additional perturbations.

Critical habitat

NMFS designated critical habitat for SR sockeye salmon on December 28, 1993 (58 FR 68543). It encompass the waters, waterway bottoms, and adjacent riparian zones of specified lakes and river reaches in the Columbia River that are or were accessible to salmon of this ESU (except reaches above impassable natural falls, and Dworshak and Hells Canyon Dams). Specific PCEs were not designated in the critical habitat final rule; instead four “essential habitat” categories were described: 1) spawning and juvenile rearing areas, 2) juvenile migration corridors, 3) areas for growth and development to adulthood, and 4) adult migration corridors. The “essential features” that characterize these sites include substrate/spawning gravel; water quality, quantity, temperature, velocity; cover/shelter; food; riparian vegetation; space; and safe passage conditions. The quality and quantity of rearing and juvenile migration essential habitats have been reduced from activities such as tilling, water withdrawals, timber harvest, grazing, mining, and alteration of floodplains and riparian vegetation. These activities disrupt access to foraging areas, increase the amount of fines in the steam substrate that support production of aquatic insects, and reduce instream cover. Adult and juvenile migration essential habitat is affected by four dams in the Snake River basin that obstructs migration and increases mortality of downstream migrating juveniles. Water quality impairments in designated critical habitat include inputs from fertilizers, insecticides, fungicides, herbicides, surfactants, heavy metals, acids, petroleum products, animal and human sewage, dust suppressants (e.g., magnesium chloride), radionuclides, sediment in the form of turbidity, and other anthropogenic pollutants. Pollutants enter the surface waters and riverine sediments from the headwaters of the Salmon River to the Columbia River estuary as contaminated stormwater runoff, aerial drift and deposition, and via point source discharges.

4.2.6 Steelhead trout

We discuss the distribution, life history, population dynamics, status, and critical habitats of the eleven species (here we use the word "species" to apply to distinct population segments, DPSs, and evolutionary significant units, ESUs) separately; however, because listed steelhead trout species are virtually indistinguishable in the wild and comprise the same biological species, we begin this section describing characteristics common across DPSs. We used information available in the 2005 West Coast salmon and steelhead status review (Good et al. 2005), various salmon ESU listing documents, and biological opinions (notably NMFS 2012a) to summarize the status of the species.

Species description and distribution

Steelhead is the common name of the anadromous form of *O. mykiss*. They are a Pacific salmonid with freshwater habitats that include streams extending from northwestern Mexico to Alaska in North America to the Kamchatka peninsula in Russia. Non-anadromous *O. mykiss* do not migrate to the ocean and remain in freshwater all their lives. These fish are commonly called rainbow trout.

Life history

Though steelhead have a longer run time than other Pacific salmonids and do not tend to travel in large schools, they can be divided into two basic run-types: the stream-maturing type (summer steelhead) and the ocean-maturing type (winter steelhead). Summer steelhead enter freshwater as sexually immature adults between May and October (Busby et al., 1996; T.E. Nickelson et al., 1992) and hold in cool, deep pools during summer and fall before moving to spawning sites as mature adults in January and February (Barnhart, 1986; T.E. Nickelson, et al., 1992). Winter steelhead return to freshwater between November and April as sexually mature adults and spawn shortly after river entry (Busby, et al., 1996; T.E. Nickelson, et al., 1992). Steelhead typically spawn in small tributaries rather than large, mainstem rivers and spawning distribution often overlaps with coho salmon, though steelhead tend to prefer higher gradients (generally two to seven percent, but up to 12 percent or more) and their distributions tend to extend further upstream than coho salmon. Summer steelhead commonly spawn higher in a watershed than do winter steelhead, sometimes even using ephemeral streams from which juveniles are forced to emigrate as flows diminish. Fry usually inhabit shallow water along banks and stream margins of streams (T.E. Nickelson, et al., 1992) and move to faster flowing water such as riffles as they grow. Some older juveniles move downstream to rear in larger tributaries and mainstem rivers (T.E. Nickelson, et al., 1992). In Oregon and California, steelhead may enter estuaries where sand bars create low salinity lagoons. Migration of juvenile steelhead to these lagoons occurs throughout the year, but is concentrated in the late spring/early summer and in the late fall/early winter periods (Shapovalov & Taft, 1954; Zedonis, 1992). Juveniles rear in freshwater for one to four years, then smolt and migrate to the ocean in March and April (Barnhart, 1986). Steelheads typically reside in marine waters for two or three years before returning to their natal streams to spawn as four or five-year olds. Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death (Busby, et al., 1996). Females spawn more than once more commonly than males, but rarely more than twice before dying (T.E. Nickelson, et al., 1992). Iteroparity is also more common among southern steelhead populations than northern populations (Busby, et al., 1996).

Steelhead feed on a variety of prey organisms depending upon life stage, season, and prey availability. In freshwater juveniles feed on common aquatic stream insects such as caddisflies, mayflies, and stoneflies but also other insects (especially chironomid pupae), zooplankton, and benthic organisms (Merz, 2002; Pert, 1987). Older juveniles sometimes prey on emerging fry, other fish larvae, crayfish, and even small mammals, though these are not a major food source (Merz, 2002). The diet of adult oceanic steelhead is comprised primarily of fish and squid (Light 1985; Burgner et al. 1992).

Status

On June 28, 2005, as part of the final listing determinations for 16 ESUs of West Coast salmon, NMFS amended and streamlined the 4(d) protective regulations for threatened salmon and steelhead (70 FR 37160) as described in the Protective Regulations for Threatened Salmonid Species section of this document. Under this change, the section 4(d) protections apply to natural and hatchery fish with an intact adipose fin, but not to listed hatchery fish that have had their adipose fin removed before release into the wild.

Critical habitat

NMFS designated critical habitat for all but one of the listed steelhead DPSs on September 2, 2005 (70 FR 52488). Areas designated as critical habitat are important for the species' overall conservation by protecting quality growth, reproduction, and feeding. At the time of designation, PCEs are identified and include sites necessary to support one or more steelhead life stage(s). PCEs in steelhead designated habitat include freshwater spawning and rearing sites, freshwater migration corridors, nearshore marine habitat, and estuarine areas. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. The critical habitat section for each listed DPS below identifies the areas included as part of the designation and discusses the current status of critical habitat.

4.2.6.1 Central California coast steelhead

Species description and distribution

The Central California Coast steelhead DPS includes all naturally spawned populations of steelhead in coastal streams from the Russian River to Aptos Creek; the drainages of San Francisco, San Pablo, and Suisun Bays eastward to Chipps Island at the confluence of the Sacramento and San Joaquin Rivers; and tributary streams to Suisun Marsh including Suisun Creek, Green Valley Creek, and an unnamed tributary to Cordelia Slough (commonly referred to as Red Top Creek). The DPS does not include the Sacramento-San Joaquin River Basin of the California Central Valley. Two artificial propagation programs are considered to be part of the DPS: the Don Clausen Fish Hatchery, and Kingfisher Flat Hatchery/Scott Creek (Monterey Bay

Salmon and Trout Project). We used information available in status reviews (Good et al. 2005; NMFS 2011j), the recovery outline (NMFS 2007a), "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" (Bjorkstedt et al. 2005), listing documents (61 FR 41541, 62 FR 43937; 71 FR 834), and previously issued biological opinions (notably NMFS 2008a and 2012a) to summarize the status of the species.

Life history

The DPS, like those to the south, is entirely composed of winter-run fish. Adults return to the Russian River and migrate upstream from December to April. Most spawning occurs from January to April. Smolts emigrate between March and May (Hayes et al. 2004; Shapovalov and Taft 1954), typically at one to four years of age, though recent studies indicate that growth rates in Soquel Creek likely prevent juveniles from undergoing smoltification until age two (Sogard et al. 2009).

Population dynamics

The Central California Coast steelhead DPS consisted of nine historic functionally independent populations and 23 potentially independent populations. Of the historic functionally independent populations, at least two are extirpated and most of the remaining populations are nearly extirpated. Historically, the entire central California coast steelhead DPS may have consisted of an average runs size of 94,000 adults in the early 1960s. Information on current steelhead populations in the DPS consists of anecdotal, sporadic surveys that are limited to only smaller portions of watersheds. Though it is not possible to calculate long-term trends for individual watersheds or the entire DPS, the limited data that do exist indicate that abundance has declined for all populations sampled compared to historical data. Current runs in the basins that originally contained the two largest steelhead populations for the DPS, the San Lorenzo and the Russian Rivers, both have been estimated at less than 15% of their abundances compared to 30 years earlier. The interior Russian River winter-run steelhead has the largest runs with an estimate of an average of over 1,000 spawners.

Status

NMFS listed the Central California Coast steelhead as threatened on August 18, 1997 (62 FR 43937), and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (i.e., destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific issue of sedimentation and channel restructuring due to floods. Spatial structure has been reduced throughout the DPS. Impassible dams have cut off substantial portions of habitat in some basins and it is estimated that 22 percent of the DPS's historical habitat has been lost behind (primarily man-made) barriers, including significant portions of the upper Russian River. Long-term population sustainability is extremely low for the southern populations in the Santa Cruz Mountains and in the San Francisco Bay, and declines in juvenile southern populations are consistent with the more general estimates of declining abundance in the region. The interior Russian River population may be able to be sustained over the long-term, but hatchery management has eroded the population's genetic diversity. Though the information for individual populations is limited, available information strongly suggests that no population is viable. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

Critical habitat

Designated critical habitat for the Central California coast steelhead DPS includes the Russian River watershed, coastal watersheds in Marin County, streams within the San Francisco Bay, and coastal watersheds in the Santa Cruz Mountains, southeast to Aptos Creek. The spawning PCE have reduced quality throughout the critical habitat; sediment fines in spawning gravel have reduced the ability of the substrate attribute to provide well oxygenated and clean water to eggs and alevins. The forage PCE has been degraded in some areas where high proportions of fines in bottom substrate limit the production of aquatic stream insects adapted to high velocity water. Elevated water temperatures and impaired water quality have further reduced the quality, quantity, and function of the rearing PCE within most streams. These impacts have diminished the ability of designated critical habitat to conserve the Central California Coast steelhead.

4.2.6.2 California Central Valley steelhead

Species description and distribution

The California Central Valley steelhead DPS includes all naturally spawned steelhead populations below natural and manmade impassable barriers in the Sacramento and San Joaquin Rivers and their tributaries, excluding steelhead from San Francisco and San Pablo Bays and their tributaries. The DPS also includes two artificial propagation programs: the Coleman National Fish Hatchery and Feather River Hatchery. We used information available in status reviews (Good et al. 2005, NMFS 2011i), the draft recovery plan (NMFS 2009a), listing documents (69 FR 33102; 71 FR 834), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

Members of this DPS have the longest freshwater migration of any population of winter steelhead. Adults return to freshwater essentially continuously from July to May, with peaks in September and February. Spawning occurs from December to April, with peaks from January to March (McEwan and Jackson 1996). Spawning occurs in small streams and tributaries directly downstream of dams. Juvenile steelhead in the Sacramento River basin migrate downstream during most months of the year, but the peak period of emigration occurs in spring, with a much smaller peak in fall. Emigrating juveniles use the lower reaches of the Sacramento River and the Delta for rearing and as a migration corridor to the ocean; some may use tidal marsh areas, non-tidal freshwater marshes, and other shallow water areas in the Delta as rearing areas for short periods before their final emigration to the sea (Hallock et al. 1961).

Population dynamics

The California Central Valley steelhead DPS may have consisted of 81 historical and independent populations (Lindley et al. 2006). Existing wild steelhead stocks in the Central Valley are mostly confined to the upper Sacramento River and its tributaries. Until recently, steelhead were considered extirpated from the San Joaquin River system; in 2004, a total of 12 steelhead smolts were collected in monitoring trawls at the Mossdale station in the lower San Joaquin River (California Department of Fish and Game, unpubl. data). Historically, annual steelhead run size for this ESU may have approached one to two million adults. By the early 1960s, the run size had declined to about 40,000 adults (McEwan 2001). Steelhead were counted at the Red Bluff Diversion Dam until 1993; counts declined from an average of 11,187 from 1967 to 1977 to an average of approximately 2,000 through the early 1990s. Estimated total annual run size for the entire Sacramento-San Joaquin system was no more than 10,000 adults during the early 1990s (D. McEwan & Jackson, 1996; D. R. McEwan, 2001). Based on catch ratios at Chipps Island in the Delta and using generous survival assumptions, the average number of steelhead females spawning naturally in the entire Central Valley during the years 1980 to 2000 was estimated at approximately 3,600.

Status

NMFS listed the California Central Valley steelhead DPS as threatened on March 19, 1998, and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the loss of most historical spawning and rearing habitat above impassable dams, restriction of natural production areas, the apparent continuing decline in abundance, and lack of monitoring efforts to assess the DPS's abundance and trends. The DPS's present distribution has been greatly reduced: about 80 percent of historic habitat has been lost behind dams and about 38 percent of habitat patches that supported independent populations are no longer accessible to steelhead (Lindley et al. 2006). Though previously thought to be extirpated from these areas, populations may exist in Big Chico and Butte Creeks and steelhead have also been observed in Clear Creek and Stanislaus River (Demko and Cramer 2000). A few wild steelhead are produced in the American and Feather Rivers. Though annual monitoring data for calculating trends are lacking, available data indicate the DPS has had a significant long-term downward trend in abundance. The losses of populations and reductions in abundance have reduced genetic diversity in the DPS. Hatchery-origin fish have also compromised the genetic diversity of the majority of the spawning runs. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

Critical habitat

Designated critical habitat for the California Central Valley steelhead DPS encompasses about 2,300 miles of stream habitat and about 250 square miles of estuarine habitat in the San Francisco-San Pablo-Suisan Bay estuarine complex and includes stream reaches such as those of the Sacramento, Feather, and Yuba Rivers, and Deer, Mill, Battle, and Antelope creeks in the Sacramento River basin; the lower San Joaquin River to the confluence with the Merced River, including its tributaries, and the waterways of the Delta. The critical habitat is degraded, and does not provide the conservation value necessary for species recovery. In addition, the Sacramento-San Joaquin River Delta provides very little function necessary for juvenile steelhead rearing and smoltification. The spawning PCE is subject to variations in flows and temperatures, particularly over the summer months. The rearing PCE is degraded by channelized, leveed, and riprapped river reaches, and sloughs common in the Sacramento-San Joaquin system. These areas typically have low habitat complexity, low abundance of food organisms, offer little protection from fish or avian predators, and commonly have elevated temperatures. The current conditions of migration corridors are substantially degraded. Both migration and rearing PCEs have reduced water quality from several contaminants introduced by dense urbanization and agriculture along the mainstems and in the Delta. In the Sacramento River, the migration corridor for both juveniles and adults is obstructed by the Red Bluff Diversion Dam gates from May 15 through September 15. The migration PCE is also obstructed by complex channel configuration making it difficult for fish to migrate successfully to the western Delta and the ocean. State and federal pumps and associated fish facilities alter flows in the Delta and impede and obstruct a functioning migration corridor. The estuarine PCE in the Delta is affected by contaminants from agricultural and urban runoff and release of wastewater treatment plants effluent. However, some complex, productive habitats with floodplains remain in the system and flood bypasses (i.e., Yolo and Sutter bypasses).

4.2.6.3 Lower Columbia River steelhead

Species description and distribution

The Lower Columbia River steelhead DPS includes all naturally spawned steelhead populations below natural and manmade impassable barriers in streams and tributaries to the Columbia River between the Cowlitz and Wind Rivers, Washington, and the Willamette and Hood Rivers, Oregon. The DPS also includes seven hatchery populations. We used information available in status reviews (Busby et al. 1996, Good et al. 2005, NMFS 2011a; Ford 2011), recovery plans (LCFRB 2010; Oregon Department of Fish and Wildlife 2010; NMFS 2013a), listing documents (61 FR 41541, 63 FR 13347, 71 FR 834), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

The Lower Columbia River steelhead DPS includes populations of summer- and winter-run steelhead. Summer-run steelhead return sexually immature to the Columbia River from May to October, and spend several months in freshwater before spawning between February and April. Winter-run steelhead enter freshwater from December to May at sexual maturity. Peak spawning occurs from April to May. Where both races spawn in the same stream, summer-run steelhead tend to spawn at higher elevations than winter-run steelhead. Fry emerge from March to July, with peaks between April and May. Steelhead smolts generally migrate at ages ranging from one to four years, but most smolt after two years in freshwater. Emigration of both summer- and winter-run steelhead generally occurs from March to June, with peak migration in April to May. Both winter- and summer-run adults normally return to freshwater after two years in the ocean.

Population dynamics

The Lower Columbia River steelhead had 17 historically independent winter-run steelhead populations and six independent summer-run steelhead populations (McElhany et al., 2003; J. Myers, et al., 2006). All historic populations are considered extant. All populations declined from 1980 to 2000, with sharp declines beginning in 1995. Historical counts in some of the larger tributaries (Cowlitz, Kalama, and Sandy Rivers) suggest the population probably exceeded 20,000 fish. During the 1990s, fish abundance dropped to 1,000 to 2,000 fish. Recent abundance estimates of natural-origin spawners range from extirpation of some populations above impassable barriers to over 700 fishes in the Kalama and Sandy winter-run populations. A number of the populations have a substantial fraction of hatchery-origin spawners in spawning areas. Many of the long-and short-term trends in abundance of individual populations are negative.

Status and trends

NMFS listed Lower Columbia River steelhead as threatened on March 19, 1998 (63 FR 13347), and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (i.e., destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific issue of genetic introgression from hatchery stocks. Spatial structure remains relatively high for most populations (LCFRB 2010, Oregon Department of Fish and Wildlife 2010). Except in the North Fork Lewis subbasin, where dams have impeded access to historical spawning habitat, most summer-run steelhead populations continue to have access to historical production areas in forested, mid- to-high-elevation subbasins that remain largely intact. Most populations of winter-run steelhead have maintained their spatial structure, though many of these habitats no longer support significant production (LCFRB 2010, Oregon Department of Fish and Wildlife 2010). Out of the 23 populations in this DPS, 16 are considered to have a low or very low probability of persisting over the next 100 years, and six populations have a moderate probability of persistence (LCFRB 2010, Oregon Department of Fish and Wildlife 2010). Only the summer-run Wind population is considered viable. The low to very low baseline persistence probabilities of most Lower Columbia River steelhead populations reflects low abundance and productivity. In addition, it is likely that genetic and life history diversity has been reduced as a result of pervasive hatchery effects and population bottlenecks. Although current Lower Columbia River steelhead populations are depressed compared to historical levels and long-term trends show declines, many populations are substantially healthier than their salmon counterparts, typically because of better habitat conditions in core steelhead production areas (LCFRB 2010a). Based on these factors, this DPS would likely have a moderate resilience to additional perturbations.

Critical habitat

Designated critical habitat for the Lower Columbia River steelhead DPS includes the following subbasins: Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Upper Cowlitz, Cowlitz, Clackamas, and Lower Willamette. The Lower

Columbia River corridor is also included in the designated critical habitat. Critical habitat is affected by reduced quality of rearing and juvenile migration PCEs within the lower portion and alluvial valleys of many watersheds. Contaminants from agriculture further affect both water quality and food production in these degraded reaches of tributaries and in the mainstem Columbia River. Several dams affect adult migration PCE by obstructing the migration corridor. Watersheds which consist of a large proportion of Federal lands (e.g., the Sandy River watershed) have relatively healthy riparian corridors that support attributes of the rearing PCE such as cover, forage, and suitable water quality.

4.2.6.4 Middle Columbia River steelhead

Species description and distribution

The Middle Columbia River steelhead DPS includes all naturally spawned steelhead populations below natural and manmade impassable barriers in streams from above the Wind River, Washington, and the Hood Rivers, Oregon and upstream to, and including, the Yakima River, Washington, excluding O. mykiss from the Snake River Basin. The DPS also includes seven artificial propagation programs. Steelhead from the Snake River basin (described in Section 6.7) are not included in this DPS. We used information available in status reviews (Busby et al. 1996, Good et al. 2005, NMFS 2011k; Ford 2011), the recovery plan (NMFS 2009c), listing documents (63 FR 11798, 64 FR 14517, 71 FR 834), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

Middle Columbia River steelhead populations are mostly of the summer-run type, with the exception of inland winter-run steelhead that occur in the Klickitat River and Fifteenmile Creek. Adult summer-run steelhead enter freshwater from June through August and adults may spend up to a year in freshwater before spawning. The majority of juveniles smolt and immigrate to the ocean as two-year olds. About equal numbers of adults in the DPS return to freshwater after spending one or two years in the ocean; however, summer-run steelhead in Klickitat River have a life cycle more like Lower Columbia River steelhead where most of returning adults have spent two years in the ocean.

Population dynamics

The Interior Columbia Technical Review Team identified 16 extant populations in four major population groups (Cascades Eastern Slopes Tributaries, John Day River, Walla Walla and Umatilla Rivers, and Yakima River) and one extant unaffiliated population (Rock Creek) (Interior Columbia Technical Review Team 2003). There are three extirpated populations: two in the Cascades Eastern Slope major population group and one in the Walla Walla and Umatilla Rivers major population group. Historic run estimates for the Yakima River indicate that annual species abundance may have exceeded 300,000 returning adults. The 10-year geometric mean for each population ranges from a low of 85 fish (Upper Yakima River) to 1,800 fish (Lower Mainstem John Day). The 10-year average proportion of hatchery-origin spawners ranges from two percent (Walla Walla Mainstem) to 39 percent (Eastside Deschutes); the majority of populations have a hatchery proportion of spawners between six to eight percent. Fifteenmile Creek has no hatchery-origin spawners.

Status
NMFS listed Middle Columbia River steelhead as threatened on March 25, 1999 (64 FR 14517), and reaffirmed their threatened status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (i.e., destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as impacts from artificial propagation. NMFS considers spatial structure and diversity of the DPS to be at moderate risk. Relative to the brood cycle just before listing (1992 to 1996 spawning year), current brood cycle (five-year geometric mean) natural abundance is substantially higher (more than twice) for seven of the populations, lower for three, and at similar levels for four populations. Three populations have insufficient data to calculate long-term trends. Short-term trends are positive for all but three populations. Viability ratings for the 17 populations are: four viable, seven maintained, one highly variable, and five high risk. Impacts from Tribal fisheries targeting Chinook salmon continue to harvest approximately five percent of summer-run steelhead in the Middle Columbia, Upper Columbia, and Snake River Basins per year. Based on these factors, this DPS would likely have a moderate resilience to additional perturbations.

Critical habitat
Designated critical habitat for the Middle Columbia River steelhead DPS includes the following subbasins: Upper Yakima, Naches, Lower Yakima, Middle Columbia/Lake Wallula, Walla Walla, Umatilla, Middle Columbia/Hood, Klickitat, Upper John Day, North Fork John Day, Middle Fork John Day, Lower John Day, Lower Deschutes, Trout, the Upper Columbia/Priest Rapids subbasins, and the Columbia River corridor. The current condition of Middle Columber River critical habitat is moderately degraded. Quality of juvenile rearing and migration PCEs has been reduced in several watersheds and in the mainstem Columbia River by contaminants from agriculture that affect both water quality and food production. Loss of riparian vegetation from grazing has resulted in high water temperatures in the John Day basin. Reduced quality of the rearing PCEs has diminished its contribution to the conservation value necessary for the recovery of the species. Several dams affect adult migration PCE by obstructing the migration corridor.

4.2.6.5 Northern California steelhead

Species description
The Northern California steelhead DPS includes all naturally spawned steelhead populations below natural and manmade impassable barriers in California coastal river basins from Redwood Creek southward to, but not including, the Russian River. The DPS also includes two artificial propagation programs: the Yeager Creek Hatchery and the North Fork Gualala River Hatchery (Gualala River Steelhead Project). We used information available in status reviews (Busby et al. 2006, Good et al. 2005; NMFS 2011j), the recovery outline (NMFS 2007b), "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" (Bjorkstedt et al. 2005), "A framework for assessing the viability of Threatened and Endangered Salmon and Steelhead in the North-central California Coast Recovery Domain" (Spence et al. 2008), listing documents (61 FR 41541, 62 FR 43937; 71 FR 834), and previously issued biological opinions (notably NMFS 2008a and 2012a) to summarize the status of the species.

Life history

This DPS includes both winter- and summer-run steelhead. In the Mad and Eel Rivers, immature steelhead may return to freshwater as "half-pounders" after spending only two to four months in the ocean. Generally, a half-pounder will overwinter in freshwater and return to the ocean in the following spring. Juvenile out-migration appears more closely associated with size than age; though juveniles generally, throughout their range in California, spend two years in freshwater. Smoltification occurs when they are between 14 to 21 cm in length.

Population dynamics

Historically, this DPS encompassed 42 independent populations of winter-run steelhead (19 functionally independent and 23 potentially independent) and 10 independent populations of summer-run steelhead. All historic populations of winter-run salmon are extant. Of the 10 summer-run steelhead populations, four are extant and six are assumed to be either extirpated or extremely depressed. Long-term data sets are limited for the Northern California steelhead. Prior to 1960, estimates of abundance specific to this DPS were available from dam counts. Cape Horn Dam in the upper Eel River reported annual average numbers of adults as 4,400 in the 1930s); Benbow Dam in the South Fork Eel River reported annual averages of 19,000 in the 1940s; and the Sweasey Dam in the Mad River reported annual averages of 3,800 in the 1940s. Estimates of steelhead spawning populations for many rivers in this DPS totaled 198,000 by the mid-1960s. For winter-run populations that have had recent counts, returns have not exceeded more than a few hundred fish, with the exception of a portion of the Gualala River population (counts of adult steelhead have averaged 1,915 fish) and at the Mad River Hatchery (average of 2,300 adults). The only summer-run steelhead population with a comprehensive time series of abundance is the Middle Fork Eel River, which has been monitored since the mid-1960s. Counts have averaged 780 fish over the period of record and 609 fish in the past 16 years. Both short-term and long-term trends are negative, though not significantly.

Status

NMFS listed Northern California steelhead as threatened on June 7, 2000 (65 FR 36074), and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (i.e., destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific issue of the introduction of a salmonid predator, the Sacramento pikeminnow (formerly known as Sacramento squawfish [Ptychocheilus grandis], and concern about the influence of hatchery stocks on native fish (i.e., genetic introgression and ecological interactions). Overall, spatial structure of the DPS is relatively intact and all diversity strata appear to be represented by extant populations. However, spatial structure and distribution within most watersheds has been adversely affected by barriers and high water temperatures. The scarcity of time series of abundance at the population level spanning more than a few years hinders assessment of the DPS's status; population level estimates of abundance are available for four of the 42 winter-run populations and for one of the 10 summer-run populations. Trend information from the available datasets suggests a mixture of patterns, with slightly more populations showing declines than increases, though few of these trends are statistically significant. Where population level estimates of abundance are available, only the Middle Fork Eel River summer-run populations are considered to have a low-risk of extinction. The remaining populations for which adult abundance has been estimated appear to be at either moderate- or high-risk of extinction. Although surveys within the summer-run steelhead watersheds do not encompass all available summer habitats, the chronically low numbers observed during surveys suggest that those populations are likely at high risk of extinction. The high number of hatchery fish in the Mad River basin, coupled with uncertainty regarding relative abundances of hatchery and wild spawners is also of concern. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

Critical habitat

Designated critical habitat for the Northern California steelhead DPS includes the following CALWATER hydrological units: Redwood Creek, Trinidad, Mad River, Eureka Plain, Eel River, Cape Mendocino, and the Mendocino Coast. The total area of critical habitat includes about 3,000 miles of stream habitat and about 25 square miles of estuarine habitat, mostly within Humboldt Bay. The current condition of designated critical habitat is moderately degraded. Portions of the rearing PCE, especially the interior Eel River, are affected by elevated temperatures from riparian vegetation removal. Spawning PCE attributes (i.e., the quality of substrate that supports spawning, incubation, and larval development) have been generally degraded throughout designated critical habitat by silt and sediment fines. The adult migration PCE function has been reduced by bridges and culverts that restrict access to tributaries in many watersheds, especially in watersheds with forest road construction.

4.2.6.6 Puget Sound steelhead

Species description

This Puget Sound DPS includes all naturally-spawned anadromous winter-run and summer-run steelhead in the river basins of Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington. The DPS is bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive). Hatchery production of steelhead is widespread throughout the DPS, but only two artificial propagation programs are included in the DPS. On June 26, 2013, NMFS proposed to change the number of artificial propagation programs included in the DPS to six (78 FR 38270). We used information available in status reviews (NMFS 2005, NMFS 2007c, Ford 2011, NMFS 2011e), the recovery outline (NMFS

2013b), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

The Puget Sound steelhead DPS contains both winter-run and summer-run steelhead, but is dominated by winter-run fish. Adult winter-run steelhead generally return to Puget Sound tributaries from December to April. Spawning occurs from January to mid-June and peaks from mid-April through May. Less information exists for summer-run steelhead as their smaller run size and higher altitude headwater holding areas have not been conducive for monitoring. Based on information from four streams, adult run time occurs from mid-April to October with a higher concentration from July to September. The majority of juveniles reside in the river system for two years with a minority migrating to the ocean as one or three-year olds. Smoltification and seaward migration occur from April to mid-May. Puget Sound steelhead spend one to three years in the ocean before returning to freshwater (Busby, et al., 1996). Due to the protection of the fjord-like marine environment of Puget Sound, juveniles and adults may hold there during emigration and immigration.

Population dynamics

Fifty-three populations of steelhead have been identified in this DPS, of which 37 are winter-run. In the early 1980s, run size for this DPS was calculated at about 100,000 winter-run fish and 20,000 summer-run fish. Available data for calculating abundance and trends are not comprehensive for the DPS, primarily represent winter-run steelhead populations, and date from 1985. Since 1985 Puget Sound winter-run steelhead abundance has shown a widespread declining trend over much of the DPS. Four of the 16 winter-run populations evaluated exhibit estimates of long-term population positive growth rates, only one significantly. Thirteen winter-run steelhead populations have sufficient data to determine recent annual abundances (2005 to 2009). Of the 13 populations, two have geometric mean abundances greater than 4,500 fish annually. The remaining populations have low geometric mean abundances; none exceeds 1,000 fish annually and only two populations exceed 500 fish annually.

Status

NMFS listed Puget Sound steelhead as threatened on May 11, 2007 (72 FR 26722). Factors contributing to the listing of this DPS include habitat loss and degradation from damming, agricultural practices, and urbanization; historic overexploitation; predation; poor oceanic and climatic conditions; and impacts from artificial propagation. Spatial structure, complexity, and connectivity have been reduced throughout the DPS. Most populations of steelhead in Puget Sound have declining estimates of mean population growth rates (typically 3 to 10 percent annually) and extinction risk within 100 years for most populations is estimated to be moderate to high. Effects of hatchery fish on the natural populations remain unknown. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

4.2.6.7 Snake River steelhead

Species description and distribution

The Snake River basin steelhead DPS includes all naturally spawned steelhead populations below natural and man-made impassable barriers in streams in the Columbia River Basin upstream from the Yakima River, Washington, to the U.S./Canada border. Six artificial propagation programs are also included in the DPS. We used information available in status reviews (Good et al. 2005, NMFS 2011c; Ford 2011), listing documents (62 FR 43937, 71 FR 834), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

Snake River basin steelhead are generally classified as summer-run fish. They return to the Columbia River from late June to October and spawn the following spring (March to May). Two life history patterns are recognized within the DPS, primarily based on ocean age and adult size upon return: A-run and B-run. A-run steelhead are typically smaller, have shorter freshwater and ocean residences (generally one year in the ocean), and begin their up-river migration earlier in the year. B-run steelhead are larger, spend more time in freshwater and the ocean (generally two years in ocean), and appear to start upstream migration later in the year. Snake River basin steelhead smoltification usually occurs at two to three years of age.

Population dynamics

The Interior Columbia Technical Review Team identified six historical major population groups in the Snake River steelhead DPS: Clearwater River, Salmon River, Grande Ronde River, Imnaha River, Lower Snake River, and Hells Canyon Tributaries. The Hells Canyon population is now extirpated; construction of Hells Canyon Dam blocked passage of upstream of the dam. The five extant major population groups support 24 extant independent populations (Interior Columbia Technical Review Team 2008). Population data are lacking for the Snake River steelhead DPS. Annual return estimates are limited to counts of the aggregate return (both A-run and B-run steelhead) over Lower Granite Dam, estimates for two populations in the Grande Ronde major population group, and index area or weir counts for portions of several other populations. The recent geometric five-year mean abundance (2003 to 2008) for Lower Granite Dam was 18,847 natural-origin returning adults. This natural origin return average represented 10 percent of total returns (of both natural and artificial origin fish) over Lower Granite Dam. The previous five-year geometric mean abundance (1997 to 2001) was 10,693 natural-origin returning adults and represented 13 percent of total returns. The five-year periods for the two Grande Ronde populations for which population-level abundance data series are available are the same as above. The recent five-year geometric mean abundance of natural origin steelhead for the Joseph Creek population was 1,925 fish compared to 2,134 fish for the previous five-year period. These returns are made up entirely of natural origin fish. The recent five-year geometric mean abundance of natural origin steelhead for the Upper Grande Ronde River was 1,425 fish compared to 1,332 fish for the previous five-year period. The returns represent 99 and 76 percent of total returns, respectively.

Status

NMFS listed Snake River Basin steelhead as threatened on August 18, 1997 (62 FR 43937), and re-affirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (i.e., destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), and, more specifically, widespread habitat blockage from hydrosystem management and potentially deleterious genetic effects from straying and introgression from hatchery fish. The level of natural production in the two populations with full data series and one of the index areas is encouraging, but the status of most populations in the DPS remains highly uncertain. The DPS is not currently considered to be viable due to high risk population ratings, uncertainty about the viability status of many populations, and overall lack of population data. A great deal of uncertainty remains regarding the relative proportion of hatchery fish in natural spawning areas near major hatchery release sites. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

Critical habitat

Designated critical habitat for the Snake River Basin steelhead DPS includes the following subbasins: Hells Canyon, Imnaha River, Lower Snake/Asotin, Upper Grand Ronde River, Wallowa River, Lower Grand Ronde, Lower Snake/Tucannon, Upper Salmon, Pahsimeroi, Middle Salmon-Panther, Lemhi, Upper Middle Fork Salmon, Lower Middle Fork Salmon, Middle Salmon, South Fork Salmon, Lower Salmon, Little Salmon, Upper and Lower Selway, Lochsa, Middle and South Fork Clearwater, and the Clearwater subbasins, and the Lower Snake/Columbia River corridor. The current condition of critical habitat designated for Snake River basin steelhead is moderately degraded. Critical habitat is affected by reduced quality of juvenile rearing and migration PCEs within many watersheds. Contaminants from agriculture affect both water quality and food production in several watersheds and in the mainstem Columbia River. Loss of riparian vegetation to grazing has resulted in high water temperatures in the John Day basin. These factors have substantially reduced the rearing PCEs' contribution to the conservation value necessary for species recovery. Several dams affect adult migration PCE by obstructing the migration corridor.

4.2.6.8 South-Central California Coast steelhead

Species description

The South-central California coast steelhead DPS includes all naturally spawned steelhead populations in streams from the Pajaro River watershed (inclusive) to, but not including, the Santa Maria River, (71 FR 5248) in northern Santa Barbara County, California. There are no artificially propagated steelhead stocks within the range of the DPS. We used information available in status reviews (Busby et al. 1996, Good et al. 2005; NMFS 2011l, Williams et al. 2011), the recovery plan (NMFS 2013c), "Steelhead of the South-central/Southern California coast: population characterization for recovery planning" (Boughton et al. 2006), "Viability criteria for steelhead of the South-central and Southern California Coast" (Boughton et al. 2007), listing documents (61 FR 41541, 62 FR 43937; 71 FR 834), and previously issued biological opinions (notably NMFS 2012a and 2013d) to summarize the status of the species.

Life history

NMFS recognizes two life-history types of winter-run steelhead in the South-central California coast DPS: fluvial-anadromous and lagoon-anadromous. Freshwater resident steelhead (rainbow trout) are not included in the DPS. Fluvial-anadromous fish spend one or two summers (occasionally more) in freshwater streams as juveniles, then smolt and migrate to the ocean, using the estuary only for acclimation to saltwater and as a migration corridor (and occasionally for spring feeding). Lagoon-anadromous fish spend either their first or second summer as juveniles in a seasonal lagoon at the mouth of a stream. Adults of both winter-run types spend two to three years in the ocean before returning to freshwater.

Population dynamics

The steelhead populations in this region have declined dramatically from estimated annual runs totaling 27,000 adults near the turn of the 19th century to approximately 4,740 adults in 1965, with a large degree of inter-annual variability. These run-size estimates are based on information from only five major watersheds in the northern portion of the DPS. Run-size estimates from coastal and inland watersheds south of the Big Sur have not been estimated or recorded. Only one population in the DPS has sufficient data to compute a trend for adult escapement, the Carmel River above San Clemente Dam. This population experienced a decline of 22 percent per year from 1963 to 1993 and an average five-year adult count of 16 adult spawners. The most recent counts (2012 to 2013) in the Carmel River indicate 452 adults at the San Clemente Dam and 204 adults at the Los Padres Dam.

Status

NMFS listed South-Central California Coast steelhead as threatened August 18, 1997 (62 FR 43937), and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (i.e., destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific concerns about genetic effects from widespread stocking of rainbow trout. The DPS consists of 12 discrete sub-populations which represent localized groups of interbreeding individuals. None of these sub-populations are considered to be viable. Most of the sub-populations are characterized by low population abundance, variable or negative population growth rates, and reduced spatial structure and diversity. Though steelhead are present in most streams in the DPS, their populations are small, fragmented, and unstable, or more vulnerable to stochastic events. In addition, severe habitat degradation and the compromised genetic integrity of some populations pose a serious risk to the survival and recovery of the DPS. The DPS is in danger of extinction. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

Critical habitat

Designated critical habitat for the South-Central California coast steelhead DPS includes the following CALWATER hydrological units: Pajaro River, Carmel River, Santa Lucia, Salinas River and Estero Bay. Migration and rearing PCEs are degraded throughout designated critical habitat by elevated stream temperatures and contaminants from urban and agricultural areas. The estuarine PCE is impacted due to breaching of estuarine areas, removal of structures, and contaminants.

4.2.6.9 Southern California steelhead

Species description and distribution

The Southern California Steelhead DPS includes all naturally spawned populations of steelhead in streams from the Santa Maria River, San Luis Obispo County, California (inclusive) to the U.S.-Mexico Border (62 FR 43937; 67 FR 21586). No artificially propagated steelhead stocks are currently recognized within the range of the DPS; however, two artificial propagation programs, the Don Clausen Fish Hatchery and the Kingfisher Flat Hatchery (Monterey Bay Salmon and Trout Project) have been proposed for inclusion in the DPS, as they were inadvertently omitted from the original listing (78 FR 38270). We used information available in status reviews (Busby et al. 1996, Good et al. 2005; NMFS 2011m, Williams et al. 2011), the recovery plan (NMFS 2012c), "Contraction of the southern range limit for anadromous Oncorhynchus mykiss" (Boughton et al. 2005), listing documents (62 FR 43937; 71 FR 834), and previously issued biological opinions (notably NMFS 2012a and 2013e) to summarize the status of the species.

Life history

Life history of the Southern California Steelhead is similar to that of the South-Central California Coast steelhead.

Population dynamics

Limited information exists for Southern California steelhead runs. Run -size estimates from coastal and inland watersheds south of the Los Angeles Watershed have generally not been estimated or recorded and no long term (greater than 20 years) time series are available for any of the populations. Based on combined estimates for only four major watersheds in the northern portion of the DPS, steelhead runs declined from estimated historic levels of 32,000 to 46,000 adults to less than 500 adults in 1996. More recent counts from various monitoring locations in the DPS have reported very small runs of less than 10 fish, with the exception of a monitoring location in Santa Ynez River that reported 16 adults in 2008.

Status

NMFS listed the Southern California steelhead as endangered on August 18, 1997 (62 FR 43937), and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (i.e., destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific concern about the widespread, dramatic declines in abundance relative to historical levels. Construction of dams and a corresponding increase in water temperatures have excluded steelhead distribution in many watersheds throughout southern California. Streams in southern California containing steelhead have declined over the last decade, with a southward proportional increase in loss of populations. Consequently, the DPS has experienced a contraction of its southern range. This range contraction affects the DPS's ability to maintain genetic and life history diversity for adaptation to environmental change. The 2005 status review concluded the chief causes for the DPS's decline include urbanization, water withdrawals, channelization of creeks, human-made barriers to migration, and the introduction of exotic fishes and riparian plants. The most recent status review indicates these threats are essentially unchanged and the species remains in danger of extinction. Based on these factors, this DPS would likely have a very low resilience to additional perturbations.

Critical habitat

Designated critical habitat for the Southern California steelhead DPS includes the following CALWATER hydrological units: Santa Maria River, Santa Ynez, South Coast, Ventura River, Santa Clara Calleguas, Santa Monica Bay, Callequas and San Juan hydrological units. All PCEs have been affected by degraded water quality by pollutants from densely populated areas and agriculture within the DPS. Elevated water temperatures impact rearing and juvenile migration PCEs in all river basins and estuaries. Rearing and spawning PCEs have been affected throughout the DPS by water management or reduction in water quantity. The spawning PCE has been affected by the combination of erosive geology features and land management activities that have resulted in excessive fines in spawning gravel of most rivers.

4.2.6.10 Upper Columbia River steelhead

Species description and distribution

The Upper Columbia River steelhead DPS includes all naturally spawned steelhead populations below natural and man-made impassable barriers in streams in the Columbia River basin upstream from the Yakima River, Washington, to the U.S.-Canada border. The DPS also includes six artificial propagation programs. We used information available in status reviews (Good et al. 2005, NMFS 2011n; Ford 2011), the recovery plan (Upper Columbia Salmon Recovery Board 2007), listing documents (62 FR 43937; 71 FR 834; 74 FR 42605), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

All Upper Columbia River steelhead are summer-run fish. Adults return in the late summer and early fall. Most adults migrate quickly to their natal tributaries, though a portion of returning adults overwinter in mainstem reservoirs, beyond upper-mid-Columbia dams in April and May of the following year. Spawning occurs in the late spring of the year following river entry. Juvenile steelhead spend one to seven years rearing in freshwater before migrating to sea. Smolt emigrate primarily at ages two and three, though some smolts in the DPS have been reported at ages up to seven. Most adult steelhead return to freshwater after one or two years in the ocean.

Population dynamics

The Upper Columbia River steelhead consists of five historic independent populations, four of which are extant (Wenatchee, Entiat, Methow, and Okanogan) and one that is functionally extinct (Crab Creek). Two additional major population groups likely existed prior to the construction of Grand Coulee and Chief Joseph dams. No direct counts of adult steelhead in the DPS are available before dam construction. Estimates of spawning escapement for all four extant populations are available through the 2008/2009 cycle year, along with preliminary estimates of the aggregate counts over Priest Rapids Dam for the 2009/2010 cycle year. The most recent five-year geometric mean abundance (2005 to 2009) of natural origin fish ranges from 116 to 819 adults in the four populations and is 3,604 adults for the aggregate count. These abundances represent nine to 47 percent of total spawner abundances (natural origin and hatchery origin). The most recent 5-year average of percent of natural origin fish for the aggregate count is 19 percent.

Status

NMFS originally listed Upper Columbia River steelhead as endangered on August 18, 1997 (62 FR 43937). NMFS changed the listing to threatened on January 5, 2006 (71 FR 834). After litigation resulting in a change in the DPS' status to endangered and then again to threatened. On August 24, 2009, NMFS reaffirmed the species' status as threatened (74 FR 42605). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (i.e., destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific issues of extremely low estimates of adult replacement ratios, habitat degradation, juvenile and adult mortality in the hydrosystem, unfavorable marine and freshwater environmental conditions, overharvest, and genetic homogenization from composite broodstock collections. Though steelhead in the DPS must pass over several dams to access spawning areas, three of the four populations are rated as low risk for spatial structure. The proportions of hatchery-origin returns in natural spawning areas remain extremely high across the DPS and continue to be a major concern. Though there has been an increase in abundance and productivity for all populations, the improvements have been minor, and none of the populations meet recovery criteria. All populations remain at high risk of extinction and the DPS, as a whole, is not viable. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

Critical habitat

Designated critical habitat for the Upper Columbia River steelhead DPS includes the following subbasins: Chief Joseph, Okanogan, Similkameen, Methow, Upper Columbia/Entiat, Wenatchee, Lower Crab, and the Upper Columbia/Priest Rapids subbasins, and the Columbia River corridor. Currently, designated critical habitat is moderately degraded. Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development. The water quality and food production features of juvenile rearing and migration PCEs in several watersheds and the mainstem Columbia River have been degraded by contaminants from agriculture. Several dams affect the adult migration PCE by obstructing the migration corridor.

4.2.6.11 Upper Willamette River steelhead

Species description

The Upper Willamette River (UWR) steelhead DPS includes all naturally spawned winter-run steelhead populations below natural and manmade impassable barriers in the Willamette River, Oregon, and its tributaries upstream from Willamette Falls to the Calapooia River (inclusive). No artificially propagated populations are included in the DPS. Hatchery summer-run steelhead occur in the Willamette Basin, but they are an out-of-basin population and not included in the DPS. We used information available in status reviews (Busby et al. 1996; Good et al. 2005, NMFS 2011d; Ford et al. 2011), the recovery plan (Oregon Department of Fish and Wildlife and NMFS 2011), listing documents (64 FR 14517; 71 FR 834), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Life history

Native steelhead in the Upper Willamette are late-migrating winter-run fish. Steelhead enter freshwater in January and February (Howell et al. 1985), but do not ascend to spawning areas until late March or April, later than other winter-run steelhead. Spawning occurs from April to June. The majority of juveniles smolt and emigrate after two years. Peak smolt emigration past Willamette Falls occurs from early April to early June, with a peak in early- to mid-May (Howell et al. 1985). Smolts generally migrate through the Columbia River via Multnomah Channel rather than the mouth of the Willamette River. Most adults return to fresh water after spending two years in the ocean.

Population dynamics

Four basins on the east side of the Willamette River historically supported independent steelhead populations, all of which remain extant. There is intermittent spawning and rearing in tributaries on the west side of the Willamette River, but these areas are not considered to be independent populations. Because native winter-run steelhead also return outside of the DPS boundaries, Willamette Falls counts represent the best estimate for the DPS abundance. The average number of steelhead passing Willamette Falls in the 1990s was less than 5,000 fish. The number increased to over 10,000 fish in 2001 and 2002. The geometric and arithmetic mean number of steelhead passing Willamette Falls for the period 1998 to 2001 were 5,819 and 6,795 fish, respectively. More recent abundances have declined. The total abundance of steelhead at Willamette Falls in 2008 was 4,915 adults. In 2009, the abundance was 2,110 fish.

Status

NMFS originally listed Upper Willamette steelhead as threatened on March 25, 1999 (64 FR 14517), and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (i.e., destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific issues of damming, water diversions, poor ocean conditions and overharvest. Though access to historical spawning grounds has been lost behind dams, the DPS remains spatially well-distributed. Three populations are considered to be in the moderate to high risk category for spatial structure and one is in the low risk category. The DPS continues to demonstrate an overall low abundance pattern. The elimination of winter-run hatchery releases reduces threats from artificial propagation, but non-native summer steelhead hatchery releases are still a concern. Human population growth within the Willamette Basin continues to be a significant risk factor for the populations. This DPS remains at a moderate risk of extinction. Based on these factors, this DPS would likely have a moderate resilience to additional perturbations.

Critical habitat

Designated critical habitat for the Upper Willamette River steelhead DPS includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Willamette River and specific stream reaches in the sub-basins: Upper Willamette, North Santiam, South Santiam, Middle Willamette, Molalla/Pudding, Yamhill, Tualatin, and Lower Willamette. Designated critical habitat is currently degraded. The water quality and food production features of juvenile rearing and migration PCEs in several watersheds and the mainstem Columbia River have been degraded by contaminants from agriculture. Several dams affect the adult migration PCE by obstructing the migration corridor.

4.2.7 Pacific eulachon

Species description and distribution

The southern population of Pacific eulachon was listed as threatened on March 18, 2010 (75 FR 13012). Eulachon are small smelt native to eastern North Pacific waters from the Bering Sea to Monterey Bay, California, or from 61º N to 31º N (Eschmeyer et al. 1983; 1944; Hay and McCarter 2000; Minckley et al. 1986). Eulachon that spawn in rivers south of the Nass River of British Columbia to the Mad River of California comprise the southern population of Pacific eulachon. This species is designated based upon timing of runs and genetic distinctions (Beacham et al. 2005; Hart and McHugh 1944; Hay and McCarter 2000; McLean et al. 1999; McLean and Taylor 2001).

Life history

Adult eulachon are found in coastal and offshore marine habitats (Allen and Smith 1988; Hay and McCarter 2000; Willson et al. 2006). Larval and post larval eulachon prey upon phytoplankton, copepods, copepod eggs, mysids, barnacle larvae, worm larvae, and other eulachon larvae until they reach adult size (WDFW and ODFW 2001). The primary prey of adult eulachon are copepods and euphausiids, malacostracans and cumaceans (Barraclough 1964; Drake and Wilson 1991; Hay and McCarter 2000; Smith and Saalfeld 1955; Sturdevant et al. 1999).

Although primarily marine, eulachon return to freshwater to spawn. Adult eulachon have been observed in several rivers along the west coast (Emmett et al. 1991; Jennings 1996; Larson and Belchik 2000; Minckley et al. 1986; Moyle 1976; Musick et al. 2000; Odemar 1964; WDFW and

ODFW 2001; Wright 1999). For the southern population of Pacific eulachon, most spawning is believed to occur in the Columbia River and its tributaries as well as in other Oregonian and Washingtonian rivers (Emmett et al. 1991; Musick et al. 2000; WDFW and ODFW 2001). Eulachon take less time to mature and generally spawn earlier in southern portions of their range than do eulachon from more northerly rivers (Clarke et al. 2007).

Spawning is strongly influenced by water temperatures, so the timing of spawning depends upon the river system involved (Willson et al. 2006). In the Columbia River and further south, spawning occurs from late January to March, although river entry occurs as early as December (Hay and McCarter 2000). Further north, the peak of eulachon runs in Washington State is from February through March while Alaskan runs occur in May and river entry may extend into June (Hay and McCarter 2000). Females lay eggs over sand, course gravel or rocky substrate. Eggs attach to gravel or sand and incubate for 30 to 40 days after which larvae drift to estuaries and coastal marine waters (Wydoski and Whitney 1979a).

Eulachon generally die following spawning (Scott and Crossman 1973). The maximum known lifespan is 9 years of age, but 20 to 30% of individuals live to 4 years and most individuals survive to 3 years of age, although spawning has been noted as early as 2 years of age (Barrett et al. 1984; Hay and McCarter 2000; Hugg 1996; WDFW and ODFW 2001; Wydoski and Whitney 1979b). The age distribution of spawners varies between river and from year-to-year (Willson et al. 2006).

Population dynamics

The southern population of Pacific eulachon was listed as threatened on March 18, 2010 (75 FR 13012). It is considered to be at moderate risk of extinction throughout its range because of a variety of factors, including predation, commercial and recreational fishing pressure (directed and bycatch), and loss of habitat. Further population decline is anticipated to continue as a result of climate change and bycatch in commercial fisheries. However, because of their fecundity, eulachon are assumed to have the ability to recover quickly if given the opportunity (Bailey and Houde 1989).

Eulachon formerly experienced widespread, abundant runs and have been a staple of Native American diets for centuries along the northwest coast. However, such runs that were formerly present in several California rivers as late as the 1960s and 1970s (i.e., Klamath River, Mad River and Redwood Creek) no longer occur (Larson and Belchik 2000). This decline likely began in the 1970s and continued until, in 1988 and 1989, the last reported sizeable run occurred in the Klamath River and no fish were found in 1996, although a moderate run was noted in 1999 (Larson and Belchik 2000; Moyle 2002). Eulachon have not been identified in the Mad River and Redwood Creek since the mid-1990s (Moyle 2002).

Critical habitat

Critical habitat has been designated for the southern population of Pacific eulachon (76 FR 65323). The designated areas are a combination of freshwater creeks and rivers and their associated estuaries, comprising approximately 539 km (335 miles) of habitat. The physical or biological features essential to the conservation of the DPS include:

1. Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation, and with migratory access for adults and juveniles. These features are essential to conservation because without them the species cannot successfully spawn and produce offspring.
2. Freshwater and estuarine migration corridors associated with spawning and incubation sites that are free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted. These features are essential to conservation because they allow adult fish to swim upstream to reach spawning areas and they allow larval fish to proceed downstream and reach the ocean.
3. Nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival. Eulachon prey on a wide variety of species including crustaceans such as copepods and euphausiids (Hay and McCarter, 2000; WDFW and ODFW, 2001), unidentified malacostracans (Sturdevant, 1999), cumaceans (Smith and Saalfeld, 1955) mysids, barnacle larvae, and worm larvae (WDFW and ODFW, 2001). These features are essential to conservation because they allow juvenile fish to survive, grow, and reach maturity, and they allow adult fish to survive and return to freshwater systems to spawn.

4.2.8 Green sturgeon

Species description and distribution

Green sturgeon have been listed as two separate DPSs, with the Southern DPS listed as threatened (71 FR 17757; April 7, 2006). The Southern DPS consists of populations south of the Eel River (Humboldt, CA), coastal and Central Valley populations, and the spawning population in the Sacramento River, CA. On June 2, 2010, NMFS issued a 4(d) Rule for the Southern DPS, applying certain take prohibitions (75 FR 30714).

Green sturgeon occur in coastal Pacific waters from San Francisco Bay to Canada. The Southern DPS of green sturgeon includes populations south of (and exclusive of) the Eel River (Adams et al. 2007). We used information available in the 2002 Status Review and 2005 Status Review Update (GSSR 2002, 2005), and the proposed and final listing rules (70 FR 17836; 71 FR 17757) to summarize the status of the species, as follows.

Life history

As members of the family Acipenseridae, green sturgeon share similar reproductive strategies and life history patterns with other sturgeon species; see discussion for shortnose sturgeon above. The Sacramento River is the location of the single, known spawning population for the green sturgeon Southern DPS (Adams et al. 2007). Green sturgeon have relatively large eggs compared to other sturgeon species (4.34mm) and grow rapidly, reaching 66mm in three weeks. Generally, sturgeon are benthic omnivores, feeding on benthic invertebrates that are abundant in the substrate in that area. Little is known specifically about green sturgeon foraging habits; generally, adults feed upon invertebrates like shrimp, mollusks, amphipods and even small fish, while juveniles eat opossum shrimp and amphipods. Juvenile green sturgeon spend 1-3 years in freshwater, disperse widely in the ocean, and return to freshwater as adults to spawn (about age 15 for males, age 17 for females).

Population dynamics

Trend data for green sturgeon is severely limited. Available information comes from two predominant sources, fisheries and tagging. Only three data sets were considered useful for the population time series analyses by NMFS' biological review team: the Klamath Yurok Tribal fishery catch, a San Pablo sport fishery tag returns, and Columbia River commercial landings. Using San Pablo sport fishery tag recovery data, the California Department of Fish and Game produced a population time series estimate for the southern DPS. San Pablo data suggest that green sturgeon abundance may be increasing, but the data showed no significant trend. The data set is not particularly convincing, however, as it suffers from inconsistent effort and since it is unclear whether summer concentrations of green sturgeon provide a strong indicator of population performance. Although there is not sufficient information available to estimate the current population size of southern green sturgeon, catch of juveniles during state and federal salvage operations in the Sacramento delta are low in comparison to catch levels before the mid-1980s.

The 5 Year Status Review for the Southern DPS was initiated in 2012 (77 FR 64959). Loss of spawning habitat and bycatch in the white sturgeon commercial fishery are two major causes for the species decline. Current threats to the Southern DPS include reduction in spawning habitat (mostly from impoundments), entrainment by water projects, contaminants, incidental bycatch and poaching. Given the small population size, the species' life history traits (e.g., slow to reach sexual maturity), and that the threats to the population are likely to continue into the future, we conclude that the Southern DPS is not resilient to further perturbations.

Critical habitat

Green sturgeon critical habitat for the Southern DPS was designated on October 9, 2009 (74 FR 52300), including coastal U.S. marine waters within 60 fathoms deep from Monterey Bay, CA to Cape Flattery, WA, including the Strait of Juan de Fuca, and numerous coastal rivers and estuaries: see the Final Rule for a complete description (74 FR 52300). Food resources were identified as a primary constituent element.

5 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).

5.1 BLM's Current Vegetation Treatment Program

BLM's current vegetation treatment program (considered in the 2007 opinion) includes a process to determine site and area specific vegetation treatments and the methods used for vegetation treatments, as well as allowing for considerations to instill protective measures for ESA-listed species and designated critical habitat into that process. The current vegetation treatment program uses prescribed fire, mechanical and manual methods, biological control agents, and herbicides containing 18 approved AIs. A more detailed account of the processes involved in the herbicide portion of the vegetation treatment program can be found in the Description of the Proposed Action Section 2.1.

In order to implement other methods in the vegetation management plan (i.e., prescribed fire, mechanical methods, etc.), BLM developed Land Use Plans. Land Use Plans outline the general resource goals and objectives based on desired future conditions for BLM-administered lands, land use allocations, and land health standards and associated guidelines on how to meet those standards. Activity Level Plans design and select the vegetation treatment methods consistent with the national treatment program to achieve the objectives of the Land Use Plans. Activity Level Plans require inventories of the land including sensitive habitat and species (including ESA-listed, candidate, or proposed species).

Site-specific vegetation treatments are designed to meet Land Use Plan goals, and include SOPs and protective measures (see section 2.1.5) that are selected and designed at the Activity Level planning stage and carried out when the Project level activities are conducted.

5.2 Ongoing Implementation of Federal Programs in the Action Area

BLM's current herbicide treatment program is managed under the authority of and in compliance with multiple statutes, executive orders, regulations and policies that either directly or indirectly mandate protections for ESA-listed species and designated critical habitat. These statutes, regulations and policies provide the standards (i.e., anti-degradation or conservation) by which ESA-listed species and critical habitat are protected generally during BLM's management of the public lands and specifically during implementation of the vegetation treatment program.

It is important to discuss the integration of these various Federal laws and policies by BLM as part of the Environmental Baseline and in a programmatic context to demonstrate that there are numerous mechanisms by which BLM must consider the environmental consequences of its ongoing action—implementing its vegetation treatment program. The addition of three new AIs—the proposed action—would be subject to all the same laws and policies that regulate the current vegetation treatment program.

5.2.1.1 Federal Land Policy and Management Act of 1976

The Federal Land Policy and Management Act of 1976 requires that public lands under BLM's jurisdiction are managed for a variety of uses, including recreation, grazing, timber harvesting, and energy and mineral development, while at the same time ensuring that important environmental (e.g., ESA-listed species), historic, cultural, and scenic values are protected. The Federal Land Policy and Management Act also provides BLM's statutory duty to prevent unnecessary degradation of the public lands.

5.2.1.2 National Environmental Policy Act

BLM must conduct reviews of its actions at all levels of planning, meaning that the Land Use Plans, Activity Level Plans, and Project Level Activities (i.e., site-specific activities) all undergo National Environmental Policy Act review. BLM prepared a programmatic Environmental Impact Statement in 2007 on its vegetation treatment program (BLM 2007a), and a draft programmatic environmental impact statement for the three proposed AIs is currently out for public comment[9]. Part of the National Environmental Policy Act review process includes examining the effects of the Federal action on the biological environment, which can include ESA-listed species and designated critical habitat.

5.2.1.3 Federal Insecticide Fungicide and Rodenticide Act and BLM Internal Guidance

BLM conducts its use of herbicides in accordance with FIFRA, which regulates the registration, sale and use of pesticides. FIFRA's purpose is to protect against any unreasonable risks to humans or the environment by taking into account the economic, social and environmental costs and benefits of the use of any pesticide. All AIs on the list of currently approved herbicides for use in BLM's vegetation management program are registered with EPA (as are the three AIs proposed for use and being considered in this Opinion). Labeling instructions which specify proper uses of herbicides to protect the environment are required to be followed in accordance with FIFRA. Also, FIFRA dictates that all requirements for the proper storage, transport and disposal of the herbicide must be followed.

FIFRA directs federal agencies to implement an integrated pest management approach in the design of pest management strategies. Pest management is a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health, and environmental risks. BLM Manual 9011 and Handbook H-9011-1 provide policy for conducting the vegetation management methods in accordance with the integrated pest management approach. The Manual and Handbook contain several requirements that pertain to the protection of the environment. The integrated pest management approach specifies that all vegetation management methods including but not limited to prevention, education, biological, cultural, mechanical, and chemical methods are to be explored. If there are a variety of viable alternatives, the most cost-effective methods shall be chosen. All proposed uses of chemical pest control methods are reviewed and studied thoroughly to evaluate the need for such uses and to

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[9] http://www.blm.gov/wo/st/en/prog/more/vegeis.html

determine the possible impacts each method may have on the ecosystem, and on the total environment. Definite boundaries for the treatment area and buffer strips along streams and other sensitive areas are established. Treated areas are to be monitored for changes over a period of time from the introduced chemicals in various parts of the environment.

5.2.1.4 Endangered Species Act and BLM Internal Guidance

BLM delineates its national guidance in the protection and management of ESA-listed species and their habitat (as well as other species of concern) in Manual 6840-Special Status Species Management. Manual 6840 reflects the purpose, policy and mandates of the ESA to use BLM's existing authority to further the purposes of the ESA to conserve ESA-listed species and the ecosystems upon which they depend. In addition, actions authorized by BLM shall further the conservation of federally listed and other special status species under the provisions of the ESA, or designate additional special status (or sensitive) species. A "sensitive species" could refer to a species that is a candidate for listing, or proposed for listing under the ESA, one that is listed by a State as threatened or endangered, or one that is designated as sensitive by a BLM State Director.

5.2.1.5 Clean Water Act

The Clean Water Act requires the restoration and maintenance of the chemical, physical and biological integrity of the waters of the U.S. The Clean Water Act regulates discharges into the waters of the U.S. (including wetlands) while considering the improvements necessary to provide waters of sufficient quality for public water supplies, propagation of fish and aquatic life, recreational purposes, and agricultural and industrial uses. The Clean Water Act requires that all of BLM's Land Use Plans be consistent with state water quality standards and that the BLM submit the Land Use Plans for state review. States develop water quality standards, and they are submitted to the Environmental Protection Agency for approval. Approving water quality standards is considered a federal action, and thus formal consultation under section 7(a)(2) of the ESA must be conducted.

5.2.1.6 Executive Orders

There have been at least two Executive Orders issued concerning the management of invasive species on federal lands, and the BLM is required to be in compliance with these Orders in implementing its vegetation treatment program.

Executive Order 11990 (42 FR 26961; May 24, 1977) requires federal agencies whose actions may affect the status of invasive species to use their programs to minimize the destruction, loss, or degradation of wetlands while preserving and enhancing their natural and beneficial values on federal property.

Executive Order 13112 (64 FR 6183; February 8, 1999) requires federal agencies whose actions may affect the status of invasive species to use their programs and authorities to:

- Prevent the introduction of invasive species,
- Detect and provide for their control in a cost-effective and environmentally-friendly manner,
- Provide for restoration of native species and habitat conditions,
- Minimize the economic, ecological and human health impacts that invasive species cause,
- Not authorize, fund, or carry out actions that are likely to introduce or spread invasive species unless:
  - The agency has determined that the benefits of such actions clearly outweigh the potential harm caused by invasive species.
  - That all feasible and prudent measures to minimize risk of harm to the environment will be taken in conjunction with those actions.

5.2.1.7 Impact of the Baseline for Ongoing Federal Activities

As is demonstrated in the preceding sections (5.1 and 5.2), BLM must comply with numerous federal environmental laws, regulations, and internal policies, each of which require consideration of ESA-listed resources when making decisions, developing policies or carrying out activities related to its vegetation treatment program.

5.3 Environmental Baseline for Ongoing Land Management Activities

The following section describes the environmental baseline for ongoing land management activities which can be found within the action area. This is meant to provide a description of the state of the administered lands that BLM is currently managing in its vegetation treatment program.

5.3.1 Hydrologic Changes

Watersheds are the natural divisions of the landscape and the basic functioning unit of hydrologic systems. Stream flow regimes and water quality can be affected by modifications to processes occurring from both natural disturbances and land management activities. Past land management activities on federally-administered lands in the western U.S. have contributed to the deterioration of wetlands and rangeland through timber harvest, grazing, recreational activities, energy extraction, and mining. Water quality and quantity are key components of wetland and riparian habitat and can also have substantial influence over the health of fish and other aquatic organisms (Dahl 2000).

Changes in hydrologic function have occurred as a result of changes in flow regimes due to dams, diversions, and surface water and groundwater withdrawal, and as a result of changes in channel geometry due to sedimentation and erosion, channelization, and constructions of roads.

Large amounts of wetland and riparian habitat, which function to cleanse water and recharge groundwater aquifers, have been lost in the western U.S. due to agriculture and urbanization, highlighting the need for riparian restoration (Kauffman et al. 1997).

5.3.2 Invasive Species

The rapid expansion of invasive species and build-up of hazardous fuels across public lands are threats to ecosystem health and one of the greatest challenges in ecosystem management. The spread of invasive plant species is one factor that degrades hydrologic function. Invasive species can be found in all taxonomic groups, from bacteria to mammals, and are second only to habitat destruction as a threat to global biodiversity (MOONEY and HOFGAARD 1999; Vitousek et al. 1996). Weed infestations are capable of destroying wildlife habitat, displacing many threatened and endangered species, and reducing plant and animal diversity. Riparian areas with invasive weeds often support fewer native insects than native species, which could affect food availability for insectivorous fish species such as salmonids. The replacement of native riparian plant species with invasive species may adversely affect stream morphology (including shading and instream habitat characteristics), bank erosion, and flow levels. The invasion of non-native plants has caused various impacts to ecosystems, including displacement and endangerment of native species, reduced site productivity, and degraded water quality (Pimentel et al. 2005; Zavaleta et al. 2001).

5.3.3 Wildfires

In addition, plant matter from invasive species can build up, creating hazardous fuels which can lead to catastrophic wildfires that adversely impact water resources and quality (Brooks et al. 2004). Changes in disturbance regimes, especially changes resulting from fire suppression, timber management practices, and livestock grazing over the past 150 years have resulted in the alteration of moderate to high levels of vegetation composition and structure and landscape mosaic patterns from historical ranges. On many rangelands, overgrazing by livestock in the late 19th and early 20th centuries reduced grass cover and scarified soil. Previously, wildland fire had maintained grasslands by rejuvenating decadent grasses and killing young woody species that might have seeded fire occurrences. The decrease in grass cover caused by overgrazing provided open sites for the establishment of woody species. Later in the 20th century, organized fire suppression further contributed to the invasion of grasslands by woody species and the increased density of woodlands and shrub lands. The impacts of various federal fire management practices can be variable, in some landscapes reducing invasive species, and in other promoting non-native invasion (Keeley 2006).

5.3.4 Pollution

New sources of pollution arose in the 20th century, including pollutants associated with agriculture, industry and other human activities (e.g., sewage, household cleaning products). Assessments conducted by EPA (Collins et al. 2001) on groundwater quality estimated that 21%

of the watersheds have serious problems. In the western U.S., watershed quality is poor to moderate over many areas due to total dissolved solids, primarily in areas associated with agricultural activities.

5.3.5 Habitat Loss

In addition to water quality and flow concerns, many wetlands and streams have lost the capability to support salmonids and other aquatic organisms. The direct and indirect effects of changes in land-use and land cover have had a lasting effect on the quantity, quality, and distribution of every major terrestrial, aquatic, and coastal ecosystem of the U.S. By the mid-1990s, at least 27 types of ecosystem had declined by more than 98% (Noss et al. 1995). More than 99% of the native prairies of Texas have been destroyed (Smith 1999). About 90% of the original 58 million hectares of tallgrass prairie had been destroyed; about 99% of the tallgrass prairie east of the Missouri River has been destroyed, and about 85% of the tallgrass prairie west of the Missouri River has been destroyed (Klopatek et al. 1979). The remaining tallgrass prairie exists in small fragments, supporting higher small mammal species diversity than upland woods or wooded streamside habitats (Payne 1999). Fragmentation and development of coastal redwood (*Sequoia sempervirens*) forests in California have impacted the habitat viability of streams for amphibians (Welsh Jr and Ollivier 1998). About 88.9% of the riparian forests of California's Central Valley have been lost (Barbour et al. 2007). Over 95% of the riparian and bottomland forests that once bordered the Sacramento River have been destroyed, and has been the subject of a large-scale restoration project since 1988 (Golet et al. 2006). Between 83-90% of the old-growth forests in the Douglass fir region of Oregon and Washington have been destroyed, likely causing changes to the fire regimes (Norse 1989; Spies et al. 1988; Wigley and Roberts 1994). Aquatic and semi-aquatic ecosystems have not fared much better than these terrestrial ecosystems. Between the 1780s and the 1980s, 30% of the nation's wetlands had been destroyed including 52% of the wetlands in Texas, 91% of all wetlands in California, including 94% of all inland wetlands (Barbour et al. 2007; Dahl 2000).

5.3.6 Climate Change

The Intergovernmental Panel on Climate Change (IPCC) estimated that average global land and sea surface temperature has increased by 0.85°C (± 0.2) since the late 1800s, with most of the change occurring since the mid-1900s (IPCC 2013). This temperature increase is greater than what would be expected given the range of natural climatic variability recorded over the past 1,000 years (Crowley and Berner 2001). The IPCC estimates that the last 30 years were likely the warmest 30-year period of the last 1,400 years, and that global mean surface temperature change will likely increase in the range of 0.3 to 0.7°C by about 2033.

The direct effects of climate change include increases in atmospheric temperatures, decreases in sea ice, and changes in sea surface temperatures, patterns of precipitation, and sea level. Indirect effects of climate change include altered reproductive seasons/locations, shifts in migration patterns, reduced distribution and abundance of prey, and changes in the abundance of competitors and/or predators. Climate change is most likely to have its most pronounced effects on species whose populations are already in tenuous positions (Williams et al. 2008), such as the ESA-listed species discussed in this opinion. The effects of climate change to specific species groups are discussed in more detail below.

5.3.7 Land Management Restoration Efforts

Beginning in the 1960s, a wide variety of programs undertaken by federal, state, and local governments, non-governmental organizations, and private individuals have been established to protect or restore our nation's forests, grasslands, wetlands, estuaries, rivers, lakes, and streams. Those programs have helped slow, and for many ecosystems, reverse declining trends that began in the past. However, these efforts have benefited some ecosystems and their associated flora and fauna more than other ecosystems. Even with efforts to restore natural disturbance regimes in the western U.S., results are elusive. The 2007 opinion presented figures on the functionality of riparian areas and wetlands located on BLM public lands in 2004: 19% of wetlands in the lower 48 states are not functioning properly, and 2% are deemed non-functional, while 8% of riparian areas are considered non-functional, and 40% functioning at risk (BLM 2005). Compared to BLM's 2014 report, 14% of wetlands on public lands are not functioning properly, and 3% are not functioning. Riparian areas on public lands in the lower 48 states in 2014 also saw a decline in functionality from 2004, with 5% considered non-functional, and 29% considered functional but at risk (BLM 2015b).

Ongoing efforts by the BLM to enhance vegetation, if designed properly, could help to restore the ecological functions of the watersheds. Improvement of watershed and water resources and quality functions would also benefit ESA-listed resources that depend upon these habitats for their survival. Vegetation treatments that control populations of non-native species on public lands would be expected to benefit native plant communities over the long term by aiding in the re-establishment of native species. The degree of benefit would depend on the success of these treatments over both the short and long term.

5.4 Environmental Baseline for Salmonids and Eulachon

The following section describes the environmental baseline for salmonids and eulachon which can be found within the action area. Salmonids and eulachon survive only in aquatic ecosystems and, therefore, depend on the quantity and quality of those ecosystems. Salmonids and eulachon share many of the same threats. Therefore, anthropogenic threats for all species and populations are summarized here. Salmon have declined under the combined effects of multiple anthropogenic stressors. The main drivers of the decline are known as the four "H"s: habitat loss, hatcheries, hydropower, and harvest. Examples of these include fishery over-harvest, competition from hatchery fish and non-native species, the effects of dams, water diversions, destruction or degradation of riparian habitat, and land use practices that destroy or degrade wetland and riparian ecosystems (Buhle et al. 2009).

5.4.1 Habitat loss

Population declines have resulted from several human-mediated causes, but the greatest negative influence has likely been the establishment of waterway obstructions such as dams, power plants and sluiceways for hydropower, agriculture, flood control and water storage. These structures have blocked salmon migration to spawning habitat or resulted in direct mortality and have eliminated entire salmon runs as a result. While some of these barriers remain, others have been reengineered, renovated or removed to allow for surviving runs to access former habitat, but success has been limited. These types of barriers alter the natural hydrograph of basins, both upstream and downstream of the structure, and significantly reduce the availability and quality of spawning and rearing habitat (Hatten and Tiffan. 2009). Many streams and rivers, particularly in urban or suburban areas, suffer from streamside development, which contributes sediment, chemical pollutants from pesticide applications and automobile or industrial activities, altered stream flows, loss of streamside vegetation and allochthonous materials to name a few. These factors can directly cause mortality, reduce reproductive success or affect the health and fitness of all salmon life stages.

5.4.2 Hydrology

Changes in hydrological regimes are closely linked to salmon abundance (Hicks et al. 1991). From studies that have examined the effects of changes in land use patterns, we know that changes in hydrology can profoundly affect salmon abundance and the amount and availability of quality habitat. Hydrology is strongly correlated to early survival and can lead to the displacement of young fish as well as altering immigration and emigration timing which impacts the relative abundance of salmon within a watershed, as well as the relative abundance of age-classes (Gregory and Bisson 1997; Hicks et al. 1991). Such ecosystem changes are also likely to alter macroinvertebrate communities and habitats, affecting the forage base for salmon and trout (McCarthy et al. 2009; Williams et al. 2009). Dams, such as the Bonneville Dam on the Hood River, have blocked eulachon from moving into former spawning habitat (Smith and Saalfeld 1955). Such damming projects also alter sedimentation and flow dynamics that eulachon have developed around in their evolution. River substrate composition, likely critical to successful spawning, is also altered by dams. The impoundment of water tends to raise water temperatures; a factor that spawning eulachon are particularly sensitive to (NMFS 2008a).

5.4.3 Harvest

Fishing pressure has also negatively impacted salmonid populations. Fishing reduces the number of individuals within a population and can lead to uneven exploitation of certain populations and size classes (Reisenbichler 1997). Targeted fishing of larger individuals results in excluding the most fecund individuals from spawning (Reisenbichler 1997). Genetic changes that promote smaller body sizes have occurred in heavily exploited populations in response to size-selective harvest pressures (Reisenbichler 1997). Fishing pressure can reduce age at maturity in fished populations as the fished populations compensate for the reductions in the numbers of spawning adults (Reisenbichler 1997).

Fisheries harvests are likely a major contributor to eulachon decline. The best available information for catches comes from the Columbia River, where catches have been as high as 5.7 million pounds per year, but averaged near 2 million pounds from 1938 to 1993 (Wydoski and Whitney 1979a). Since 1993, catches have not exceeded 1 million pounds annually and the median catch has been 43,000 pounds (97.7% reduction in catch), even when effort is accounted for (WDFW and ODFW 2001). Bycatch from fishing along U.S. and Canadian coasts has also been high, composing up to 28% of the total catch by weight (DFO 2008; Hay and McCarter 2000).

5.4.4 Hatcheries

Each year hatcheries along the west coast of the United States release millions of juvenile salmon (Beamish et al. 1997), with 200 million salmon released annually into the Columbia River alone. Hatcheries have the potential to reduce the viability of natural salmon populations through behavioral or reproductive incompatibility, introgression, and the alteration of run times (Ruckelshaus et al. 2002). These potential risks are not trivial; in chinook populations where hatchery fish are marked, escaped hatchery salmon can constitute up to 60% of the spawning population in areas without planned supplementation programs (Ruckelshaus et al. 2002).

5.4.5 Aquatic nuisance species

Aquatic nuisance species (ANS), also described as non-native or invasive species, adversely affect listed salmon species through several mechanisms, including: predation, competition, trophic structure alteration, introgression, and transfer of pathogens (Sanderson et al. 2009a). Channel catfish, small and largemouth bass, and walleye prey on juvenile salmon (Sanderson et al. 2009a). Juvenile shad prey heavily on zooplankton, which are also the primary prey for juvenile Chinook salmon (Haskell et al. 2006). The presence of brook trout in the Columbia River Basin is associated with a 12% reduction in the survival of juvenile salmon (Levin et al. 2002). Non-native crustaceans, mollusks, and plants pose significant risks to salmonids and the function of their ecosystems. For example, the invasive New Zealand mud snail has been detected in the diet of juvenile Columbia River Chinook salmon, indicating the potential for a shift in estuarine food web structure (Bersine et al. 2008). Non-native quagga and zebra mussel invasions in the eastern U.S. have resulted in competition with native mussels, disruption of food webs, and bioaccumulation of toxins; similar threats are expected if these species invade western waterways (Sanderson et al. 2009a). Aquatic plants, such as purple loosestrife and Eurasian water milfoil, have been introduced to the Pacific Northwest through ballast water. These rapidly decomposing plants have the potential to alter ecosystem function through changes in seasonal nutrient availability and depressed dissolved oxygen concentrations (Blossey et al. 2001; Cronin et al. 2006; Unmuth et al. 2000). Climate change is likely to facilitate the establishment and expansion of ANS. In summary, non-native species have adversely affected salmonid species, primarily through predation and competition; however, they also have the potential, through the mechanisms listed above, to equal or exceed the impacts caused by overharvest, habitat loss, hatcheries, and threats to the hydrosystem (Ruckelshaus et al. 2002; Sanderson et al. 2009a).

5.4.6 Pollution

Salmonids are exposed to a number of contaminants throughout their range and life history cycle. Exposure to pollution is also of significant concern for all life stages, but is likely particularly significant for freshwater life stages. Organic pollutants, particularly PCBs, Dichlorodiphenyltrichloroethane (DDT), and its congeners, pesticides, and endocrine disruptors are of particular concern. These chemicals can inhibit smell, disrupt reproductive behavior and physiology, impair immune function, and lead to mortality through impairment of water balance when traveling between fresh and salt water systems (Varanasi et al. 1993). Diffuse and extensive population centers contribute increase contaminant volumes and variety from such sources as wastewater treatment plants and sprawling development. Urban runoff from impervious surfaces and roadways often contains oil, copper, pesticides, PAHs, and other chemical pollutants and flow into surface waters. Point and nonpoint pollution sources entering rivers and their tributaries affect water quality in available spawning and rearing habitat for salmon. Juvenile salmonids that inhabit urban watersheds often carry high contaminant burdens, which is partly attributable to the biological transfer of contaminants through the food web (Varanasi et al. 1993). Eulachon ecotoxicological studies show high contaminant burdens, particularly of arsenic and lead (EPA 2002; Futer and Nassichuk 1983; Rogers et al. 1990).

5.4.7 Climate Change

All species discussed in this Opinion including Pacific salmon and eulachon are or are likely to be threatened by the direct and indirect effects of global climatic change. Global climate change stressors, including consequent changes in land use, are major drivers of ecosystem alterations (USEPA 2008). Climate change is projected to have substantial direct effects on individuals, populations, species, and the community structure and function of marine, coastal, and terrestrial ecosystems in the foreseeable future (IPCC 2002a; IPCC 2013; McCarty 2001; Parry et al. 2007). Increasing atmospheric temperatures have already contributed to changes in the quality of freshwater, coastal, and marine ecosystems and have contributed to the decline of populations of endangered and threatened species (Karl et al. 2009b; Littell et al. 2009; Mantua et al. 1997b).

Warming water temperatures attributed to climate change can have significant effects on survival, reproduction, and growth rates of aquatic organisms (Staudinger et al. 2012). For example, warmer water temperatures have been identified as a factor in the decline and disappearance of mussel and barnacle beds in the Northwest (Harley 2011). Increasing surface water temperatures can cause the latitudinal distribution of freshwater and marine fish species to change: as water temperatures rise, cold and warm water species will spread northward (Britton et al. 2010; Hiddink and ter Hofstede 2008). Cold water fish species and their habitat will begin to be displaced by the warm water species (Britton et al. 2010; Hiddink and ter Hofstede 2008). Fish species are expected to shift latitudes and depths in the water column, and the increasing temperatures may also result in expedited life cycles and decreased growth (Perry et al. 2005). Shifts in migration timing of pink salmon (*Oncorhynchus gorbuscha*), which may lead to high pre-spawning mortality, have also been tied to warmer water temperatures (Taylor 2008).

Climate change is also expected to impact the timing and intensity of stream seasonal flows (Staudinger et al. 2012), potentially impacting Pacific salmonids and eulachon, as well as other aquatic species. Warmer temperatures are expected to reduce snow accumulation and increase stream flows during the winter, cause spring snowmelt to occur earlier in the year, and reduced summer stream flows in rivers that depend on snow melt. As a result, seasonal stream flow timing will likely shift significantly in sensitive watersheds (Littell et al. 2009). Warmer temperatures may also have the effect of increasing water use in agriculture, both for existing fields and the establishment of new ones in once unprofitable areas (ISAB 2007a). This means that streams, rivers, and lakes will experience additional withdrawal of water for irrigation and increasing contaminant loads from returning effluent. Changes in stream flow due to use changes and seasonal run-off patterns may alter predator-prey interactions and change species assemblages in aquatic habitats. For example, a study conducted in an Arizona stream documented the complete loss of some macroinvertebrate species as the duration of low stream flows increased (Sponseller et al. 2010). As it is likely that intensity and frequency of droughts will increase across the southwest (Karl et al. 2009b), similar changes in aquatic species composition in the region is likely to occur.

Over the past 200 years, the oceans have absorbed about half of the CO2 produced by fossil fuel burning and other human activities. This increase in CO2 has led to a reduction of the pH of surface seawater of 0.1 units, equivalent to a 30 percent increase in the concentration of hydrogen ions in the ocean. If global emissions of CO2 from human activities continue to increase, the average pH of the oceans is projected to fall by 0.5 units by the year 2100 (RoyalSocietyofLondon 2005). In addition to global warming, acidification poses another significant threat to oceans because many major biological functions respond negatively to increased acidity of seawater. Photosynthesis, respiration rate, growth rates, calcification rates, reproduction, and recruitment may be negatively impacted with increased ocean acidity (RoyalSocietyofLondon 2005). Kroeker et al (Kroeker et al. 2010) reviewed 139 studies that quantified the effect of ocean acidification on survival, calcification, photosynthesis, growth, and reproduction. Their analysis determined that the effects were variable depending on species, but effects were generally negative, with calcification being one of the most sensitive processes. Their meta-analysis was not able to show significant negative effects to photosynthesis. Although the scale of acidification changes would vary regionally, the resulting pH could be lower than the oceans have experienced over at least the past 420,000 years and the rate of change is probably one hundred times greater than the oceans have experienced at any time over that time interval. Aquatic species, especially marine species, already experience stress related to the impacts of rising temperature.

Increasing atmospheric temperatures have already contributed to changes in the quality of the freshwater, coastal and marine ecosystems that are essential to the survival and recovery of salmon populations and have contributed to the decline of populations of endangered and threatened species (Karl et al. 2009a; Littell et al. 2009; Mantua et al. 1997a). Since the late 1970s, sea surface temperatures have increased and coastal upwelling -which is recognized as an important mechanism governing the production of both phytoplankton and zooplankton- has decreased resulting in reduced prey availability and poorer marine survival of Pacific salmon. Changes in the number of Chinook salmon escaping into the Klamath River between 1978 and 2005 corresponded with changes in coastal upwelling and marine productivity and the survival of Snake River spring/summer Chinook salmon and Oregon coho salmon has been predicted using indices of coastal ocean upwelling (Elsner and Hamlet 2010; Karl et al. 2009a; Littell et al. 2009). The majority (90%) of year-to-year variability in marine survival of hatchery reared coho salmon between 1985 and 1996 can be explained by coastal oceanographic conditions.

Changes in temperature and precipitation projected over the next few decades are projected to decrease snow pack, affect stream flow and water quality throughout the Pacific Northwest region (Knowles et al. 2006; Mote et al. 2008; Rauscher et al. 2008; Stewart et al. ; Stewart et al. 2004). Warmer temperatures are expected to reduce snow accumulation and increase stream flows during the winter, cause spring snowmelt to occur earlier in the year causing spring stream flows to peak earlier in the year, and reduced summer stream flows in rivers that depend on snow melt (most rivers in the Pacific Northwest depend on snow melt). As a result, seasonal stream flow timing will likely shift significantly in sensitive watersheds (Littell et al. 2009).

The States of Idaho, Oregon, and Washington, are likely to experience increased forest growth over the next few decades followed by decreased forest growth as temperature increases overwhelm the ability of trees to make use of higher winter precipitation and higher carbon dioxide. In coastal areas, climate change is forecast to increase coastal erosion and beach loss (caused by rising sea levels), increase the number of landslides caused by higher winter rainfall, inundate areas in southern Puget Sound around the city of Olympia, Washington (Littell et al. 2009).

Rising stream temperatures will likely reduce the quality and extent of freshwater salmon habitat. The duration of periods that cause thermal stress and migration barriers to salmon is projected to at least double by the 2080s for most analyzed streams and lakes (Littell et al. 2009). The greatest increases in thermal stress (including diseases and parasites which thrive in warmer waters) would occur in the Interior Columbia River Basin and the Lake Washington Ship Canal. The combined effects of warming stream temperatures and altered stream flows will very likely reduce the reproductive success of many salmon populations in Washington watersheds, but impacts will vary according to different life-history types and watershed-types. As more winter precipitation falls as rain rather than snow, higher winter stream flows scour streambeds, damaging spawning nests and washing away incubating eggs for Pacific Northwest salmon. Earlier peak stream flows flush young salmon from rivers to estuaries before they are physically mature enough for transition, increasing a variety of stressors including the risk of being eaten by predators.

As a result of these changes, about one third of the current habitat for either the endangered or threatened Northwest salmon species will no longer be suitable for them by the end of this century as key temperature thresholds are exceeded (Littell et al. 2009). As summer temperatures increase, juvenile salmon are expected to experience reduced growth rates, impaired smoltification and greater vulnerability to predators.

5.4.8 The Impact of the Baseline for salmonids

The primary causes for declines in salmonid populations are overharvest, habitat loss, competition with hatchery fish, and reduced water quality as a result of hydropower projects. These factors continue to threaten Pacific salmon, and Pacific eulachon populations. Effects of herbicide exposure will be reviewed in the Effects of the Action section.

5.5 Environmental Baseline for Green Sturgeon

The following section describes the environmental baseline for green sturgeon, which can be found within the action area.

5.5.1 Bycatch

Directed harvest in commercial fisheries of green sturgeon is prohibited. Green sturgeon are frequently caught incidentally in tribal gill-net salmon fisheries and in white sturgeon commercial and sport fisheries (NMFS 2010). Commercial fishing trawls also represent a source of bycatch for green sturgeon during their oceanic phase (Lindley et al. 2008). Estimates of green sturgeon bycatch in West coast groundfish trawl fisheries were generated based on observer data collected from 2002-2008, and ranged from 782 to 51 individuals annually; post capture survival rates were not calculated and remain uncertain (Bellman et al. 2010).

Despite the harvest bans, adult sturgeon are believed to be especially vulnerable to fishing gears for other anadromous species (such as shad, striped bass and herring) during times of extensive migration – particularly the spawning migration upstream, followed by movement back downstream (Litwiler 2001).

5.5.2 Dams

Dams are used to impound water for water resource projects such as hydropower generation, irrigation, navigation, flood control, industrial and municipal water supply, and recreation. Although information is lacking on the effects of dams to green sturgeon Southern DPS specifically, dams do represent a significant threat to all listed sturgeon species. In some rivers, these species have been extirpated due to the construction of impassable dams (SSRT 2010).

Perhaps the biggest impact dams have on sturgeon is the loss of upriver spawning and rearing habitat. Migrations of sturgeon in rivers without barriers are wide-ranging with total distances exceeding 200 km or more depending on the river system (Kynard 1997). Dams have restricted spawning activities to areas below the impoundment, often in close proximity to the dam, but unsuitable for survival of juveniles (Cooke et al. 2004; Kynard 1997). Dams pose a threat to green sturgeon Southern DPS, in particular on the Sacramento River, with dams blocking access to putative spawning habitat (Thomas et al. 2014).

The construction of dams has blocked upriver passage for the majority of sturgeon populations, including the green sturgeon Southern DPS. Dams can have profound effects on sturgeon species by fragmenting populations, eliminating or impeding access to historic habitat, modifying free-flowing rivers to reservoirs and altering downstream flows and water temperatures. Dams can fragment sturgeon populations. This has been the case for shortnose and Atlantic sturgeon populations on the Connecticut River and the Santee-Cooper River system (SSRT 2010), although no known similar cases exist for green sturgeon.

Dams can also alter water conditions and quality, making the water unsuitable for sturgeon. Hill (1996) identified the following potential impacts from hydropower plants and their associated dams: altered DO concentrations; artificial destratification; water withdrawal; changed sediment load and channel morphology; accelerated eutrophication and change in nutrient cycling; and contamination of water and sediment. Furthermore, activities associated with dam maintenance, such as dredging and minor excavations along the shore, can release silt and other fine river sediments that can be deposited in nearby spawning habitat. Dams can also reduce habitat diversity by forming a series of homogeneous reservoirs; these changes generally favor different predators, competitors and prey, than were historically present in the system (Auer 1996b).

The suitability of riverine habitat for sturgeon spawning and rearing depends on annual fluctuations in flow, which can be greatly altered or reduced by the presence and operation of dams (Cooke et al. 2004). Effects on spawning and rearing may be most dramatic in hydropower facilities operating in peaking mode (Auer 1996b). Daily peaking operations store water above the dam when demand is low and release water for electricity generation when demand is high, creating substantial, daily fluctuations in flow and temperature regimes. Kieffer and Kynard (2012) have documented flow fluctuations for hydroelectric power generation affected access to spawning habitat and possibly deterred spawning of shortnose sturgeon on the Connecticut River. Similar results were reported in studies conducted for lake sturgeon (*A. fulvescens*) in the Sturgeon River, Michigan (Auer 1996a) and white sturgeon (*A. transmontanus*) in the Columbia River, Oregon and Washington (Parsley and Beckman 1994). Auer (1996a) demonstrated that there is greater spawning success of lake sturgeon on the Sturgeon River, MI, when facilities operated in the more natural "run-of-the-river" mode.

5.5.3 Dredging

Dredging is a common practice in numerous rivers nationwide to maintain shipping channels. Other purposes for dredging include construction of infrastructure and marine mining. Dredging may have adverse impacts on aquatic ecosystems including direct removal or burial of organisms; increased turbidity; contaminant re-suspension; noise/disturbance; alterations to hydrodynamic regime and physical habitat as well as actual loss of riparian habitat (Winger et al. 2000). Specifically for listed sturgeon species, dredging poses a threat by altering water quality and degrading or eliminating suitable habitat (ASSRT 2007; NMFS 2010; SSRT 2010). Many rivers and estuaries that support sturgeon populations are periodically dredged for flood control or to support commercial shipping and recreational boating.

Hydraulic dredges can lethally take sturgeon by entraining sturgeon in dredge drag arms and impeller pumps (NMFS 1998). In addition to direct effects, indirect effects from either mechanical or hydraulic dredging include destruction of benthic feeding areas, disruption of spawning migrations, and deposition of resuspended fine sediments in spawning habitat (NMFS 1998).

Another critical impact of dredging is that deepening river channels allows the encroachment of low D.O. and high salinities upriver after channelization (Collins et al. 2001). Adult sturgeon can tolerate periods of low D.O. and high salinities, but juveniles are less tolerant of these conditions in laboratory studies. Collins et al. (2001) concluded harbor modifications in the lower Savannah River have altered hydrographic conditions for juvenile sturgeon by extending high salinities and low D.O. upriver.

Dredging and filling eliminates deep holes and alters rock substrates, making bottom habitat more homogenous and less suitable for sturgeon (Smith and Clugston 1997). Nellis et al. (2007) documented dredge spoil drifted 12 km downstream over a 10 year period in the Saint Lawrence River, and those spoils have significantly less macrobenthic biomass compared to control sites, thus possibly reducing prey resources for sturgeon. Using an acoustic trawl survey, researchers found Atlantic and lake sturgeon were substrate dependent and avoided spoil dumping grounds (McQuinn and Nellis 2007). Similarly, Hatin et al. (2007) tested whether dredging operations affected Atlantic sturgeon behavior by comparing catch per unit effort before and after dredging events in 1999 and 2000. The authors documented a three to seven-fold reduction in Atlantic sturgeon presence after dredging operations began, indicating sturgeon avoid these areas during operations.

5.5.4 Blasting

Bridge demolition and other projects may include plans for blasting with powerful explosives. Sturgeon are particularly susceptible to effects of underwater explosions and are killed over a greater range than other organisms (Lewis 1996). Unless proper precautions mitigate the damaging effects of shock wave transmission to physostomous fish like sturgeon, internal damage and/or death may result (NMFS 1998).

A study testing the effects of underwater blasting on juvenile shortnose sturgeon and striped bass was conducted with several test runs with fish in cages at increasing distances from the blasting site (35, 70, 140, 280 and 560 ft upstream and downstream of the blast area). A control group of 200 fish was held 0.5 miles from the blast site (Moser 1999). Test blasting was conducted with and without an air curtain in-place 50 ft from the blast site. Survival was similar for both species. External assessments of impacts to the caged fish were conducted immediately after the blasts and 24 h later, with some sacrificed for later necropsy. Externally, shortnose sturgeon and striped bass selected for necropsy all appeared to be in good condition externally and behaviorally after blasts. However, results of necropsies found many had substantial internal injuries. Moser concluded many of the injuries would have resulted in eventual mortality (Moser 1999). Fish held in cages at 70 ft from blast sites were less seriously impacted by the test blasting than those held at 35 ft. Shortnose sturgeon suffered fewer, less severe internal injuries than striped bass tested. There appeared to be no reduction of injury in fish experiencing blasts while air curtains were in place.

Although the effects of blasting have not been specifically examined in other species of sturgeon, due to their physical similarities, it is likely the effects are similar to those experienced by shortnose sturgeon in the above blasting study (Moser 1999). In construction projects involving blasting which might occur within the range of ESA-listed sturgeon species, the effects of the action are considered and mitigated for by changing the timing of the blasting period to avoid species, and hydroacoustic monitoring (Carlson and Johnson 2010).

5.5.5 Water quality

Water quality in river and estuary systems is affected by human activities conducted in close proximity to the watershed (i.e., the riparian zone) and by activities conducted more remotely in the upland portion of the watershed. Industrial activities can result in discharges of pollutants, addition of nutrients, and changes in water temperature and DO levels. Coastal and riparian areas are also heavily impacted by real estate development and urbanization resulting in storm water discharges, non-point source pollution, and erosion. All of these factors can lead to deteriorated water quality which can be seen as overall habitat degradation, having significant impacts to the ecosystem and the biological organisms within. Degraded water quality can substantially harm all species of listed sturgeon (ASSRT 2007; NMFS 2010; SSRT 2010; USFWS and GSMFC 1995).

Specific optimal water quality ranges vary between sturgeon species, but must be within an appropriate range for successful spawning and juvenile survival (Collins et al. 2000). Low DO levels and high water temperatures are of particular concern, because these factors may limit available habitat and survival of juveniles and early life stage sturgeon. Temperature stresses were shown to cause notochord abnormalities in larval green sturgeon, with significant decreases in larval survival at temperatures between 26-28°C and temperatures above 28°C being lethal (Linares-Casenave et al. 2013).

Secor and Gunderson (1998) and Collins et al. (2001) hypothesized survival of juvenile sturgeon in estuaries may be compromised due to combined effects of increased hypoxia and temperature in nursery areas. Hypoxia affects sturgeon species more than other fish species due to their limited ability to oxyregulate at low DO (Secor and Gunderson 1998; Secor and Niklitschek 2002). Sturgeon species during the first year of life are particularly susceptible to low DO because of their limited locomotive means to escape from hypoxic waters (Secor and Niklitschek 2002).

5.5.6 Contaminants and Pesticides

The life history of sturgeon (i.e., long lifespan, extended residence in estuarine habitats, benthic foraging) predispose them to long-term, repeated exposure to environmental contamination and potential bioaccumulation of heavy metals and other toxicants (Dadswell 1979). These contaminants settle to the river bottom and are later consumed by benthic feeders, such as macroinvertebrates, and then work their way higher into the food web (i.e., to sturgeon). Some of these compounds may affect physiological processes and impede a fish's ability to withstand stress, while simultaneously increasing the stress of the surrounding environment by reducing D.O., altering pH, and changing other physical properties of the water. In addition, forestry and agricultural practices can result in erosion, run-off of fertilizers, herbicides, insecticides or other chemicals, nutrient enrichment and alteration of water flow.

Contaminants like dioxin, heavy metals, mercury, and other by-products of agricultural, municipal and industrial waste have been documented in tissue samples collected from shortnose sturgeon throughout their range, as well as in Gulf and Atlantic sturgeon (SSRT 2010). Levels of contaminants in wild green sturgeon are not known, but heavy contaminant loads have been found in white sturgeon, which co-occur with green sturgeon (NMFS 2010). Studies have implicated contaminants in inhibiting growth and reproductive development, and lower reproductive success in white sturgeon (Feist et al. 2005) (Foster et al. 2001a) (Foster et al. 2001b) (Kruse and Scarnecchia 2002).(Feist et al. 2005; Foster et al. 2001a; Foster et al. 2001b; Kruse and Scarnecchia 2002). Heavy metals and contaminants have been found in white sturgeon tissue (Greenfield et al. 2005) (Fairey et al. 1997; Greenfield et al. 2005) Green sturgeon are susceptible to negative effects from contaminant exposure. In a lab study, juvenile green sturgeon exposed to methyl mercury had significantly higher mortality than white sturgeon exposed to the same or higher levels (Lee et al. 2011).

The long-term effects of heavy metal and organochlorine accumulation in sturgeon tissue are not known (Ruelle and Henry 1992; Ruelle and Keenlyne 1993). High levels of pesticides and contaminants, including chlorinated hydrocarbons, in several other fish species are associated with reproductive impairment (Hammerschmidt et al. 2002; Moore and Waring 2001), reduced survival of larval fish (Jezierska et al. 2009), delayed maturity (Jorgensen et al. 2004) and skeletal deformities (Villeneuve et al. 2005). Pesticide and contaminant exposure in fish may affect anti-predator and homing behavior, reproductive function, physiological maturity, and swimming ability (Beauvais et al. 2000; Moore and Lower 2001; Scholz et al. 2000; Scott and Sloman 2004).

Pesticides are prevalent in the water bodies of the Sacramento River Basin, where Southern DPS green sturgeon are known to occur (Domagalski et al. 2000). Pesticides in the estuarine environment could indirectly affect green sturgeon by affecting their prey species (Moser and Lindley 2007).

5.5.7 Climate change

Climate change has the potential to affect all listed sturgeon in similar, if not more significant, ways than it affects salmonids. Elevated air temperatures could lead to precipitation falling as rain instead of snow. Additionally, snow would likely melt sooner and more rapidly, potentially leading to greater flooding during melting and lower water levels at other times, as well as warmer river temperatures (ISAB 2007b). It is possible that the effects of climate change could have localized effects and regional differences with areas of the country being affected by these factors to varying degrees based on localized features such as elevation and human population density (SSRT 2010). Increased extremes in river flow (i.e., periods of flooding and low flow) can alternatively disrupt and fill in spawning habitat that sturgeon rely upon (ISAB 2007b). Although sturgeon can spawn over varied benthic habitat, they prefer localized depressions in riverbeds (Erickson et al. 2001; Moyle et al. 1992; Moyle et al. 1995; Rien et al. 2001).

As with other anadromous fishes, sturgeon are uniquely evolved to the environments that they live in. Because of this specificity, broad scale changes in environment can be difficult to adapt to, including changes in water temperature (Cech Jr. et al. 2000). Sturgeon are also directly sensitive to elevated water temperatures. Temperature triggers spawning behavior. Warmer water temperatures can initial spawning earlier in a season for salmon and the same can be true for sturgeon (ISAB 2007b). If water temperatures become anomalously warm, juvenile sturgeon may experience elevated mortality due to lack of cooler water refuges. If temperature rise beyond thermal limits for extended periods, habitat can be lost; this could be the case if southern habitats warm, resulting in range loss (Lassalle et al. 2010).

Apart from direct changes to sturgeon survival, altered water temperatures may disrupt habitat, including the availability of prey (ISAB 2007b). Warmer temperatures may also have the effect of increasing water use in agriculture, both for existing fields and the establishment of new ones in once unprofitable areas (ISAB 2007b). This means that streams, rivers, and lakes will experience additional withdrawal of water for irrigation and increasing contaminant loads from returning effluent. Overall, it is likely that global warming will increase pressures on sturgeon survival and recovery.

5.5.8 Poaching

Poaching is a concern for green sturgeon due to demand for black-market caviar (NMFS 2010).

5.5.9 Research permits and authorizations

Sturgeon have been the focus of scientific research for decades. Research for green sturgeon is regulated under the Southern DPS 4(d) Rule (75 FR 30714). Directed research on sturgeon species in the U.S. is carefully controlled and managed so it does not operate to the disadvantage of the species. As such, all research has been conditioned with mitigation measures protective of the species ensuring impacts on target and non-target species are minimal.

5.5.10 Artificial propagation

Aquaculture or research facilities currently raising captive green sturgeon on watersheds of native sturgeon populations pose the potential for escapement and impacts to the wild population. There have been verified reports of cultured sturgeon escaping from hatcheries (SSRT 2010; USFWS and GSMFC 1995). Escapement of non-native sturgeon from aquaculture facilities could have possible negative impacts on the wild populations of sturgeon through competition for food and habitat, hybridization, and the spread of fish pathogens. In the mid-1990s, hatchery-raised Atlantic sturgeon have been deliberately released into watersheds like the Hudson River and the Chesapeake Bay in efforts to re-stock the local populations. Concerns over the impacts to genetic diversity of the wild populations and the potential for the spread of disease from the hatchery fish has led some to question the feasibility of re-stocking as a management tool (ASSRT 2007; USFWS and GSMFC 1995).

5.5.11 The Impact of the Baseline for green sturgeon

Green sturgeon have faced numerous threats across their range that have led to them being listed under the ESA, and those threats are likely to continue into the future, including dams, habitat loss and degradation, and poor water quality. Though direct harvest is now prohibited, many sturgeon are caught as bycatch or poached. Other threats include: scientific research, artificial propagation, climate change, and contaminants. Effects of herbicide exposure will be reviewed in the Effects of the Action section.

5.6 Environmental Baseline for Southern Resident killer whales

The following section describes the environmental baseline for Southern Resident killer whales, which can be found feeding upon Chinook salmon, which can be found within the action area.

5.6.1 Whaling

Prior to 1900, aboriginal hunting and early commercial whaling on the high seas, using hand harpoons, took an unknown number of whales (Johnson and Wolman 1984). Modern commercial whaling removed approximately 50,000 whales annually. In 1965, the IWC banned the commercial hunting of whales. Although commercial harvesting no longer targets whales in the proposed action area, prior exploitation may have altered the population structure and social cohesion of species, such that effects on abundance and recruitment continued for years after harvesting has ceased.

5.6.2 Shipping

Ships have the potential to affect cetaceans through strikes, noise (discussed below), and disturbance by their physical presence. Ship strikes are considered a serious and widespread threat to whales. This threat is increasing as commercial shipping lanes cross important breeding and feeding habitats and as whale populations recover and populate new areas or areas where they were previously extirpated (Swingle et al. 1993; Wiley et al. 1995). As ships continue to become faster and more widespread, an increase in ship interactions with cetaceans is to be expected. Studies indicate that the probability of fatal injuries from ship strikes increases as vessels operate at speeds above 14 knots (Laist et al. 2001).

Responses to vessel interactions include interruption of vital behaviors and social groups, separation of mothers and young, and abandonment of resting areas (Bejder et al. 1999; Boren et al. 2001; Colburn 1999; Constantine 2001; Cope et al. 1999; Kovacs and Innes. 1990; Kruse 1991; Mann et al. 2000; Nowacek et al. 2001; Samuels et al. 2000; Samuels and Gifford. 1998; Wells and Scott 1997). Whale watching, a profitable and rapidly growing business with more than 9 million participants in 80 countries and territories, may increase these types of disturbance and negatively affect the species (Hoyt 2001).

5.6.3 Noise

Noise generated by human activity adversely affects cetaceans in the action area. Noise is generated by commercial and recreational vessels, aircraft, commercial sonar, military activities, seismic exploration, in-water construction activities, and other human activities. These activities occur within the action area to varying degrees throughout the year. Whales generate and rely on sound to navigate, hunt, and communicate with other individuals. Anthropogenic noise can interfere with these important activities. The effects of noise on whales can range from behavioral disturbance to physical damage (Richardson et al. 1995).

Commercial shipping traffic is a major source of low frequency anthropogenic noise in the oceans (NRC 2003). Although large vessels emit predominantly low frequency sound, studies report broadband noise from large cargo ships above 2 kHz, which may interfere with important biological functions of cetaceans (Holt 2008). Commercial sonar systems are used on recreational and commercial vessels and may affect marine mammals (NRC 2003). Although little information is available on potential effects of multiple commercial sonars to marine mammals, the distribution of these sounds would be small because of their short durations and the fact that the high frequencies of the signals attenuate quickly in seawater (Richardson et al. 1995).

Seismic surveys using towed airguns also occur within the action area and are the primary exploration technique to locate oil and gas deposits, fault structure, and other geological hazards. Airguns generate intense low-frequency sound pressure waves capable of penetrating the seafloor and are fired repetitively at intervals of 10-20 seconds for extended periods (NRC 2003). Most of the energy from the guns is directed vertically downward, but significant sound emission also extends horizontally. Peak sound pressure levels from airguns usually reach 235-240 dB at dominant frequencies of 5-300 Hz (NRC 2003). Most of the sound energy is at frequencies below 500 Hz.

5.6.4 Navy Activities

The Navy conducts military readiness activities, which can be categorized as either training or testing exercises, throughout the action area. During training, existing and established weapon systems and tactics are used in realistic situations to simulate and prepare for combat. Activities include: routine gunnery, missile, surface fire support, amphibious assault and landing, bombing, sinking, torpedo, tracking, and mine exercises. Testing activities are conducted for different purposes and include at-sea research, development, evaluation, and experimentation. The Navy performs testing activities to ensure that its military forces have the latest technologies and techniques available to them. Navy activities are likely to produce noise and visual disturbance to cetaceans throughout the action area.

5.6.5 Fisheries

Whales are known to feed on several species of fish that are harvested by humans (Waring et al. 2008). Therefore, competition with humans for prey is a potential concern. Reductions in fish populations, whether natural or human-caused, may affect the survival and recovery of several populations.

Entrapment and entanglement in fishing gear is a frequently documented source of human-caused mortality in marine mammals (see Dietrich et al. 2007). These entanglements also make animals more vulnerable to additional dangers (e.g., predation and ship strikes) by restricting their agility and swimming speed. Cetaceans that die from entanglement in commercial fishing gear often sink rather than strand ashore thus making it difficult to accurately determine the extent of such mortalities.

5.6.6 Pollution

Contaminants cause adverse health effects in cetaceans. Contaminants may be introduced by rivers, coastal runoff, wind, ocean dumping, dumping of raw sewage by boats and various industrial activities, including offshore oil and gas or mineral exploitation (Garrett 2004; Grant and Ross 2002; Hartwell 2004). The accumulation of persistent pollutants through trophic transfer may cause mortality and sub-lethal effects in long-lived higher trophic level animals (Waring et al. 2008), including immune system abnormalities, endocrine disruption, and reproductive effects (Krahn et al. 2007). Recent efforts have led to improvements in regional water quality and monitored pesticide levels have declined, although the more persistent chemicals are still detected and are expected to endure for years (Grant and Ross 2002; Mearns 2001).

Exposure to hydrocarbons released into the environment via oil spills and other discharges pose risks to marine species. Cetaceans are generally able to metabolize and excrete limited amounts of hydrocarbons, but exposure to large amounts of hydrocarbons and chronic exposure over time pose greater risks (Grant and Ross 2002). Cetaceans have a thickened epidermis that greatly reduces the likelihood of petroleum toxicity from skin contact with oils (Geraci 1990), but they may inhale these compounds at the water’s surface and ingest them while feeding (Matkin and Saulitis 1997). Hydrocarbons also have the potential to impact prey populations, and therefore may affect listed species indirectly by reducing food availability.

Cetaceans are also impacted by marine debris, which includes: plastics, glass, metal, polystyrene foam, rubber, and derelict fishing gear. Marine debris is introduced into the marine environment through ocean dumping, littering, or hydrologic transport of these materials from land-based sources. Even natural phenomena, such as tsunamis and continental flooding, can cause large amounts of debris to enter the ocean environment. Cetaceans often become entangled in marine debris. They may also ingest it while feeding, potentially leading to digestive problems, injury, or death.

5.6.7 Aquatic Nuisance Species

Aquatic nuisance species (ANS) are aquatic and terrestrial organisms, introduced into new habitats throughout the United States and other areas of the world, that produce harmful impacts on aquatic ecosystems and native species (http://www.anstaskforce.gov). They are also referred to as invasive, alien, or nonindigenous species. Introduction of these species is cited as a major threat to biodiversity, second only to habitat loss (Wilcove et al. 1998). They have been implicated in the endangerment of 48% of the species listed under ESA (Czech and Krausman

1997). Over 250 nonindigenous species of invertebrates, algae, and microorganisms have established themselves in the coastal marine ecosystems of California, whose waters have been the subject of most in-depth analyses of aquatic invasions in the United States.

5.6.8 Scientific Research

Scientific research permits, issued by NMFS, authorize the study of listed resources in the action area. The primary objective of these studies is generally to monitor populations or gather data for behavioral and ecological studies. Activities authorized include: aerial and vessel surveys, photo-identification, biopsy sampling, and attachment of scientific instruments. These activities may result in harassment, stress, and injury.

5.6.9 Whale Watching

Although considered by many to be a non-consumptive use of cetaceans with economic, recreational, educational and scientific benefits, whale watching is not without negative impacts. It has the potential to harass whales by altering feeding, breeding, and social behavior or even injury if the vessel gets too close. Another concern is that preferred habitats may be abandoned if disturbance levels are too high. Several studies have specifically examined the effects of whale watching, and investigators have observed a variety of short-term responses from animals, including: no apparent response; changes in vocalizations; duration of time spent at the surface; swimming speed, angle, or direction; respiration rate; dive time; feeding behavior; and social behavior (NMFS 2006). Responses appear to be dependent on factors such as vessel proximity, speed, and direction, as well as the number of vessels in the vicinity (Au and Green. 2000; Corkeron 1995; Erbe 2002; Magalhaes et al. 2002; Richter et al. 2003; Scheidat et al. 2004; Watkins 1986; Williams et al. 2002a; Williams et al. 2002b). Foote et al. (2004) reported that Southern Resident killer whale call duration in the presence of whale watching boats increased by 10-15 percent between 1989-1992 and 2001-2003, indicating compensation for a noisier environment. Disturbance by whale watch vessels has also been noted to cause newborn calves to separate briefly from their mothers' sides, which leads to greater energy expenditures by the calves (NMFS 2006). Although numerous short-term behavioral responses to whale watching vessels are documented, little information is available on whether long-term negative effects result from whale watching (NMFS 2006).

5.6.10 Climate Change

Climate change is projected to have substantial direct and indirect effects on individuals, populations, species, and the structure and function of marine ecosystems in the near future (IPCC 2002b). From 1906-2006, global surface temperatures have risen 0.74° C and continue to rise at an accelerating pace; 11 of the 12 warmest years on record since 1850 have occurred since 1995 (Poloczanska et al. 2009). The direct effects of climate change include increases in atmospheric temperatures, decreases in sea ice, and changes in sea surface temperatures, patterns of precipitation, and sea level.

Indirect effects of climate change include altered reproductive seasons/locations, shifts in migration patterns, reduced distribution and abundance of prey, and changes in the abundance of competitors and/or predators. Climate change is most likely to have its most pronounced effects on species whose populations are already in tenuous positions (Isaac 2008). As such, we expect the extinction risk of listed species to rise with global warming. Cetaceans with restricted distributions linked to water temperature may be particularly exposed to range restriction (Issac 2009; Learmonth et al. 2006). MacLeod (2009) estimated that, based upon expected shifts in water temperature, 88 percent of cetaceans would be affected by climate change, 47 percent would be negatively affected, and 21 percent would be put at risk of extinction. Of greatest concern are cetaceans with ranges limited to non-tropical waters and preferences for shelf habitats (Macleod 2009).

The potential for invasive species to spread under the influence of climactic change is also a concern. If water temperatures warm in marine ecosystems, native species may shift poleward to cooler habitats, opening ecological niches that can be occupied by invasive species introduced via ships' ballast water or other sources (Philippart et al. 2011; Ruiz et al. 1999). Invasive species that are better adapted to warmer water temperatures would outcompete native species that are physiologically geared towards lower water temperatures; such a situation currently occurs along central and northern California (Lockwood and Somero 2011).

5.6.11 Summary of Environmental Baseline for Southern Resident Killer Whales

Numerous factors have contributed to the endangered status of cetaceans, including: whaling, shipping, noise, Navy activities, fisheries, pollution, scientific research, marine mammal viewing, and climate change. Though the threat of whaling has declined dramatically over time, the other threats remain and will continue into the future. Such threats must be considered as part of the baseline when evaluating the effects of the action on the viability of the species.

Effects of the Action on ESA-Listed Species and Critical habitat

Section 7 regulations define "effects of the action" as the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but are reasonably certain to occur. This effects analyses section is organized following the stressor, exposure, response, risk assessment framework.

As was stated in Section 3, this biological opinion includes both a jeopardy analysis and an adverse modification analysis.

The jeopardy analysis relies upon the regulatory definition of "to jeopardize the continued existence of a listed species," which is "to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50

CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species. As described earlier, the universe of likely responses is considered in evaluating whether those responses lead to fitness consequences for the individual and (if appropriate), the affected population and species as a whole to determine the likelihood of jeopardy.

The adverse modification analysis considers the impacts on the conservation value of designated critical habitat. 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, which was invalidated by Gifford Pinchot Task Force v. USFWS, 378 F.3d 1059 (9th Cir. 2004), amended by 387 F.3d 968 (9th Cir. 2004). Instead, we have relied upon the statutory provisions of the ESA to complete our analysis with respect to critical habitat.

5.7 Stressors Associated with the Proposed Action

Stressors are any physical, chemical or biological entity that can induce an adverse response. The potential stressors we expect to result from the proposed action are discussed below, and could affect ESA-listed species and designated critical habitat directly and indirectly.

Based on a review of available information, we determined that these possible stressors outlined below would be likely to occur during site-specific vegetation treatment programs. Whether or not any of these stressors would be discountable or insignificant is something that would be determined on a site-specific basis during consultations with NMFS Regional Offices.

5.7.1 Stressors to ESA-listed Species

Stressors to ESA-listed species could come in the form of direct effects and indirect effects.

- Direct mortality at any life history stage;
- An increase or decrease in growth;
- Changes in reproductive behavior;
- A reduction in the number of eggs produced, fertilized, or hatched;
- Developmental abnormalities, including behavioral deficits or physical deformities;
- Reduced ability to osmoregulate or adapt to salinity gradients;
- Reduced ability to tolerate shifts in other environmental variables (e.g., temperature or increased stress);
- An increased susceptibility to disease;
- An increased susceptibility to predation; and,
- Changes in migratory behavior.

Indirect effects to ESA-listed species would come primarily in the form of impacts to prey species and the loss of riparian vegetation. Herbicides can impair the physical, biological and chemical processes that collectively support the aquatic ecosystem (Preston 2002). Herbicides alter watershed characteristics by:

- Disrupting the growth of riparian deciduous vegetation,
- Reduction of delivery of leaves and intermediate-sized wood (i.e., fallen logs, leaves that provide detritus and cover for aquatic life), and
- Alteration of hydrologic and sediment delivery processes (Spence et al. 1996).

Indirect effects are those effects that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur. Compromising the food chain could be categorized as an indirect effect to ESA-listed fishes and Southern Resident killer whales. The integrity of the aquatic food chain is an essential biological requirement for salmonids and killer whales, and the possibility that herbicide applications will alter productivity and watersheds characteristics of streams and rivers exist. Macroinvertebrates and aquatic plants are generally more sensitive than fish to the toxic effects of herbicides. The application of herbicides can affect the productivity of the stream by altering the composition of benthic algal communities—the food source of macroinvertebrates. Benthic algae are important primary producers in aquatic habitats, and are thought to be the principal source of energy in many mid-sized streams (Minshall 1978; Murphy 1998; Vannote et al. 1980). Herbicides can directly kill algal populations at acute levels or indirectly promote algal production by increasing solar radiation reaching streams by disruption of riparian vegetation growth.

The disruption of riparian vegetative growth carries with it other adverse consequences for salmonid habitat, such as loss of shade, bank destabilization and sediment control. The loss of tree cover can cause the water temperature of streams to increase, and reduce levels of dissolved oxygen. Changing these water parameters could negatively impact ESA-listed fishes, particularly Pacific salmonids.

Stressors to Designated Critical habitat

Stressors associated with the proposed action would come in the form of impacts to the primary constituent elements or essential features of designated critical habitat in the action area. The PCEs for Pacific Salmonids refer to the need for adequate substrate, water quantity, quality, temperature, and velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions for all life stages (and thus, encompassing a variety of habitats, including freshwater, estuarine, and marine.)

The PCEs for Southern DPS green sturgeon critical habitat have been identified for freshwater, estuarine, and marine environments and for each life stage. For freshwater areas, the PCEs include: abundant food resources, substrate type or size, suitable water flow, quality, and depth, sediment quality and safe migratory passage.

The PCEs for Southern Resident killer whales include adequate prey resources.

If the conservation value of any of the PCEs were degraded by the stressors associated with the proposed activities, the ability of the critical habitat to function and its capacity to support endangered species would be negatively impacted.

5.8 Mitigation to Minimize or Avoid Exposure

Mitigation measures to minimize or avoid exposure for ESA-listed resources from the proposed activity can be categorized in two general areas: 1) the BLM vegetation management program procedures currently in place and analyzed in the 2007 biological opinion, and 2) the recommendations put forth in the Ecological Risk Assessments for each of the three proposed AIs which will be used as guidance at the local level.

5.8.1 BLM Vegetation Management Program Procedures

BLM developed manuals and policies at the national level to comply with the relevant statutes and other mandates that determine how BLM is to conduct its vegetation treatment program to restore and protect public lands (Section 5.2). These manuals and policies are implemented at the field level in the form of Land Use Plans (LUPs) which outline the general resource goals and objectives based on desired future conditions for the land, land use allocations (e.g., timber harvest, grazing allotments), and land health standards and associated guidelines on how to meet those standards. Activity Level Plans design and select the vegetation treatment methods to achieve the objectives of the LUPs.

Activity Level Plans require inventories of the land including sensitive habitat or listed or otherwise sensitive species. The requirements of the national vegetation management plan are implemented at two stages in BLM’s process:

- Activity Level Plans when land and treatment methods are selected, and at the
- Project Level when site-specific treatments are selected and designed to meet LUP goals and objectives while minimizing any adverse effect of treatment activities to ESA-listed resources (and other sensitive resources).

The vegetation treatment methods, including SOPs and proposed protective measures are selected and designed at the Activity Level planning stage and further refined and carried out during the actual site-specific treatments—that is, the Project Level activities. It is only at this stage that BLM proposes to conduct any site-specific vegetation treatment activities using herbicides containing the three proposed AIs (or any currently-approved AIs).

The 2007 section 7 consultation focused on the general nature of the national guidance accompanying this national vegetation program (i.e., SOPs and protective measures). Specifically, the 2007 opinion focused on how that guidance would be incorporated into the Activity Level plans which design and select vegetation treatment methods, and more importantly, various site-specific treatment activities since this is when ESA-listed resources may be exposed to any direct or indirect effects caused by the treatment program. The structure of that national guidance remains in effect as we consider the effects of the proposal to three new AIs to BLM's list of currently approved herbicides in this present consultation.

BLM addresses threatened and endangered species issues using the section 7 regulations (50 CFR 402). BLM delineates the requirements of the ESA, especially section 7, in its Manual 6840 (see Section 5.2.1.4). Manual 6840 reiterates that BLM must ensure that all actions it authorizes, funds or carries out are in compliance with the ESA by:

- Evaluating all proposed actions to determine if individuals or populations of ESA-listed species or their habitat, including designated critical habitat, may be affected.
- Initiating consultation with USFWS and/or NMFS, including preparation of biological assessments, as appropriate, for those actions that may affect listed species or their habitats.
- Ensuring that BLM not carry out any action during consultation that would cause an irreversible or irretrievable commitment of resources such that it would foreclose the formulation or implementation of any reasonable and prudent alternative measure that might avoid jeopardy to listed species and/or prevent the adverse modification of critical habitat.
- Ensuring that BLM actions will not reduce the likelihood of survival and recovery of any ESA-listed species or destroy or adversely modify their designated critical habitat.
- Implementing mandatory terms and conditions and reasonable and prudent alternatives as outlined in final biological opinions.
- Implementing conservation recommendations included in biological opinions if they are consistent with BLM land use planning and policy and they are technologically and economically feasible.
- Conferring with USFWS and/or NMFS on any action that is likely to adversely affect a proposed species or proposed critical habitat.

It is important to point out that the programmatic structure for BLM's vegetation treatment program was evaluated during consultation with NMFS in 2007, and that any future use of the three proposed AIs—aminopyralid, rimsulfuron, and fluroxypyr—would be subjected to this same programmatic structure.

5.8.1.1 BLM Site-Specific Section 7 Consultations

BLM's national vegetation treatment program was evaluated in 2007. In reaching its no jeopardy conclusion in the 2007 opinion, NMFS stipulated that although the vegetation treatment management activities themselves were likely to cause adverse effects to ESA-listed species, these effects would not happen until after section 7 consultation on site-specific activities occurred. These consultations were to occur at the Regional offices as warranted, based on the nature of the action, characteristics of the site, presence of ESA-listed resources, and any other relevant factors. Because all of these variables could not be known at the national program level, we must rely on subsequent section 7 consultations on BLM's site-specific activities.

In assessing the effects of the proposed action, it is important to evaluate whether the assumptions made in the 2007 biological opinion can be considered valid. The 2007 opinion stated: "The presence or absence of site-specific consultations when they are warranted and the results of those consultations would constitute evidence that would allow us to evaluate the validity of this national consultation. If those site-specific consultations form a pattern that demonstrates that our general consultation was generally false (rather than false in a handful of specific cases), that pattern would constitute new information that reveals effects of the vegetation treatment program that would have to be considered in a subsequent programmatic consultation (NMFS 2007)."

Since 2007, BLM has conducted informal and formal consultations with NMFS Regional Offices on site-specific noxious weed and other vegetation management treatments. We searched the online Public Consultation Tracking System and contacted NMFS Regional Offices, to identify Regional consultations that have been conducted since 2007 on site-specific vegetation treatment programs in the action area. The consultations we identified, along with descriptions and outcomes, are described in Table 6.

Table 6. BLM site-specific vegetation treatment program ESA section 7 consultations conducted by NMFS Regional Offices from 2007-present.

Consultation Tracking Number	Consultation Name	Consultation Type	Location of Activity	Consultation Outcome	Take Authorized
NWR-2012-1465	Bally Mountain Vegetation Management	Formal Consultation	Idaho and Adams Counties, Idaho	Biological Opinion: No Jeopardy/No Adverse Modification	Extent of take exceeded if more than once in a year, in any unit disturbed by project activities, there is evidence of rills or gullies carrying sediment to stream channels

Consultation Tracking Number	Consultation Name	Consultation Type	Location of Activity	Consultation Outcome	Take Authorized
WCR-2014-605	2014-2024 Riparian Noxious Weed Control Program	Formal Consultation	Custer and Blaine Counties, Idaho	Biological Opinion: No Jeopardy/No Adverse Modification	Extent of take exceeded if BLM chemically treats >160 riparian acres adjacent to waters occupied by anadromous fish in any year
WCR-2015-2310	Hazard Creek Fuels Management and Crossing Maintenance Project	Informal Consultation	Idaho County, Idaho	Letter of Concurrence: No Jeopardy/No Adverse Modification	No take authorized
NWR-2007-3164	Cottonwood Area Noxious Weeds	Informal Consultation	Idaho County, Idaho	Technical Assistance Provided	No take authorized

Since none of these site-specific consultations have resulted in jeopardy findings, it would indicate that the assumptions made in the 2007 national programmatic consultation are valid, at least to date. In order for these assumptions to continue to be valid, the same trend of no jeopardy conclusions would have to continue in future site-specific consultations concerning BLM's vegetation treatment program activities. Those activities could involve all available permitted treatment options, as well as treatment methods using herbicides containing the three proposed AIs considered in this consultation. Once again, as in the 2007 consultation, if there were a pattern of jeopardy conclusions at the site-specific level involving the use of the three proposed AIs, such a pattern would challenge the validity of this consultation. This pattern would constitute new information that would have to be considered in a subsequent programmatic consultation.

Numerous other informal and formal consultations have taken place between BLM and NMFS Regional Offices concerning actions involving timber sales, road restoration projects, installation of estuary habitat improvement structures, wetland restoration, grazing actions, boat ramp removals, and the integrated pest management programs (which includes the application of pesticides). While these categories of actions do not fall within BLM's vegetation management treatment program, the fact that these consultations are occurring do demonstrate that BLM works to fulfill its obligations under the ESA across several programs, including its vegetation management program.

As a result of BLM seeking input from the Services, a series of questions were developed for the PUP and to be entered into the National Invasive Species Information Management System. This tracking system used by BLM is currently used to track pesticide use on BLM lands, and will now also be used to track local level section 7 consultations. These questions record whether ESA-listed resources are present in the proposed treatment area, whether or not the BLM field office sought section 7 consultation with the Services, and the outcome of the consultation. The National Invasive Species Information Management System generates an annual report, and this information on site-specific consultations will be provided to NMFS and USFWS. Once implemented, this portion of the vegetation treatment program will serve as a valuable tool, providing a summary from BLM on site-specific vegetation management program consultations in a single annual report.

5.8.2 Ecological Risk Assessments Mitigation Measures

In addition to identifying potential risks of an AI to non-target plants and animals, the ERAs are meant to provide more detailed guidance to land managers when deciding what herbicides to use and what protective measure to take. While the SOPs and the programmatic conservation measures (sections 2.1.5 and 2.1.6) do provide mitigation measures for using herbicides containing aminopyralid, fluroxypyr, and rimsulfuron (or any of the other currently approved AIs), these measures are general and are meant to be tailored by the BLM field offices during the planning of site-specific activities.

Each of the three proposed AIs had an ERA prepared for it, and each ERA presents the potential risk to non-target plants and animals under a variety of exposure scenarios. Various exposure pathways were evaluated (see section 2.1.7), and estimated exposure concentrations for the receptor groups were identified. RQs were calculated and then compared to levels of concern for specific risk categories (BLM 2014a; BLM 2014c; BLM 2014d). In BLM's SOP, as a precaution to minimize impacts to protected species, BLM will survey a project site for ESA-listed resources and engage with the Services for section 7 consultations as necessary. A site-specific section 7 consultation would be necessary if ESA-listed resources would be exposed to the proposed site-specific activities. During a site-specific consultation, the ERAs would be used as a reference to develop mitigation measures.

One of the more practically applicable pieces of information provided in the ERAs in terms of mitigation measures are the recommended distances for buffer zones when herbicides are applied. The buffer zone distances were developed for ground and aerial application, at both the typical and maximum application rates, and over different terrains (e.g., forest, non-forested land). Specific buffer zone distances were calculated for when rare, threatened or endangered species are present to minimize effects to these species. The ERAs also provide explicit instruction for land managers to consider the proximity of application areas to salmonid habitat and the effects of herbicides on riparian vegetation (BLM 2014c) (BLM 2014d) (BLM 2014a). The ERAs concluded that adherence to the application guidelines would minimize the potential negative effects on non-target plants and animals, and any indirect effects to salmonids or their habitat.

5.9 Exposure and Response Analysis

The response analyses determine how listed resources are likely to respond after exposure to a stressor created by the action in the action area. Our response analysis attempts to detect potential lethal, sub-lethal (or physiological), or behavioral responses that might result in reducing the fitness of listed individuals. Ideally, response analyses would consider and weigh evidence of adverse consequences as well as evidence suggesting the absence of such consequences.

ESA-listed resources could be exposed to herbicides containing the proposed AIs—aminopyralid, fluroxypyr, and rimsulfuron—by co-occurring on BLM-administered lands where a vegetation management program using the AIs is being carried out. While exposure concentrations were estimated for some modeled aquatic habitats, we expect actual exposure could be either greater than or less than the predicted concentrations considering the variability in habitats used by individuals of these species and potential differences in site-specific conditions. For this consultation, it is difficult to predict either number of individuals exposed or the magnitude of exposure of ESA-listed resources due to the broad scope of the action and the numerous variables at the site-specific project level which would influence how the individual actions are conducted.

5.9.1 Exposure and ESA-Listed Resources

There are several factors about any site-specific vegetation management project that could affect the amount of exposure to ESA-listed resources which could occur. These factors include the location where the vegetation management treatment project would occur, and how a site-specific project is designed.

5.9.1.1 Exposure and Location

At this stage in this consultation, we have no way of knowing where exactly site-specific vegetation management projects would occur. The proposed action area includes 247 million acres of public lands throughout the western U.S., including Alaska. BLM has the authority to use herbicides to treat up to 932,000 acres annually (or about 0.4% of BLM-administered lands), and for the purposes of evaluating effects on ESA-listed resources, we are using this figure in this consultation (BLM 2015a). Implementing vegetation treatment programs is also contingent on funding. The number of acres of public lands treated using herbicides from 2006 to 2012 varied from 305,971 to 647,368 annually (BLM 2015a).

We can assume that ESA-listed species or designated critical habitats that co-occur on BLM-administered lands where vegetation treatment programs are being carried out could be exposed to the proposed AIs. ESA-listed species range and designated critical habitat fall within five of the 17 states in the action area: Alaska, Washington, Idaho, Oregon, and California. BLM provided GIS data online[10], NMFS downloaded the files representing BLM-administered lands, and compared these areas against GIS files depicting ESA-listed species range and designated critical habitat[11]. The amount of expected exposure of ESA-listed resources would be a function of the amount of BLM-administered lands in a given area, and the occurrence of ESA-listed species and designated critical habitat.

BLM-administered lands are not evenly distributed between the states in the action area, with some states possessing more public lands than others. Of the five states in the action area where ESA-listed resources occur, Alaska has the highest number of acres of BLM-administered land (BLM 2014b). Alaska is followed by Oregon, California, Idaho, and Washington (Table 7).

Table 7 Number of acres of public lands under BLM administration in Alaska, Idaho, Washington, Oregon and California, fiscal year 2013, with the number of ESA-listed species considered in this opinion occurring in each state. Adapted from BLM Public Land Statistics 2013, Table 1-4.

State	Acres	ESA-listed species (n)
Alaska	72,363,733	1
Idaho	11,612,848	7
Washington	429,083	15
Oregon	16,142,471	13
California	15,343,828	13

However, a greater amount of acreage of BLM land does not necessarily directly relate to a higher probability of expected exposure for all ESA-listed resources. ESA-listed species and designated critical habitat are not evenly distributed throughout the action area, and may not be present on all BLM-administered lands, or there might be more ESA-listed resources found in some states than others. For instance, although Alaska has over 72 million acres of BLM-administered lands within its boundaries, the only ESA-listed species considered in this opinion which occurs in Alaska is eulachon. Designated critical habitat could be exposed to the proposed

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[10] http://www.geocommunicator.gov/GeoComm/services.htm#Download
http://www.geocommunicator.gov/GeoComm/services.htm#Download

[11] NMFS GIS files are available online at http://www.nmfs.noaa.gov/gis/data/fisheries.htm
http://www.nmfs.noaa.gov/gis/data/fisheries.htm

actions if a site-specific vegetation management treatment program took place in an area where critical habitat had been designated. Critical habitat has been designated for eulachon, green sturgeon, and nearly every Pacific salmonid DPS (Table 4). There is no designated critical habitat for these species in Alaska, but there is designated critical habitat in Washington, Idaho, Oregon, and California, and occurs on BLM-administered lands. Whether or not any particular unit of designated critical habitat on BLM-administered lands in the action would also be part of a vegetation management treatment program would be evaluated at the site-specific level during subsequent consultations.

In Idaho, Oregon, and California, there is a relatively greater amount of BLM-administered land than in other states (Table 7), and thus a higher probability that BLM vegetation treatment programs would occur in these states. We expect that ESA-listed resources in Idaho, Oregon, and California to thus have a higher likelihood of exposure to the proposed action than do ESA-listed resources in Washington or Alaska. According to the SOP, during the planning phase and prior to any vegetation program being carried out, BLM would conduct a site survey to determine the presence or absence of any ESA-listed resources, and consult with the Services as necessary. The actual likelihood of exposure to any ESA-listed resources due to the proposed action would be determined at the site- and project-specific level in future consultations.

It is possible that ESA-listed species like Pacific salmonids, eulachon, and green sturgeon of both sexes could be exposed to herbicides containing the three proposed AIs at all life stages, with the exception of those life stages which occur in the marine or estuarine environments. Southern Resident killer whales could be exposed by consuming Chinook salmon exposed to the proposed AIs, most probably while feeding during the summer months (May-September) (Hanson et al. 2010a). Herbicides would not be used in coastal areas, and the herbicides containing the three proposed AIs are not registered for aquatic use. However, when these species are in life stages that bring them inland to freshwater habitat (e.g., spawning adults, early life stages, and larvae), the likelihood of exposure to the proposed activities would be greater.

5.9.1.2 Exposure and Project Design

Vegetation management is achieved through a variety of means, as described in BLM's 2007 BA, and could include prescribed fire, non-commercial thinning, and herbicide use, among other methods (BLM 2007b). A site-specific vegetation management program may not necessarily include the use of all available methods, depending on the goals of the program at that site or any other practical reasons. As was discerned from the review of the informal and formal section 7 consultations, herbicides are just one of several techniques that are employed in vegetation treatment programs during site-specific projects. For instance, the 2014-2024 Riparian Noxious Weed Control Program is using a combination of five specific herbicides, manual control, biological agents, and cultural control (i.e., preventing weed introduction by requiring certain actions on public lands, like only using certified weed-free grains or seed). In the Bally Mountain

Vegetation Management Project, the actions include timber harvest and prescribed fire to meet program goals of riparian restoration.

Therefore, herbicides containing aminopyralid, fluroxypyr, and rimsulfuron (or any of the other currently approved AIs) would not necessarily be used in every site-specific treatment program. Even the frequency of AI use is expected to vary, as shown in Table 2 (BLM 2015a). Because of this, ESA-listed species or designated critical habitat may not be exposed to herbicides containing the proposed AIs when BLM conducts a site-specific vegetation management program. Those resources could still be exposed to other treatment methods, and the effects of those actions would be evaluated during Regional consultations on site-specific treatment programs.

It is not possible to know the frequency or level of intensity to which ESA-listed species or designated critical habitat would be exposed by the proposed activities. The design of any future site-specific vegetation treatment activities can depend on any number of local conditions and project-specific goals. In turn, the likelihood of exposure for ESA-listed resources to herbicides containing the proposed AIs is highly variable, and we are not able to definitively determine the extent or magnitude of exposure in the scope of this consultation. As part of their SOP (see section 2.1.5), BLM would review any proposed project site for ESA-listed resources, and engage with the Services in section 7 consultation as needed—that is, if it was determined that ESA-listed resources could be exposed to herbicides containing the proposed AIs. Subsequent consultations on site-specific activities, which would take place at the appropriate Regional Office, would be more able to accurately assess the level of exposure for ESA-listed resources.

5.9.2 Exposure and the Ecological Risk Assessments

The National Academy of Sciences National Research Council developed guidelines for USFWS, NMFS and EPA for assessing risks to threatened and endangered species from pesticides (NRC 2013). This guidance contained a general pathway for assessing risk in ecological risk assessments and during ESA section 7 consultations. It involves an exposure analysis, followed by an effects analysis, to arrive at a risk characterization for the pesticide (or herbicide).

All three of the proposed AIs have been registered in accordance with FIFRA (EPA 1998) (EPA 2005) (DuPont 2009), and BLM prepared ERAs and provided these documents during consultation. Pathways for aminopyralid, rimsulfuron, and fluroxypyr, exposure evaluated included:

- Direct contact with the herbicide or a contaminated water body,
- Off-site spray drift to terrestrial areas and water bodies (modeled using AgDRIFT®),
- Surface runoff from the application area to off-site soils or water bodies (modeled using GLEAMS),

- Accidental spills to water bodies.

For exposure pathways in or around water, the two generic water bodies are used in the exposure situation—a small pond and a stream meant to be typical of a low-order stream in the Pacific Northwest, suitable for anadromous salmonids. The ERAs used a surrogate species—rainbow trout (*Oncorhynchus mykiss*), to evaluate the effects of exposure on ESA-listed Pacific salmonids.(BLM 2015a{BLM, 2014 #4532) (BLM 2014d) (BLM 2014c). Although there is the potential for accidental spills into waterbodies, or off-site drift into waterbodies, it should be pointed out that none of the proposed AIs are registered for aquatic use {BLM, 2015 #4529}.

There is a lack of species-specific information, and this, along with other factors, complicates our ability to accurately predict an ESA-listed species' response to exposure from any of the proposed AIs. To account for that, the ERAs took a protective approach in assessing risk to ESA-listed resources. Impacts to listed species were evaluated by assuming exposure of the species and their habitat (e,g, food and cover) to peak concentrations estimated to occur in habitat near the treatment site during runoff and spray drift events.

As mentioned above, the ERAs used a surrogate species to represent the effects of AI exposure to ESA-listed Pacific salmonids only. The effects of exposure from the proposed AIs on Southern resident killer whales, eulachon or green sturgeon are unknown, and were not specifically addressed in the ERAs. However, we believe that the recommended mitigation measures in place to protect ESA-listed Pacific salmonids would also serve to protect eulachon and green sturgeon. Eulachon and green sturgeon could be subjected to the same direct and indirect effects from the proposed action as any of the ESA-listed salmonids, and mitigation measures like the programmatic requirements for consultation, standard operating procedures, and recommended buffer distances, would serve to minimize exposure for green sturgeon and eulachon as well. Furthermore, we believe that minimizing the likelihood of exposure to Chinook salmon and other Pacific salmonids would reduce the likelihood that Southern Resident killer whales or their designated critical habitat could be affected by the proposed action. If Southern Resident killer whales consume Chinook salmon that had been exposed to the three proposed AIs, Southern Resident killer whales and their critical habitat could be indirectly affected by herbicides. Thus, reducing the likelihood of exposure for Chinook salmon would in turn reduce the likelihood of exposing Southern Resident killer whales and their critical habitat to the proposed action. Should any new information specific to the effects of any of the proposed AIs on eulachon or green sturgeon (or any other species considered in this consultation) become available, that information would be incorporated into any subsequent consultation on a site-specific vegetation management program.

In the context of risk assessment, effects can be characterized as lethal, sublethal, indirect and cumulative, and can occur at the individual or population level. Lethal effects from herbicide exposure would mean that exposure resulted in the death of ESA-listed species. Sublethal effects in ESA-listed species could be diminished sensory capacity, reaction time, swimming ability, buoyancy control, or other behaviors or functions that impact an individual's ability to survive, thrive, or reproduce. Indirect effects to ESA-listed species could be impacts to prey dynamics or habitat quality, or other factors that inhibit an ESA-listed species' ability to feed or have adequate habitat.

Lethal effects would constitute take by killing an ESA-listed species. Both sublethal and indirect effects that impact individual fitness would constitute take and fit under the NMFS definition of "harm" (50 CFR 222.102): "an act which 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."

The ERAs assessed direct effects by using a risk quotient model that involved dividing an estimated exposure concentration by an effect concentration based on published data. The LC_{50}[12] for each AI were calculated using rainbow trout as a surrogate species. The LC_{50} for aminopyralid, rimsulfuron, and fluroxypyr are >100 mg/L, >390 mg/L, and 13.4 mg/L respectively (DuPont 2009; EPA 1998; EPA 2005). The risk quotient is then compared to levels of concern established by the EPA Office of Pesticide Programs to determine the likelihood of an effect in the exposure situations (e.g., direct contact, off-site spray, surface runoff, or accidental spill). The recommended buffer distances were then derived from the modeled distances in exposure situations.

While risk quotients using LC_{50} data are an efficient way to characterize risk, the approach is less than ideal for making endangered species determinations because they do not provide information to evaluate the probability of effects to individuals (NRC 2013). Additionally, the risk quotient approach does not address impacts at the population scale. Assessing population level effects requires more involved analysis and may include population modeling, using parameters specific to a particular species or the characteristics of an area (if available) during subsequent site-specific consultations.

5.9.3 Response Analysis

Based on the information presented in the AI fact sheets, the ERAs, and SOPs, herbicides containing aminopyralid, rimsulfuron, and fluroxypyr pose little risk of acute mortality to ESA-listed species through direct contact due to the relatively low LC_{50} for each AI. Provided the land managers follow all necessary protocol during site-specific application, accidental spills are unlikely, and the likelihood of spray drift is diminished with the use of the recommended buffer distances. Sublethal effects to fish species from exposure to aminopyralid, fluroxypyr or rimsulfuron were not observed (BLM 2014a; BLM 2014c; BLM 2014d).

However, we must also consider the response to the ESA-listed species' habitat from the AIs, especially potential impacts to riparian vegetation. Significantly altering the vegetation

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[12] LC50 is the lethal concentration required to kill 50% of the population.

surrounding streams occupied by ESA-listed fish can affect water quality parameters like temperature and dissolved oxygen. Loss of vegetation can increase the amount of sediment that can wash into a waterbody. An herbicide containing one of the proposed AIs could impact the quantity, quality or presence of prey species that ESA-listed species rely upon, which in turn could have detrimental effects on ESA-listed species. It should be noted that, in this case, an indirect effect on an ESA-listed species could also mean a direct effect to a primary constituent element (PCE) of designated critical habitat. A PCE for Southern Resident killer whale critical habitat includes adequate prey resources (e.g., Chinook salmon); therefore, a direct or indirect effect to Chinook salmon that affects its ability to be present as prey in Southern Resident killer whale critical habitat would constitute an adverse modification. Several of the critical habitat designations for ESA-listed fish contain PCEs that dictate particular water quality, substrate and tree cover requirements. If use of an herbicide in a vegetation management program resulted in a loss of riparian vegetation, it could constitute an adverse modification of critical habitat. During consultation while conferring with NMFS staff, some concerns were expressed about the indirect effects of the use of rimsulfuron in riparian areas because it is toxic to vascular plants. Harming vegetation in riparian zones could have indirect effects on ESA-listed species and designated critical habitat. However, by applying the recommended buffer distances, and using the information available in the ERAs during site-specific vegetation treatment consultations, the likelihood of a response from indirect effects of exposure is diminished.

While vegetation removal treatments can result in adverse effects to ESA-listed species and designated critical habitat through increased rates of erosion and reduced soil productivity in riparian areas, these effects are generally short-term in nature; as native vegetation becomes re-established, functionality returns to the treated area Although repeated treatments are required in some circumstances, these treatments could help to restore the ecological functions of watersheds. Vegetation treatments that control populations of non-native species on BLM-administered lands would be expected to benefit native plant communities over the long-term by aiding in the re-establishment of native species. Improvements of watersheds and water resources and quality would also benefit listed resources that depend upon these habitats for their survival. The degree of benefit would depend on the success of these treatments over both the short and long-term.

5.10 Risk Analysis

In following the NRC guidance, this section will discuss risk characterization—that is, to acknowledge data gaps, natural variability, and other parameters that influence our confidence in the degree of risk exposure poses to ESA-listed resources (NRC 2013).

The ecological significance of sublethal toxicological effects to individual fish or Southern Resident killer whales depends on the degree to which essential behavior patterns are impaired, and the number of individuals exposed to those harmful effects. Sublethal effects could compromise the viability and genetic integrity of wild populations if the effects are widespread across an entire DPS or ESU, or if localized exposures result in the concentrated loss of fish in a geographic area occupied by a local population with unique genetic traits.

The potential for individual fitness consequences (i.e., assessment endpoints described in the ERAs) can be evaluated by comparing the range in expected exposure concentrations with adverse effect levels in the context of aquatic habitat utilization. These endpoints would be most appropriately applied during site-specific consultations on vegetation treatment programs at the Regional level.

There are numerous complexities when it comes to assessing the potential ecological risk associated with the use of herbicides containing the three proposed AIs. Therefore, the most meaningful and applicable risk analysis will occur at the site specific level during subsequent consultations at the Regional Offices. The ERAs prepared for aminopyralid, rimsulfuron, and fluroxypyr took a concentration ratio approach, and made recommendations to reduce expected environmental concentrations (e.g. increased buffer distances) below effect thresholds. The recommendations in the ERAs are to be used as guidance by BLM land managers when site-specific vegetation programs are designed and implemented. Furthermore, programmatic conservation measures (discussed in section 2.1.6) provide additional instruction on how vegetation management programs are to be carried out in order to protect ESA-listed species and designated critical habitat. Each one of these sources can be utilized by the Services and BLM during site-specific consultations.

5.11 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Population growth rates and urbanization are expected to increase in the future, compounding already tenuous ecosystems for ESA-listed resources. State and private activities on lands adjacent to BLM-administered lands include pesticide treatments on agricultural lands and rangelands as well as private lawns which could adversely affect ESA-listed resources by drift and runoff either directly killing ESA-listed species or degrading riparian habitat that provides shade, cover, and other essential functions. Legacy pesticides such as DDT and non-point source pollution will continue to impact the water quality essential to the survival and recovery of ESA-listed species.

5.12 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 5.11) to the environmental baseline (Section 5) and the cumulative effects (Section 5.11) to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a ESA-listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species. These assessments are made in full consideration of the status of the species and critical habitat (Section 4).

The following discussions summarize the probable risks the proposed action poses to threatened and endangered species by taxa and critical habitat that are likely to be exposed. These summaries integrate the exposure profiles presented previously with the results of our response analyses for each of the actions considered in this opinion.

Factors discussed in the cumulative effects section (5.11) like pesticide treatments occurring on adjacent lands and habitat degradation are expected continue into the future and pose risks to ESA-listed resources. The factors affecting the baselines for each species considered in this opinion (e.g., climate change, habitat loss, pollution, etc.) as expected to continue as well. As discussed in the environmental baseline 5.2.1.4), the framework of BLM's current vegetation management program serves to insure that future site-specific vegetation treatment programs will be properly examined and designed to minimize risk to ESA-listed resources. It also works to insure that the agency fulfills its requirements under section 7 of the ESA. Furthermore, one of the primary goals of the BLM vegetation management program is to reduce or remove invasive plants from BLM-administered lands. Ideally, such actions would allow native plants to re-establish, improving habitat for ESA-listed species, in particular, Pacific salmon (Sanderson et al. 2009b).

The Regional consultations that have occurred since the 2007 opinion (Table 6) indicate that BLM's SOPs are being implemented, and resulting in no jeopardy opinions, lending credence to the assertion that BLM's current framework is effective. The Regional consultation reporting that will be in place (section 2.1.9) will provide us with a mechanism for tracking how the BLM vegetation management program is being implemented. This will allow us to better identify, analyze and collect information about herbicide use on BLM lands, and in turn to more comprehensively analyze risk to ESA-listed resources by better informing future baselines. As to assessing risk from the three AIs to species in this consultation, we cannot say with any certainty that ESA-listed fish or Southern Resident killer whales will not be harmed through sublethal effects or indirectly harmed through toxic effects on other aquatic organisms and riparian vegetation. Sublethal effects from water contamination by herbicides cannot be discounted based on the available information. Water contamination by herbicides is likely to occur in occasional circumstances, and sublethal effects from herbicides may occur within the range of concentrations likely to occur under the proposed action. Of the particular herbicides containing the AIs proposed for use, little is known about their sublethal effects on ESA-listed Pacific salmonids, Southern Resident killer whales, green sturgeon or eulachon, their effects on aquatic ecosystems, or threshold concentrations where these sublethal effects might occur. Where sublethal assays have been reported for salmonids, harmful effects occur at concentrations as much as several orders of magnitude less than the lethal endpoints used by EPA to assess pesticide risk.

The critical habitat elements most likely to be affected by the proposed action include water quality, riparian vegetation, natural cover/shelter, and forage/food. Modification of these PCEs may affect freshwater spawning, rearing or migration in the action area. Proper function of these essential features is necessary to support successful adult and juvenile migration, adult holding, spawning, incubation, rearing, and the growth and development of juvenile fish. Effects of chemical weed treatments on designated critical habitat will vary at each location. Potential for effects will depend on the size of the treatment area, the chemicals used, method of application, distance from water, and vegetative characteristics of the treatment areas. All of these factors would be evaluated at subsequent site-specific vegetation treatment program consultations at the Regional Offices. Additional protective measures could be applied as necessary.

In addition to the effects from use of herbicides containing aminopyralid, rimsulfuron, and fluroxypyr, we must also consider the effects in context of the continued implementation of BLM’s national vegetation treatment program. We have no evidence that the SOPs and protective measures in place that are part of the national vegetation program, are, by themselves alone, sufficient to prevent adverse effects to ESA-listed resources. Instead, it is only through site-specific consultations that vegetation management activities are more specifically tailored to avoid or minimize adverse effects to ESA-listed resource. Since local-level section 7 consultations will be tracked, and vegetation management activities are scrutinized for project implementation, effectiveness monitoring for actual amounts or extent of take will enable NMFS to examine the actual effects of vegetation treatments and determine when adjustments are needed to further reduce adverse effects. To further monitor the program, BLM developed questions for the PUP in to National Invasive Species Information Management System to record whether ESA-listed resources are present in a treatment area, and the results of any subsequent section 7 consultation (2.1.9). The annual report generated from this system will provide valuable information to NMFS and BLM on the efficacy of the SOPs, the presence of ESA-listed resources, and the outcomes of site-specific vegetation treatment program consultations.

BLM ensures that its vegetation treatment program is not likely to jeopardize the continued existence of threatened and endangered species and not likely to adversely modify their critical habitat through the programmatic vegetation treatment process, during which vegetation treatments are designed to avoid or minimize adverse effects to listed resources. Subsequent site-specific consultations account for not only individual effects to ESA-listed species and critical habitat, but also any incremental cumulative effects caused by on-going vegetation treatment activities.

6 CONCLUSION

After reviewing the current status of the ESA-listed species, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent actions, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of Southern Resident killer whales, eulachon, green sturgeon, any ESA-listed DPS/ESU of Chinook, chum, coho or sockeye salmon or steelhead, or to destroy or adversely modify any of the critical habitat designated for these species.

7 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a 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 regulation to include significant habitat modification or degradation that results in death or injury to ESA-listed species by significantly impairing essential behavioral patterns, including breeding, 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. Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement.

The proposed addition of the three new AIs—aminopyralid, fluroxypyr, and rimsulfuron—to BLM's list of approved herbicides in its vegetation treatment program does not authorize the "take" of threatened or endangered species unless that "take" has already been exempted from the prohibitions of section 9 of the Endangered Species Act of 1973, as amended, through a separate biological opinion. As actions pertaining to the use of herbicides containing the three new AIs arise within the action area (i.e., any of the 17 Western states), NMFS would conduct a separate section 7 consultation and issue a separate biological opinion before any endangered or threatened species might be "taken"; the amount or extent of "take" would be identified in those subsequent consultations. Therefore, no incidental takes of ESA-listed fish or wildlife species is identified or exempted from the prohibitions of section 9 of the ESA in this opinion.

8 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on ESA-listed species or critical habitat, to help implement recovery plans or develop information (50 CFR 402.02).

We recommend the following conservation recommendation, which would provide information for future consultations involving the addition of active ingredients to BLM's vegetation treatment program that may affect ESA-listed species or designated critical habitat:

- In future programmatic consultations on any proposed changes to the vegetation treatment program, the BLM should include annual reports from the National Invasive Species Information Management System.

  1. To the maximum extent attainable, BLM should utilize their existing programs to protect and restore riparian habitat, including native plant species. Doing so can help improve baseline conditions for aquatic species by reducing sedimentation, nutrification, and deposition of pesticides and other contaminants into aquatic habitats.

In order for NMFS' Office of Protected Resources Endangered Species Act Interagency Cooperation Division to be kept informed of actions minimizing or avoiding adverse effects on, or benefiting, ESA-listed species or their critical habitat, BLM should notify the Endangered Species Act Interagency Cooperation Division of any conservation recommendations they implement in their final action.

9 REINITIATION OF CONSULTATION

This concludes formal consultation for BLM's proposal to add three new active ingredients aminopyralid, fluroxypyr, and rimsulfuron to its list of approved active ingredients for use on BLM lands in 17 Western states. As 50 CFR 402.16 states, reinitiation of formal consultation is required where discretionary Federal agency 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 agency action that may affect ESA-listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an effect to the ESA-listed species or critical habitat that was not considered in this opinion, or (4) a new species is ESA-listed or critical habitat designated that may be affected by the action.

This vegetation treatment program requires subsequent section 7 review on site-specific vegetation treatments and does not authorize take of ESA-listed species unless that take has been exempted from the section 9 prohibitions by a biological opinion on a site-specific action where a vegetation treatment using herbicides containing the AIs aminopyralid, fluroxypyr, and rimsulfuron is anticipated to take ESA-listed species or adversely modify designated critical habitat. There is no incidental take identified or exempted in this programmatic biological opinion. If take is anticipated for site-specific treatments, then the amount or extent of take will be identified during those consultations. In instances where the amount or extent of authorized take is exceeded, BLM must immediately request reinitiation of section 7 consultation from the NMFS region that conducted the consultation for the site-specific activity. Reinitiation of consultation may also be required on this opinion.

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