UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Blvd., Suite 1100
PORTLAND, OREGON 97232-1274

Refer to NMFS No: WCRO-2018-00288

May 10, 2019

Leanne Marten
Northern Region
26 Fort Missoula Road
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Randy Moore
Pacific Southwest Region
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Intermountain Region
Federal Building
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Diane Guidry, Acting
Pacific Northwest Region
Forest Service
1220 Southwest Third Avenue
Portland, Oregon 97204

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, Concurrence Letter, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Aerial Application of Fire Retardant on National Forest System Land within the jurisdiction of the National Marine Fisheries Service West Coast Region; California, Oregon, Washington, and Idaho

Dear Ms. Marten; Ms. Rasure; Mr. Moore; and Ms. Guidry:

Thank you for your letter of February 27, 2018, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the above referenced action.

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)(16 U.S.C. 1855(b)) for this action, and concluded that the action would adversely affect Pacific Coast Salmon EFH. Therefore, we have included the results of that review in Section 3 of this document.

In this biological opinion (Opinion), NMFS concludes that the action, as proposed, is not likely to jeopardize the continued existence of the following ESA-listed species:

Chinook Salmon: California Coastal; Central Valley Spring-run; Lower Columbia River; Puget Sound; Sacramento Winter-run; Snake River Fall-run; Snake River Spring/summer; Upper Columbia River Spring-run; and Upper Willamette River.

Steelhead: Puget Sound; Central California Coast; Central Valley; Lower Columbia River; Mid-Columbia River; Northern California; Snake River Basin; South-Central California Coast; Southern California; Upper Columbia River; and Upper Willamette River.

Chum: Hood River Canal Summer-run.

Coho Salmon: Lower Columbia River; Oregon Coast; and Southern Oregon/Northern California Coast.

Sockeye Salmon: Snake River.

NMFS also determined the action will not destroy or adversely modify designated critical habitat for all the above referenced species. Rationale for our conclusions is provided in the attached Opinion.

As required by section 7 of the ESA, NMFS provides an incidental take statement (ITS) with the Opinion. The ITS describes reasonable and prudent measures (RPM) NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this action. The take statement sets forth nondiscretionary terms and conditions, including reporting requirements, that the U.S. Forest Service (USFS) and any permittee who performs any portion of the action must comply with to carry out the RPM. Incidental take from actions that meet these terms and conditions will be exempt from the ESA take prohibition.

Although the USFS did not make ESA determinations for Southern Resident killer whales (*Orcinus orca*) and their critical habitat, NMFS' analysis identified potential impacts on the whale's prey base. For this reason, and in accordance with NMFS' policy on marine mammals, the attached document concludes the proposed action "may affect," but is "not likely to adversely affect" Southern Resident killer whales and their critical habitat.

Additionally, the USFS determined that the proposed action would have adverse effects on Columbia River chum salmon, North American green sturgeon, Pacific eulachon, and their designated critical habitats. However, upon completing our effects analysis, it is NMFS opinion that the proposed action is not likely to adversely affect these species or their designated critical habitats

This document also includes the results of our analysis of the action's effects on EFH pursuant to section 305(b) of the MSA, and includes seven Conservation Recommendations to avoid, minimize, or otherwise offset potential adverse effects on EFH. These Conservation Recommendations are a non-identical set of the ESA Terms and Conditions. Section 305(b)(4)(B) of the MSA requires federal agencies provide a detailed written response to NMFS within 30 days after receiving these recommendations.

If the response is inconsistent with the EFH Conservation Recommendations, the USFS must explain why the recommendations will not be followed, including the justification for any disagreements over the effects of the action and the recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many Conservation Recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the EFH portion of this consultation, NMFS asks that you clearly identify the number of Conservation Recommendations accepted.

Please contact Mr. Justin Yeager, Ellensburg, Washington, Justin.yeager@noaa.gov, 509-962-8911 x805; Ms. Nikki Leonard, Boise, Idaho, Nikki.leonard@noaa.gov, 208-378-5708; Mischa Connine, Portland, Oregon, Mischa.connine@noaa.gov 503-230-5401; Naseem Alston, maseem.alston@noaa.gov, 916-930-3655, Sacramento, California; or Eric Shott, Santa Rosa, California, eric.shott@noaa.gov, 707-575-6089if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Michael P. Tehan
Assistant Regional Administrator
Interior Columbia Basin Office

Enclosure

cc: J. Kahn – NMFS
E. Shott – NMFS
L. Conway – USFS

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion, Concurrence Letter, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response

Aerial Application of Fire Retardant on National Forest System Land within the Jurisdiction of the National Marine Fisheries Service West Coast Region; California, Oregon, Washington, and Idaho
NMFS Consultation Number: **WCRO-2018-00288**

Action Agency: U.S. Forest Service

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Hood Canal Summer-run Chum Salmon	Threatened	Yes	No	Yes	No
Puget Sound Chinook Salmon	Threatened	Yes	No	Yes	No
Puget Sound Steelhead	Threatened	Yes	No	Yes	No
Middle Columbia River Steelhead	Threatened	Yes	No	Yes	No
Snake River Fall-run Chinook Salmon	Threatened	Yes	No	Yes	No
Snake River Spring/Summer-run Chinook Salmon	Threatened	Yes	No	Yes	No
Snake River Sockeye Salmon	Endangered	Yes	No	Yes	No
Snake River Steelhead	Threatened	Yes	No	Yes	No
Upper Columbia River Spring-run Chinook Salmon	Endangered	Yes	No	Yes	No
Upper Columbia River Steelhead	Threatened	Yes	No	Yes	No
Columbia River Chum Salmon	Threatened	No	-	No	-
Lower Columbia River Chinook Salmon	Threatened	Yes	No	Yes	No
Lower Columbia River Coho Salmon	Threatened	Yes	No	Yes	No
Lower Columbia River Steelhead	Threatened	Yes	No	Yes	No
Upper Willamette River spring Chinook Salmon	Threatened	Yes	No	Yes	No
Upper Willamette River Steelhead	Threatened	Yes	No	Yes	No
Oregon Coast Coho Salmon	Threatened	Yes	No	Yes	No

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Southern Oregon /Northern California Coast Coho Salmon	Threatened	Yes	No	Yes	No
Northern California Steelhead	Threatened	Yes	No	Yes	No
California Coastal Chinook Salmon	Threatened	Yes	No	Yes	No
California Central Valley Steelhead	Threatened	Yes	No	Yes	No
Central Valley Spring-run Chinook Salmon	Threatened	Yes	No	Yes	No
Sacramento River Winter-run Chinook Salmon	Endangered	Yes	No	Yes	No
South-Central California Coast Steelhead	Threatened	Yes	No	Yes	No
Southern California Steelhead	Endangered	Yes	No	Yes	No
Central California Coast Steelhead	Threatened	Yes	No	Yes	No
Pacific Eulachon	Threatened	No	-	No	-
North American Green Sturgeon	Threatened	No	-	No	-
Southern Resident Killer Whale	Endangered	No	-	No	-

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Issued By:

Michael P. Tehan
Assistant Regional Administrator

Date: May 17, 2019

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ACRONYM	DEFINITION
B/R	Basin and Range
BA	Biological Assessment
BLM	Bureau of Land Management
BOR	Bureau of Reclamation
CC	California Coastal
CCC	Central California Coast
CCV	California Central Valley
cfs	cubic feet per second
cps	Centipoise
CS	Cascades-Sierra Nevada Mountains
CU	Columbia-Snake River Plateaus
CV	Central Valley
DCH	Designated Critical Habitat
DNA	Deoxyribonucleic Acid
DO	Dissolved Oxygen
DPS	Distinct Population Segment
DQA	Data Quality Act
E	Endangered
EFH	Essential Fish Habitat
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Units
HAPCs	Habitat Areas of Particular Concern
IC	Incident Commander
ITS	Incidental Take Statement
LC	Lower Coast
LWD	Large Woody Debris
mg/L	Milligrams per Liter
mi^2	square miles
mm	Millimeter
MPG	Major Population Groups
mph	Miles per Hour
MR	Middle Rocky
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NC	Northern California
NF	National Forest

ACRONYM	DEFINITION
NFS	National Forest System
NH_3	Un-ionized Ammonia
NH_4^+	Ionized Ammonia
NMFS	National Marine Fisheries Service
NR	Northern Rocky
O.	*Oncorhynchus*
Opinion	Biological Opinion
PB	Pacific Border
PBF	Physical and Biological Features
PCEs	Primary Constituent Elements
people/mi^2	people per square miles
PFMC	Pacific Fishery Management Council
ppm	Parts per Million
QPL	Qualified Products List
ROD	Record of Decision
RPM	Reasonable and Prudent Measure
SC	Southern California
S-CCC	South-Central California Coast
SONCC	Southern Oregon Northern California Coast
SRKWs	Southern Resident Killer Whale
T	Threatened
TRT	Technical Recovery Team
USFS	U. S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UV	Ultraviolet
VSP	Viable Salmonid Population
WCR	West Coast Region
WFCS	Wildland Fire Chemical Systems
WFDSS	Wildland Fire Decision Support System
WO	Washington Office

1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3 below.

1.1 Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (Opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), and implementing regulations at 50 CFR 402.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 600.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). A complete record of this consultation is on file at the Snake Basin Office in Boise, Idaho.

1.2 Consultation History

Listed below is the consultation history between the U.S. Forest Service (USFS) and NMFS between 2011 and 2018.

- November 7, 2011: NMFS issued the national biological opinion entitled "Aerial Application of Long-term Fire Retardants on All Forest Service Lands" (2011 Opinion) (NMFS tracking # PBO, FPR-2010-19) which exempted take up to one intrusion event per evolutionarily significant unit (ESU) or distinct population segment (DPS). The 2011 Opinion defined one intrusion event as when retardant is delivered to a stream designated as critical habitat or the 300-foot riparian area on each side of the stream.

- 2013–2016: Annual letters from the USFS to NMFS documenting compliance with Term and Conditions 1.a. and 1.b. in the 2011 Opinion (NMFS 2011). Each letter summarizes annual number of fire retardant applications on each Forest identified in the 2011 Opinion, and whether or not the application intruded into the buffer or water.

  May 21, 2014: Letter from USFS to NMFS documenting addition of Phos-Check MVP-F and Phos-Chek MVP-Fx to the long-term fire retardant Qualified Products List (QPL), which is a list of approved retardant formulations. The QPL contains retardant formulations that have undergone laboratory testing sufficient to show that they meet USFS standards; most notably in terms of low toxicity.
- November 25, 2015: In response to July 2013 Road 210 Fire intrusion, USFS provided NMFS with the final Biological Assessment (BA) to initiate consultation for Aerial

Application of Long-term Fire Retardant in the Snake River basin. An intrusion means the application of fire retardant into water while a misapplication means the application of fire retardant into the avoidance area that does not enter water.

- May 17, 2016: NMFS issued an Opinion entitled "Opinion for Aerial Application of Fire Retardant in the Snake River basin" (NMFS 2016s) (NMFS tracking # WCR-2015-1976). The take allowed under this Opinion was exceeded in 2016.

- July 26, 2016: Letter from the USFS to NMFS documenting addition of Phos-Check LC-95A-Fx and Phos-Chek 259-Fx to the QPL.

- January 25, 2017: Meeting held in Washington D.C. with NMFS and USFS to review findings and accomplishments from the past 5 years of implementation of 2011 Opinion and record of decision (ROD). Agreement reached on the components of the 5-year compliance review document for the Nationwide Aerial Application of Fire Retardant on National Forest System Lands.

- March 3, 2017: First interagency webinar presentation on investigative studies of the environmental safety of fire retardant and fire suppressant chemicals by the United States Geological Survey (USGS), Columbia Environmental Research Center in Columbia, Missouri. Topics included overview of study plan, results of studies, planned studies, and next phases moving forward. Participation included NMFS' Washington Office (WO) Headquarters and numerous field personnel, U.S. Fish and Wildlife Service's (USFWS) WO, other USGS study participants, and multiple USFS staff including Missoula Technology Development Center, WO Fire and Aviation Management, Rocky Mountain Research Station, and field personnel.

- March 6, 2017: Letter from the USFS to NMFS requesting reinitiation for aerial retardant activities in NMFS' West Coast Region (WCR). The USFS also requested early involvement for updating the 2011 BA with new information and monitoring data for ESA-listed species covered by NMFS' WCR.

- April 28, 2017: Meeting held in Portland, Oregon with NMFS and the USFS. Topics included: a summary of the findings of the 5-year compliance review document; the path forward for updating monitoring information and an updated ITS for the 2011 BA and Opinion; review of 2017 interim information; finalization of team members to develop a process to document information relevant to Aerial Application of Fire Retardant between 2012 and 2016; and, discussion regarding an update to the ITS for some NMFS WCR species covered in the 2011 BA and Opinion.

- May 24, 2017: Interagency call lead by USGS with NMFS and the USFS to discuss additional refinement of the spill calculator, a model that predicts the distance downstream that toxicity from a retardant intrusion will persist (the modeled point where the retardant will have been diluted to 10 percent of the LC_{50} [lethal concentration for 50 percent of the organisms]).

- May 26, 2017: Letter from the USFS to NMFS documenting additional protection measures (expanded 600-foot buffers during key spawning periods at specific locations) for 2017 on National Forests at their ITS limit or to reduce the potential of an intrusion.

- June 16, 2017: Interagency call lead by USGS with NMFS and the USFS to discuss additional refinement of the spill calculator.

- July 14, 2017: Interagency webinar led by USGS; presentation of observations and results of investigations of environmental safety of aerial fire retardants.

- August 3, 2017: Letter from NMFS to the USFS documenting NMFS WCR will conduct Section 7 consultation as described in the 2011 Opinion, and describing an expanded buffer from 300- to 600-foot in highly sensitive areas for the 2017 fire season.

- September 21, 2017: Draft tiered BA to 2011 BA submitted to NMFS for review.

- October 2, 2017: Comments and review of draft addendum from NMFS to the USFS and conference call discussing NMFS comments.

- December 13, 2017: Revised addendum to 2011 BA (including edits resulting from October 2 NMFS comments) submitted to NMFS for review.

- January 31, 2018: Interagency call between the USFS and NMFS to discuss NMFS' comments on December 13 draft addendum.

- February 14, 2018: Final draft addendum submitted to NMFS for review. This consultation is tiered to the 2011 Opinion and covers the area contained within the WCR only. The 2011 Opinion remains in force for the rest of the country.

- March 1, 2018: NMFS received a consultation package via email.

Although the USFS did not make ESA determinations for Southern Resident killer whales (SRKW) (*Orcinus orca*) and their critical habitat[1], NMFS' review of the action's effects on salmon and steelhead identified potential impacts on the prey availability for the whales. For this reason, this document also provides an analysis of effects, concluding with a determination of "may affect, not likely to adversely affect" for SRKW and their critical habitat (Section 2.12).

Additionally, the USFS determined that the proposed action would have adverse effects on Columbia River chum salmon, North American green sturgeon, Pacific eulachon, and their designated critical habitats. However, upon completing our effects analysis, it is NMFS opinion that the proposed action will not likely adversely affect these species or their designated critical habitats. This analysis is found in Section 2.12 of this document.

[1] Southern Resident Killer whales were listed as endangered on November 18, 2005 (70 FR 69903); critical habitat was designated on November 29, 2006 (71 FR 69054).

1.3 Proposed Federal Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies (50 CFR 402.02). For the EFH consultation, an action means all activities or programs authorized, funded, or undertaken, or proposed to be authorized funded, or undertaken by a federal agency (50 CFR 600.910). "Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart from the action under consideration (50 CFR 402.02). No interrelated or interdependent actions have been identified for this proposed action.

The 2011 Opinion (NMFS 2011) requires reinitiation if the extent of take specified in the ITS is exceeded. The NMFS 2011 Opinion defines "the exceedance of anticipated Incidental Take" as the point when more than one intrusion event has affected an ESA-listed species during the life of the proposed action (January 1, 2012 to January 1, 2022). In the western United States, multiple national forests have had one or more intrusion event(s) and are at, or have exceeded, the limit of the extent of take anticipated in the 2011 Opinion. In addition, two intrusions in 2016 on the Dry Creek Fire on the Sawtooth National Recreation Area in Idaho exceeded the extent of incidental take anticipated by the subsequent 2016 Snake River Opinion (NMFS# WCR-2015-1976). This Opinion serves as the reinitiation for both the 2011 and 2016 Opinions as it pertains to species under the jurisdiction of the NMFS WCR.

The USFS requested reinitiation of ESA-Section 7 consultation on its long-term fire retardant specifications as well as its continued aerial application of approved long-term fire retardants on USFS lands with ESA-listed species and critical habitat covered by NMFS WCR, including California, Oregon, Washington, and Idaho. The proposed action, as described in the 2011 Opinion (NMFS# FPR-2010-19) and modified as described below, is what is proposed in this consultation. The Proposed Action section of the 2011 Opinion is attached as Appendix A. The 2011 Opinion calls for reinitiation of consultation in 2020 with the issuance of a new Opinion in 2021. This current Opinion will cover the WCR until that time.

1.3.1 Approval process and new fire retardants

The USFS qualifies new long-term fire retardants in accordance with USFS Specification 5100-304c as well as the continued use of long-term fire retardants on the QPL dated September 5, 2017. In accordance with Section 3.5.1 of the specification, all long-term fire retardants considered for use under the fire retardant program must be composed of ammonium polyphosphate, monoammonium phosphate, or diammonium phosphate to impart combustion retarding effectiveness. Additionally, Section 3.4.2 of the specification requires that for fish toxicity all approved fire retardants have an LC_{50} (lethal concentration where 50 percent of the organisms die) for rainbow trout (*Oncorhynchus mykiss*) exposed to the concentrate to be above 100 milligrams per Liter (mg/L). In addition to these active ingredients, the compounds are combined with gum thickeners, such as guar gum, and suspending agents, such as clay, dyes, and corrosion inhibitors. The QPL is available on the USFS website https://www.fs.fed.us/rm/fire/wfcs/ret.htm. Each chemical is listed at a specific mix ratio.

Additional information on these wildland fire chemicals can be found at https://www.fs.fed.us/managing-land/fire/chemicals.

The USFS qualifies long-term fire retardants for use under its fire management program after the fire retardant products and their ingredients have been evaluated by the Wildland Fire Chemical Systems (WFCS) office and provided they meet USFS Specification 5100-304c requirements. Once approved, the WFCS maintains the long-term fire retardant QPL, which is one of three QPLs (the others are Class A Foams and Water Enhancers). This Opinion analyzes the effects of the currently approved aerially applied long-term fire retardants. The use of other firefighting chemicals, such as foams, and activities authorized, funded, or carried out by the USFS in response to wildland fires that were not proposed as part of the federal action, are not analyzed herein.

Four retardants have been approved and added to the list of long-term fire retardants since the 2011 Opinion. The current QPL is displayed in Table 1. The 2011 Opinion assessed three chemical bases, and noted that under the proposed action new formulations could be approved without reinitiation of consultation if the LC_{50} for rainbow trout exposed to the retardant was less toxic then 100 mg/L of retardant concentration in solution. The four retardants approved in 2014 and 2016 meet this requirement. NMFS was notified through letters from the USFS of additions in 2014 and 2016 to the QPL.

Table 1. Long-Term Retardants on the Current Qualified Products List.

Retardant	Comments
Phos-Chek MVP-Fx	Approved 2014
Phos-Chek LC-95A-Fx	Approved 2016
Phos-Chek LC-95A-R	Approved 2011
Phos-Chek LC-95-W	Approved 2011
Phos-Chek LC-95A-F	Approved 2011
Phos-Chek MVP-F	Approved 2014
Phos-Chek 259-Fx	Approved 2016
Retardants listed below were included in the 2011 BA but are no longer used.	
Phos-Chek D75-F	No longer produced, not used since 2012
Phos-Chek D75-R	No longer produced, not used since 2012
Phos-Chek G75-F	No longer produced, not used since 2012
Phos-Chek G75-W	No longer produced, not used since 2012
Phos-Chek P100-F	No longer produced, expect all stores to be depleted in 2018
Phos-Chek 259-F	No longer produced, expect all stores to be depleted in 2018

1.3.2 Fire Retardant Application

The proposed action includes aerial delivery of retardant only and does not address ground-based application of retardants, foams, water enhancers or other fire suppression activities. The USFS' proposed action does not include any other activities related to firefighting, wildland fires, emergency consultation, or the effects of wildland fire.

The 2011 BA (p. 9–17) and 2018 BA describes retardants and methods for aerial delivery of retardants on USFS lands in detail and is hereby incorporated by reference. All aerially applied retardants must meet USFS Specification 5100-304c requirements for long-term retardants including fish toxicity specifications. See Table 1 for a list of approved retardants. The type of retardant available and applied at a fire depends on a variety factors. For example, the infrastructure at an air tanker base may only allow mixing of a powder or liquid formulation. The capacity to store retardants at a tanker base may preclude use of some retardant types. In California, Phos-Chek MVP-Fx is a powder formulation, and all tanker bases have been converted or constructed to mix and add water for aerial use of Phos-Chek MVP-Fx. Air tanker bases, where most aircraft and retardants are stationed, are not all owned and managed by the USFS. Federally contracted aircraft that apply retardant may come from either USFS, Bureau of Land Management (BLM), or state air tanker bases. Aircraft cross jurisdictional lines, particularly from CAL FIRE bases in California or from BLM bases in the western states.

In order to assist in implementing the 2011 ROD's (USFS 2011) direction and requirements on using aerial application of fire retardants on national forest system lands, the USFS developed the Implementation Guide for Aerial Application of Fire Retardant (USFS 2012). The guide consists of direction for personnel such as pilots, Fire Management Officers, Incident Commanders (ICs), Resource Advisors, and others involved in the use of aerial fire retardant. It outlines the reporting and monitoring requirements at the local and national level, avoidance area mapping, data management, and coordination and reinitiation of consultation with regulatory agencies. The 2012 guide was updated in 2015, and last updated in 2016. Updates to the guide are conducted when there is a change in items such as new websites, new tools for assisting with intrusion effects, such as photos of coverage levels, or any other new information.

1.3.3 Avoidance Area Mapping Requirements

Avoidance areas are those areas within which the application of aerial fire retardant is not permitted. They provide a buffer between the aerial fire-fighting actions and anadromous habitat and are sometimes referred to as buffers in this Opinion. The avoidance area direction and national mapping process is described in the Implementation Guide and the 2018 BA. In 2017, as a result of some national forests reaching their incidental take limit, the USFS, with technical assistance from NMFS, implemented interim direction for specific forests with select Chinook and sockeye species. Buffers around aerial fire retardant avoidance areas were expanded to 600 feet, with the intent of reducing the risk for a retardant intrusion in specific areas during critical salmonid life stages (i.e., adult holding, spawning and early egg incubation). The 2017–18 maps are posted on the Aerial Fire Retardant website: https://www.fs.fed.us/managing-land/fire/chemicals/fisheries. However, the expanded buffers of 600 feet are not part of the proposed action.

Under the terms of the 2011 Opinion, local mitigation measures can be implemented, such as adjustment to buffer areas. For this consultation, NMFS will conduct our analysis using 300-foot avoidance areas because the USFS indicated this is the avoidance area it will use.

2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provides an Opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

The USFS determined the proposed action is likely to adversely affect:

> **Chinook Salmon:** California Coastal; Central Valley Spring-run; Lower Columbia River; Puget Sound; Sacramento Winter-run; Snake River Fall-run; Snake River Spring/summer; Upper Columbia River Spring-run; and Upper Willamette River.
>
> **Steelhead:** Puget Sound; Central California Coast; Central Valley; Lower Columbia River; Mid-Columbia River; Northern California; Snake River Basin; South-Central California Coast; Southern California; Upper Columbia River; and Upper Willamette River.
>
> **Chum:** Hood River Canal Summer-run.
>
> **Coho Salmon:** Lower Columbia River; Oregon Coast; and Southern Oregon/Northern California Coast.
>
> **Sockeye Salmon:** Snake River

The USFS also determined that the proposed action would adversely affect designated critical habitat for all these species.

2.1 Analytical Approach

This Opinion includes both a jeopardy analysis and/or 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.

This Opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (81 FR 7214).

The designations of critical habitat for species uses the term primary constituent element (PCE) or essential features. The new critical habitat regulations (81 FR 7414) replace this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a ''destruction or adverse modification'' analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this Opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Identify the range-wide status of the species and critical habitat expected to be adversely affected by the proposed action.

- Describe the environmental baseline in the action area.

- Analyze the effects of the proposed action on both species and their habitat using an "exposure-response-risk" approach.

- Describe any cumulative effects in the action area.

- Integrate and synthesize the above factors by: (1) Reviewing the status of the species and critical habitat; and (2) adding the effects of the action, the environmental baseline, and cumulative effects to assess the risk that the proposed action poses to species and critical habitat.

- Reach a conclusion about whether species are jeopardized or critical habitat is adversely modified.

- If necessary, suggest a reasonable and prudent alternative (RPA) to the proposed action.

2.2 Range-wide Status of the Species and Critical Habitat

This Opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02.

This Opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds that make up the designated area, and discusses the current function of the essential PBF that help to form that conservation value. Some of the designations of critical habitat for WCR species used the term "essential features" while others used "primary constituent elements". Both terms were used to identify features essential to the conservation of the species. New critical habitat regulations (81 FR 7214) replace these with PBF, the current terminology used to define critical habitat under the ESA.

One factor affecting the status of ESA-listed species considered in this Opinion, and aquatic habitat at large, is climate change. Climate change is likely to play an increasingly important role in determining the abundance and distribution of ESA-listed species, and the conservation value of designated critical habitats. These changes will not be spatially homogeneous across the West Coast. The largest hydrologic responses are expected to occur in basins with significant snow accumulation, where warming decreases snow pack, increases winter flows, and advances the timing of spring melt (Melillo et al. 2014; Mote et al. 2016). Rain-dominated watersheds and those with significant contributions from groundwater may be less sensitive to predicted changes in climate (Melillo et al. 2014; Tague et al. 2013).

During the last century, average regional air temperatures in the Pacific Northwest increased by 1–1.4°F as an annual average, and up to 2°F in some seasons (based on average linear increase per decade; (Abatzoglou et al. 2014; Kunkel et al. 2013). In California, average annual air temperatures, heat extremes, and sea level have all increased over the last century (Kadir et al. 2013). Warming is likely to continue during the next century as average temperatures are projected to increase another 3 to 10°F, with the largest increases predicted to occur in the summer (Lindley et al. 2007; Melillo et al. 2014; Moser et al. 2012). Decreases in summer precipitation of as much as 30 percent by the end of the century are consistently predicted across climate models (Melillo et al. 2014). Precipitation is more likely to occur during October through March, less during summer months, and more winter precipitation will be rain than snow (Dalton et al. 2013; ISAB 2007; Melillo et al. 2014; USGCRP 2009). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and water temperatures will be warmer (ISAB 2007; USGCRP 2009).

Models consistently predict increases in the frequency of severe winter precipitation events (i.e., 20-year and 50-year events), in the western United States (Dominguez et al. 2012). The largest increases in winter flood frequency and magnitude are predicted in mixed rain-snow watersheds (Mote et al. 2016). Heat waves are expected to occur more often, and heat wave temperatures are likely to be higher (Hayhoe et al. 2004; Kadir et al. 2013; Moser et al. 2012). Total precipitation in California may decline; critically dry years may increase (Lindley et al. 2007; Moser et al. 2012). Wildfires are expected to increase in frequency and magnitude (Moser et al. 2012; Westerling et al. 2011).

In many areas, existing cold-water salmonid habitat is likely to exceed key water temperature thresholds by the end of this century (USGCRP 2009). Higher temperatures will reduce the quality of available salmonid habitat for most freshwater life stages (ISAB 2007). Reduced flows will make it more difficult for migrating fish to pass physical and thermal obstructions, limiting their access to available habitat (Isaak et al. 2012; Mantua et al. 2010). Temperature increases shift timing of key life cycle events for salmonids and species forming the base of their aquatic foodwebs (Crozier et al. 2011; Tillmann and Siemann 2011; Winder and Schindler 2004). Higher stream temperatures will also cause decreases in dissolved oxygen and may also cause earlier onset of stratification and reduced mixing between layers in lakes and reservoirs, which can also result in reduced oxygen (Winder and Schindler 2004). Higher temperatures are likely to cause several species to become more susceptible to parasites, disease, and higher predation rates (Crozier et al. 2008; Wainwright and Weitkamp 2013).

As more basins become rain-dominated and prone to more severe winter storms, higher winter stream flows may increase the risk that winter or spring floods in sensitive watersheds will damage spawning redds and wash away incubating eggs (Goode et al. 2013). Earlier peak stream flows will also alter migration timing for salmon smolts, and may flush some young salmon and steelhead from rivers to estuaries before they are physically mature, increasing stress and reducing smolt survival (Lawson et al. 2004; McMahon and Hartman 1989).

In addition to changes in freshwater conditions, predicted changes for coastal waters as a result of climate change include increasing surface water temperature, increasing but highly variable acidity, and increasing storm frequency and magnitude (Melillo et al. 2014). Elevated ocean temperatures already documented for the Pacific Northwest are highly likely to continue during the next century, with sea surface temperature projected to increase by 1.0–3.7°C by the end of the century (IPCC 2014). Habitat loss, shifts in species' ranges and abundances, and altered marine food webs could have substantial consequences to anadromous, coastal, and marine species in the Pacific Northwest (Tillmann and Siemann 2011).

Moreover, as atmospheric carbon emissions increase, increasing levels of carbon are absorbed by the oceans, changing the pH of the water. Acidification also impacts sensitive estuary habitats, where organic matter and nutrient inputs further reduce pH and produce conditions more corrosive than those in offshore waters (Feely et al. 2012; Sunda and Cai 2012).

Global sea levels are expected to continue rising throughout this century, reaching likely predicted increases of 10–32 inches by 2081–2100 (IPCC 2014). These changes will likely result in increased erosion and more frequent and severe coastal flooding, and shifts in the composition of nearshore habitats (Tillmann and Siemann 2011). Estuarine-dependent salmonids such as chum (*O. keta*) and Chinook salmon (*O. tshawytscha*) are predicted to be impacted by significant reductions in rearing habitat in some coastal areas (Glick et al. 2007).

Historically, warm periods in the coastal Pacific Ocean have coincided with relatively low abundances of salmon and steelhead, while cooler ocean periods have coincided with relatively high abundances, and therefore these species are predicted to fare poorly in warming ocean conditions (Scheuerell et al. 2005; Zabel et al. 2006). This is supported by the recent observation that anomalously warm sea surface temperatures off the coast of Washington from 2013 to 2016 resulted in poor coho (*O. kisutch*) and Chinook salmon body condition for juveniles caught in those waters (NWFSC 2015). Changes to estuarine and coastal conditions, as well as the timing of seasonal shifts in these habitats, have the potential to impact a wide range of listed aquatic species (Tillmann and Siemann 2011).

The adaptive ability of these threatened and endangered species is depressed due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation. Without these natural sources of resilience, systematic changes in local and regional climatic conditions due to anthropogenic global climate change will likely reduce long-term viability and sustainability of populations (NWFSC 2015). New stressors generated by climate change, or existing stressors with effects that have been amplified by climate change, may also have synergistic impacts on species and ecosystems (Doney et al. 2012). These conditions will possibly intensify the climate change stressors inhibiting recovery of ESA-listed species in the future. However, the activities consulted on in this Opinion will be re-consulted on in 2 years as a part of the update of the 2011 national consultation. It is unlikely that climate change will change enough in the next 2 years to greatly affect this proposed action's effects.

2.2.1 Status of the Species

Table 2 provides a summary of listing and recovery plan information, status summaries and limiting factors for the species addressed in this Opinion. More information can be found in recovery plans and status reviews for these species. These documents are available on the NMFS WCR website (http://www.westcoast.fisheries.noaa.gov/).

Table 2. Listing classification and date, recovery plan reference, most recent status review, status summary, and limiting factors for species considered in this Opinion.

Species	Listing Classification and Date	Status Summary and Limiting Factors
Lower Columbia River Chinook Salmon	Listing Classification and Date: Threatened 6/28/2005 Recovery Plan Reference: (NMFS 2013a) Status Review: (NMFS 2016i)	Status Summary: This ESU comprises 32 independent populations. Twenty-seven populations are at very high risk, two are at high risk, one is at moderate risk, and two are at very low risk. Overall, there was little change since the last status review in the biological status of this ESU, although there are some positive trends. Increases in abundance were noted in about 70 percent of the fall-run populations and decreases in hatchery contribution were noted for several populations. Relative to baseline viable salmonid population (VSP) levels identified in the recovery plan, there has been an overall improvement in the status of a number of fall-run populations, although most are still far from the recovery plan goals. Limiting Factors: Reduced access to spawning and rearing habitat Hatchery-related effects Harvest-related effects on fall Chinook salmon An altered flow regime and Columbia River plume Reduced access to off-channel rearing habitat Reduced productivity resulting from sediment and nutrient-related changes in the estuary
Upper Columbia River Spring-Run Chinook Salmon	Listing Classification and Date: Endangered 6/28/2005	Status Summary: This ESU comprises three independent populations. All three are at high risk. Current estimates of natural origin spawner abundance increased relative to the levels observed in the prior review for all three extant populations, and productivities were higher for the Wenatchee and Entiat populations and unchanged for the Methow population. However, abundance and productivity

Species	Listing Classification and Date	Status Summary and Limiting Factors
	Recovery Plan Reference: (UCSRB 2007) Status Review: (NMFS 2016o)	remained well below the viable thresholds called for in the Upper Columbia Recovery Plan for all three populations. Limiting Factors: Effects related to hydropower system in the mainstem Columbia River Degraded freshwater habitat Degraded estuarine and nearshore marine habitat Hatchery-related effects Persistence of non-native (exotic) fish species Harvest in Columbia River fisheries
Snake River Spring/Summer-run Chinook Salmon	Listing Classification and Date: Threatened 6/28/2005 Recovery Plan Reference: (NMFS 2017b) Status Review: (NMFS 2016m)	Status Summary: This ESU comprises 28 extant and four extirpated populations. All except one extant population (Chamberlin Creek) are at high risk. Natural origin abundance has increased over the levels reported in the prior review for most populations in this ESU, although the increases were not substantial enough to change viability ratings. Relatively high ocean survivals in recent years were a major factor in recent abundance patterns. While there have been improvements in abundance and productivity in several populations relative to prior reviews, those changes have not been sufficient to warrant a change in ESU status. Limiting Factors: Degraded freshwater habitat Effects related to the hydropower system in the mainstem Columbia River Altered flows and degraded water quality Harvest-related effects Predation
Upper Willamette River Chinook Salmon	Listing Classification and Date: Threatened 6/28/2005 Recovery Plan Reference: (ODFW and NMFS 2011) Status Review: (NMFS 2016p)	Status Summary: This ESU comprises seven populations. Five populations are at very high risk, one population is at moderate risk (Clackamas River) and one population is at low risk (McKenzie River). Consideration of data collected since the last status review in 2010 indicates the fraction of hatchery origin fish in all populations remains high (even in Clackamas and McKenzie populations). The proportion of natural origin spawners improved in the North and South Santiam basins, but is still well below identified recovery goals. Abundance levels for five of the seven populations remain well below their recovery goals. Of these, the Calapooia River may be functionally extinct and the Molalla River remains critically low. Abundances in the North and South Santiam rivers have risen since 2010, but still range only in the high hundreds of fish. The Clackamas and McKenzie populations have previously been viewed as natural population strongholds, but have both experienced declines in abundance despite having access to much of their historical spawning habitat. Overall, populations appear to be at either moderate or high risk, there has been likely little net change in the VSP score for the ESU since the last 2011 status review, so the ESU remains at moderate risk. Limiting Factors: Degraded freshwater habitat Degraded water quality Increased disease incidence Altered stream flows Reduced access to spawning and rearing habitats Altered food web due to reduced inputs of microdetritus Predation by native and non-native species, including hatchery fish

Species	Listing Classification and Date	Status Summary and Limiting Factors
		Competition related to introduced salmon and steelhead Altered population traits due to fisheries and bycatch
Snake River Fall-Run Chinook Salmon	Listing Classification and Date: Threatened 6/28/2005 Recovery Plan Reference: (NMFS 2017a) Status Review: (NMFS 2016m)	Status Summary: This ESU has one extant population. Historically, large populations of fall Chinook salmon spawned in the Snake River upstream of the Hells Canyon Dam complex. The extant population is at moderate risk for both diversity and spatial structure and abundance and productivity. The overall viability rating for this population is 'viable.' Overall, the status of Snake River fall Chinook salmon has clearly improved compared to the time of listing and compared to prior status reviews. The single extant population in the ESU is currently meeting the criteria for a rating of 'viable' developed by the Interior Columbia Basin Technical Recovery Team, but the ESU as a whole is not meeting the recovery goals described in the recovery plan for the species, which require the single population to be "highly viable with high certainty" and/or will require reintroduction of a viable population above the Hells Canyon Dam complex. Limiting Factors: Degraded floodplain connectivity and function Harvest-related effects Loss of access to historical habitat above Hells Canyon and other Snake River dams Impacts from mainstem Columbia River and Snake River hydropower systems Hatchery-related effects Degraded estuarine and nearshore habitat
Puget Sound Chinook Salmon	Listing Classification and Date: Threatened 6/28/2005 Recovery Plan Reference: (NMFS 2007) Status Review: (NMFS 2016l)	Status Summary: This ESU comprises 22 populations distributed over five geographic areas. Most populations within the ESU have declined in abundance over the past 7 to 10 years, with widespread negative trends in natural-origin spawner abundance, and hatchery-origin spawners present in high fractions in most populations outside of the Skagit watershed. Escapement levels for all populations remain well below the Puget Sound Technical Recovery Team (TRT) planning ranges for recovery, and most populations are consistently below the spawner-recruit levels identified by the TRT as consistent with recovery. Limiting Factors: Degraded floodplain and in-river channel structure Degraded estuarine conditions and loss of estuarine habitat Degraded riparian areas and loss of in-river large woody debris (LWD) Excessive fine-grained sediment in spawning gravel Degraded water quality and temperature Degraded nearshore conditions Impaired passage for migrating fish Severely altered flow regime
Hood Canal Summer-Run Chum Salmon	Listing Classification and Date: Threatened 6/28/2005 Recovery Plan Reference: (NMFS 2007)	Status Summary: This ESU is made up of two independent populations in one major population group (MPG). Natural-origin spawner abundance has increased since ESA-listing and spawning abundance targets in both populations have been met in some years. Productivity was quite low at the time of the last review, though rates have increased in the last 5 years, and have been greater than replacement rates in the past 2 years for both populations. However, productivity of individual spawning aggregates shows only two of eight aggregates have viable performance. Spatial structure and diversity viability parameters for each population have increased and nearly meet the viability criteria. Despite

Species	Listing Classification and Date	Status Summary and Limiting Factors
	Status Review: (NMFS 2016l)	substantive gains towards meeting viability criteria in the Hood Canal and Strait of Juan de Fuca summer chum salmon populations, the ESU still does not meet all of the recovery criteria for population viability at this time. Limiting Factors: Reduced floodplain connectivity and function Poor riparian condition Loss of channel complexity sediment accumulation Altered flows and water quality
Lower Columbia River Coho Salmon	Listing Classification and Date: Threatened 6/28/2005 Recovery Plan Reference: (NMFS 2013a) Status Review: (NMFS 2016i)	Status Summary: Of the 24 populations that make up this ESU, 21 are at very high risk, one is at high risk, and two are at moderate risk. Recent recovery efforts may have contributed to the observed natural production, but in the absence of longer-term data sets it is not possible to parse out these effects. Populations with longer-term data sets exhibit stable or slightly positive abundance trends. Some trap and haul programs appear to be operating at or near replacement, although other programs still are far from that threshold and require supplementation with additional hatchery-origin spawners. Initiation of or improvement in the downstream juvenile facilities at Cowlitz Falls, Merwin, and North Fork Dam are likely to further improve the status of the associated upstream populations. While these and other recovery efforts have likely improved the status of a number of coho salmon populations, abundances are still at low levels and the majority of the populations remain at moderate or high risk. For the Lower Columbia River region land development and increasing human population pressures will likely continue to degrade habitat, especially in lowland areas. Although populations in this ESU have generally improved, especially in the 2013/14 and 2014/15 return years, recent poor ocean conditions suggest that population declines might occur in the upcoming return years. Limiting Factors: Degraded estuarine and near-shore marine habitat Fish passage barriers Degraded freshwater habitat: Hatchery-related effects Harvest-related effects An altered flow regime and Columbia River plume Reduced access to off-channel rearing habitat in the lower Columbia River Reduced productivity resulting from sediment and nutrient-related changes in the estuary Juvenile fish wake strandings Contaminants
Oregon Coast Coho Salmon	Listing Classification and Date: Threatened 6/20/2011 Recovery Plan Reference: (NMFS 2016r) Status Review: (NMFS 2016k)	Status Summary: This ESU comprises 56 populations including 21 independent and 35 dependent populations. The last status review indicated a moderate risk of extinction. Significant improvements in hatchery and harvest practices have been made for this ESU. Most recently, spatial structure conditions have improved in terms of spawner and juvenile distribution in watersheds; none of the geographic area or strata within the ESU appear to have considerably lower abundance or productivity. The ability of the ESU to survive another prolonged period of poor marine survival remains in question. Limiting Factors: Reduced amount and complexity of habitat including connected floodplain habitat

Species	Listing Classification and Date	Status Summary and Limiting Factors
		Degraded water quality Blocked/impaired fish passage Inadequate long-term habitat protection Changes in ocean conditions
Southern Oregon Northern California Coast Coho Salmon	Listing Classification and Date: Threatened 6/28/05 Recovery Plan Reference: (NMFS 2014a) Status Review (NMFS 2016n)	Status Summary: This ESU comprises 31 independent, nine dependent, and five ephemeral populations all grouped into seven diversity strata. Of the 31 independent populations, 24 are at high risk of extinction and six are at moderate risk of extinction. The extinction risk of an ESU depends upon the extinction risk of its constituent independent populations; because the population abundance of most independent populations are below their depensation threshold, the Southern Oregon Northern California Coast (SONCC) coho salmon ESU is at high risk of extinction and is not viable Limiting Factors: Lack of floodplain and channel structure Impaired water quality Altered hydrologic function Impaired estuary/mainstem function Degraded riparian forest conditions Altered sediment supply Increased disease/predation/competition Barriers to migration Fishery-related effects Hatchery-related effects
Snake River Sockeye Salmon	Listing Classification and Date: Endangered 6/28/2005 Recovery Plan Reference: (NMFS 2015) Status Review: (NMFS 2016m)	Status Summary: This single population ESU is at very high risk due to small population size. There is high risk across all four basic risk measures. Although the captive brood program has been successful in providing substantial numbers of hatchery produced fish for use in supplementation efforts, substantial increases in survival rates across all life history stages must occur to reestablish sustainable natural production. In terms of natural production, the Snake River sockeye ESU remains at extremely high risk although there has been substantial progress on the first phase of the proposed recovery approach – developing a hatchery-based program to amplify and conserve the stock to facilitate reintroductions. Limiting Factors: Effects related to the hydropower system in the mainstem Columbia River Reduced water quality and elevated temperatures in the Salmon River Water quantity Predation
Upper Columbia River Steelhead	Listing Classification and Date: Threatened 1/5/2006 Recovery Plan Reference: (UCSRB 2007) Status Review: (NMFS 2016o)	Status Summary: This DPS comprises four independent populations. Three populations are at high risk of extinction while one is at moderate risk. Upper Columbia River steelhead populations have increased relative to the low levels observed in the 1990s, but natural origin abundance and productivity remain well below viability thresholds for three out of the four populations. The status of the Wenatchee River steelhead population continued to improve from previous years. The abundance and productivity viability rating for the Wenatchee River exceeds the minimum threshold for 5 percent extinction risk. However, the overall DPS status remains unchanged from the prior review, remaining at high risk driven by low abundance and productivity relative to viability objectives and diversity concerns.

Species	Listing Classification and Date	Status Summary and Limiting Factors
		Limiting Factors: Adverse effects related to the mainstem Columbia River hydropower system Impaired tributary fish passage Degraded floodplain connectivity and function, channel structure and complexity, riparian areas, LWD recruitment, stream flow, and water quality Hatchery-related effects Predation and competition Harvest-related effects
Lower Columbia River Steelhead	Listing Classification and Date: Threatened 1/5/2006 Recovery Plan Reference: (NMFS 2013a) Status Review: (NMFS 2016i)	Status Summary: This DPS comprises 23 historical populations, 17 winter-run populations and six summer-run populations. Nine populations are at very high risk, seven are at high risk, six are at moderate risk, and one population is at low risk. The majority of winter-run steelhead populations in this DPS continue to persist at low abundances. Hatchery interactions remain a concern in select basins, but the overall situation is somewhat improved compared to prior reviews. Summer-run steelhead populations were similarly stable, but at low abundance levels. The decline in the Wind River summer-run population is a source of concern, given that this population has been considered one of the healthiest of the summer-runs; however, the most recent abundance estimates suggest that the decline was a single year aberration. Passage programs in the Cowlitz and Lewis basins have the potential to provide considerable improvements in abundance and spatial structure, but have not produced self-sustaining populations to date. Even with modest improvements in the status of several winter-run DPS, none of the populations appear to be at fully viable status, and similarly none of the MPGs meet the criteria for viability. Limiting Factors: Degraded estuarine and nearshore marine habitat Degraded freshwater habitat Reduced access to spawning and rearing habitat Avian and marine mammal predation Hatchery-related effects An altered flow regime and Columbia River plume Reduced access to off-channel rearing habitat in the lower Columbia River Reduced productivity resulting from sediment and nutrient-related changes in the estuary Juvenile fish wake strandings Contaminants
Upper Willamette River Steelhead	Listing Classification and Date: Threatened 1/5/2006 Recovery Plan Reference: (ODFW and NMFS 2011) Status Review: (NMFS 2016p)	Status Summary: This DPS has four demographically independent populations. Three populations are at low risk and one is at moderate risk. Declines in abundance noted in the last status review continued through the period from 2010–2015. While rates of decline appear moderate, the DPS continues to demonstrate the overall low abundance pattern that was of concern during the last status review. The causes of these declines are not well understood, although much accessible habitat is degraded and under continued development pressure. The elimination of winter-run hatchery release in the basin reduces hatchery threats, but non-native summer steelhead hatchery releases are still a concern for species diversity and a source of competition for the DPS. While the collective risk to the persistence of the DPS has not changed significantly in recent years, continued declines and potential negative impacts from climate change may cause increased risk in the near future.

Species	Listing Classification and Date	Status Summary and Limiting Factors
		Limiting Factors: Degraded freshwater habitat Degraded water quality Increased disease incidence Altered stream flows Reduced access to spawning and rearing habitats due to impaired passage at dams Altered food web due to changes in inputs of microdetritus Predation by native and non-native species, including hatchery fish and pinnipeds Competition related to introduced salmon and steelhead Altered population traits due to interbreeding with hatchery origin fish
Middle Columbia River Steelhead	Listing Classification and Date: Threatened 1/5/2006 Recovery Plan Reference: (NMFS 2009) Status Review: (NMFS 2016j)	Status Summary: This DPS comprises 17 extant populations. The DPS does not currently include steelhead that are designated as part of an experimental population above the Pelton Round Butte Hydroelectric Project. Returns to the Yakima River basin and to the Umatilla and Walla Walla Rivers have been higher over the most recent brood cycle, while natural origin returns to the John Day River have decreased. There have been improvements in the viability ratings for some of the component populations, but the DPS is not currently meeting the viability criteria in the Middle Columbia River steelhead recovery plan. In general, the majority of population level viability ratings remained unchanged from prior reviews for each major population group within the DPS. Limiting Factors: Degraded freshwater habitat Mainstem Columbia River hydropower-related impacts Degraded estuarine and nearshore marine habitat Hatchery-related effects Harvest-related effects Effects of predation, competition, and disease
Snake River Basin Steelhead	Listing Classification and Date: Threatened 1/5/2006 Recovery Plan Reference: (NMFS 2017b) Status Review: (NMFS 2016m)	Status Summary: This DPS comprises 24 populations. Two populations are at high risk, 15 are rated as maintained, three are rated between high risk and maintained, two are at moderate risk, one is viable, and one is highly viable. Four out of the five MPGs are not meeting the specific objectives in the draft recovery plan based on the updated status information available for this review, and the status of many individual populations remains uncertain. A great deal of uncertainty still remains regarding the relative proportion of hatchery fish in natural spawning areas near major hatchery release sites within individual populations. Limiting Factors: Adverse effects related to the mainstem Columbia River hydropower system Impaired tributary fish passage Degraded freshwater habitat Increased water temperature Harvest-related effects, particularly for B-run steelhead Predation Genetic diversity effects from out-of-population hatchery releases
Puget Sound Steelhead	Listing Classification and Date:	Status Summary: This DPS comprises 32 populations. The DPS is currently at very low viability, with most of the 32 populations and all three population groups at low viability.

Species	Listing Classification and Date	Status Summary and Limiting Factors
	Threatened 5/11/2007 Recovery Plan Reference: In Development Status Review: (NMFS 2016l)	Information considered during the most recent status review indicates that the biological risks faced by the Puget Sound Steelhead DPS have not substantively changed since the listing in 2007, or since the 2011 status review. Furthermore, the Puget Sound Steelhead TRT recently concluded that the DPS was at very low viability, as were all three of its constituent MPGs, and many of its 32 populations. In the near term, the outlook for environmental conditions affecting Puget Sound steelhead is not optimistic. While harvest and hatchery production of steelhead in Puget Sound are currently at low levels and are not likely to increase substantially in the foreseeable future, some recent environmental trends not favorable to Puget Sound steelhead survival and production are expected to continue. Limiting Factors: Continued destruction and modification of habitat Widespread declines in adult abundance despite significant reductions in harvest Threats to diversity posed by use of two hatchery steelhead stocks Declining diversity in the DPS, including the uncertain but weak status of summer-run fish A reduction in spatial structure Reduced habitat quality Urbanization Dikes, hardening of banks with riprap, and channelization
California Coastal Chinook Salmon	Listing Classification and Date: Threatened 6/28/05 Recovery Plan Reference: (NMFS 2016q) Status Review (NMFS 2016f)	Status Summary: The ESU was historically comprised of 38 populations, which included 32 fall-run populations and six spring-run populations across four diversity strata. All six of the spring-run populations were classified as functionally independent, but are considered extinct. Concerns regarding the lack of population-level estimates of abundance, the loss of populations from one diversity stratum, as well as poor ocean survival contributed to the conclusion that California Coastal (CC) Chinook salmon are "likely to become endangered" in the foreseeable future. Limiting Factors: Degraded estuarine and nearshore marine habitat Degraded floodplain connectivity and function Degraded channel structure and complexity Degraded riparian areas and LWD recruitment Degraded stream substrate Decreased stream flow Degraded water quality
Central California Coast Steelhead	Listing Classification and Date: Threatened 1/5/2006 Recovery Plan Reference: (NMFS 2016q) Status Review (NMFS 2016h)	Status Summary: The Central California Coast (CCC) steelhead DPS historically consisted of five Diversity Strata with 38 independent populations of winter-run steelhead (12 functionally independent and 26 potentially independent) and 22 dependent populations. The most recent status update concludes that the CCC steelhead DPS remains "likely to become endangered in the foreseeable future," as new and additional information available since that last status review does not appear to suggest a change in extinction risk. Limiting Factors: Degraded estuarine and nearshore marine habitat

Species	Listing Classification and Date	Status Summary and Limiting Factors
		Degraded floodplain connectivity and function Degraded channel structure and complexity Degraded riparian areas and LWD recruitment Degraded stream substrate Barriers to migration Decreased stream flow Degraded water quality Increased predation, competition, and disease
Northern California Steelhead	Listing Classification and Date: Threatened 1/5/2006 Recovery Plan Reference: (NMS 2016q) Status Review (NMFS 2016f)	Status Summary: The Northern California (NC) steelhead DPS historically consisted of five Diversity Strata with 41 independent populations of winter-run steelhead (19 functionally independent and 22 potentially independent) and 10 populations of summer steelhead (all functionally independent). The most recent status review by Williams et al. (2016) reports that available information for winter-run and summer-run populations of NC steelhead do not suggest an appreciable increase or decrease in extinction risk since publication of the last viability assessment. In general, population abundance was very low relative to historical estimates, and recent trends are downwards in most stocks. Limiting Factors: Degraded estuarine and nearshore marine habitat Degraded floodplain connectivity and function Degraded channel structure and complexity Degraded riparian areas and LWD recruitment Degraded stream substrate Decreased stream flow Degraded water quality Increased predation, competition, and disease
California Central Valley Steelhead	Listing Classification and Date: Threatened 1/5/2006 Recovery Plan Reference: (NMFS 2014b) Status Review (NMFS 2016a)	Status Summary: Lindley et al. (2006) estimated that historically there were at least 81 independent Central Valley steelhead populations distributed primarily throughout the eastern tributaries of the Sacramento and San Joaquin Rivers. There are indications that natural production of steelhead continues to decline and is now at a very low levels. Their continued low numbers in most hatcheries, domination by hatchery fish, and relatively sparse monitoring makes the continued existence of naturally reproduced steelhead a concern. We therefore conclude that California Central Valley (CCV) steelhead remain listed as threatened, as the DPS is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Limiting Factors: Degraded estuarine and nearshore marine habitat Degraded floodplain connectivity and function Degraded channel structure and complexity Degraded riparian areas and LWD recruitment Degraded stream substrate Decreased stream flow Degraded water quality Barriers to migration Hatchery related effects Increased predation, competition, and disease

Species	Listing Classification and Date	Status Summary and Limiting Factors
Central Valley Spring-Run Chinook Salmon	Listing Classification and Date: Threatened 6/28/2005 Recovery Plan Reference: (NMFS 2014b) Status Review (NMFS 2016b)	Status Summary: The Central Valley (CV) TRT estimated that historically there were 18 or 19 independent populations of CV spring-run Chinook salmon, along with a number of dependent populations, all within four distinct geographic regions (i.e., diversity groups). Of these populations, only three independent populations currently exist (Mill, Deer, and Butte Creeks tributary to the upper Sacramento River), and they represent only the northern Sierra Nevada diversity group. Overall, the Southwest Fishery Science Center concluded in their viability report (Williams et al. 2016) that the status of CV spring-run Chinook salmon (through 2014) has probably improved since the 2010/2011 status review and that the ESU's extinction risk may have decreased. However, 2015 and 2016 observed sharp declines. Therefore, the ESU is still facing significant extinction risk, and that risk is likely to increase over the next few years as the full effects of the most recent severe drought are realized. Limiting Factors: Degraded estuarine and nearshore marine habitat Degraded floodplain connectivity and function Degraded channel structure and complexity Degraded riparian areas and LWD recruitment Degraded stream substrate Decreased stream flow Degraded water quality Barriers to migration Hatchery related effects Harvest related adverse effects Increased predation, competition, and disease
Sacramento River Winter-Run Chinook Salmon	Listing Classification and Date: Endangered 6/28/2005 Recovery Plan Reference: (NMFS 2014b) Status Review (NMFS 2016e)	Status Summary: The Sacramento winter-run Chinook salmon ESU is comprised of only one population that spawns below Keswick Dam. The ESU is at a high risk of extinction in the long term. The extinction risk for the winter-run Chinook salmon ESU has increased from moderate risk to high risk of extinction since 2005, and several listing factors have contributed to the recent decline, including drought, poor ocean conditions, and hatchery influence. Thus, large-scale fish passage and habitat restoration actions are necessary for improving the winter-run Chinook salmon ESU viability. Limiting Factors: Degraded estuarine and nearshore marine habitat Degraded floodplain connectivity and function Degraded channel structure and complexity Degraded riparian areas and LWD recruitment Degraded stream substrate Decreased stream flow Degraded water quality Barriers to migration Hatchery related effects Harvest related adverse effects Increased predation, competition, and disease
South-Central California Coast Steelhead	Listing Classification and Date: Threatened	Status Summary: Analyses conducted by the South-Central California Coast (S-CCC) steelhead TRT indicate the S-CCC steelhead DPS consists of 12 discrete subpopulations representing localized groups of interbreeding individuals, and none of these

Species	Listing Classification and Date	Status Summary and Limiting Factors
	1/5/2006 Recovery Plan Reference: (NMFS 2013b) Status Review (NMFS 2016c)	subpopulations currently meet the definition of viable. Most of these subpopulations can be characterized by low population abundance, variable or negative population growth rates, and reduced spatial structure and diversity. The two most recent status updates conclude that the S-CCC steelhead DPS remains “likely to become endangered in the foreseeable future”. Limiting Factors: Degraded estuarine and nearshore marine habitat Degraded floodplain connectivity and function Degraded channel structure and complexity Degraded riparian corridors and elimination of downstream recruitment of spawning gravels and LWD Degraded stream substrate and lack of natural structural diversity Migration barriers preclude access to spawning grounds Decreased stream flow/altered flow regime Degraded water quality Artificially narrow riparian buffers
Southern California Steelhead	Listing Classification and Date: Endangered 1/5/2006 Recovery Plan Reference: (NMFS 2012) Status Review (NMFS 2016d)	Status Summary: While 46 drainages support the Southern California (SC) steelhead DPS, only 10 population units possess a high and biologically plausible likelihood of being viable and independent. NMFS concluded SC steelhead DPS was in danger of extinction throughout all or a significant portion of its range. Limiting Factors: Absent or limited and degraded estuarine and nearshore marine habitat Absent or limited and degraded floodplain connectivity and function Severely degraded channel structure and complexity Degraded riparian corridors and elimination of downstream recruitment of spawning gravels and LWD Absent or severely degraded stream substrate and minimal natural structural diversity; loss of instream refugia Severe migration barriers preclude access to spawning grounds Severely truncated stream flow during migration windows/severely altered flow regime Degraded water quality Increased predation, competition, and disease Artificially narrow and extremely restricted riparian buffers

2.2.2 Status of the Critical Habitat

This section describes the status of designated critical habitat affected by the proposed action by examining the condition and trends of the essential PBF of that habitat throughout the designated areas. These features are essential to the conservation of the ESA-listed species because they support one or more of the species’ life stages (e.g., sites with conditions that support spawning, rearing, migration and foraging).

A summary of the status of critical habitats for the remainder of the ESU/DPS considered in this Opinion, is provided in Table 3, below.

Table 3. Critical habitat, designation date, federal register citation, and status summary for critical habitat considered in this Opinion.

ESU/DPS	Designation	Geographical Extent	Status of Critical Habitat
Lower Columbia River Chinook Salmon	9/02/2005 70 FR 52630	Critical habitat is designated in the following states and counties: (i) Oregon (OR)—Clackamas, Clatsop, Columbia, Hood River, and Multnomah. (ii) Washington (WA)—Clark, Cowlitz, Klickitat, Lewis, Pacific, Skamania, and Wahkiakum. Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/frn/2005/70fr52731.pdf).	Tributary habitat degradation is a limiting factor for this ESU. Widespread development and other land use activities have disrupted watershed processes, reducing water quality, and diminishing habitat quantity, quality, and complexity. Activities have adversely affected stream and side channel structure, riparian conditions, floodplain function, sediment conditions, and water quality and quantity (NMFS 2013a). Reduced complexity, connectivity, quantity, and quality of habitat used for spawning, rearing, foraging, and migrating continues to be a concern for this ESU. Loss of habitat from conversion to agricultural or urbanized uses continues to be a particular concern throughout the lower Columbia River region, especially the loss of habitat complexity in the lower tributary/mainstem Columbia River interface, and concomitant changes in water temperature (NMFS 2016i).
Upper Columbia River Spring-run Chinook Salmon	9/02/2005 70 FR 52630	Critical habitat is designated in the following states and counties: (i) OR—Clatsop, Columbia, Gilliam, Hood River, Morrow, Multnomah, Sherman, Umatilla, and Wasco; (ii) WA—Benton, Chelan, Clark, Cowlitz, Douglas, Franklin, Grant, Kittitas, Klickitat, Okanogan, Pacific, Skamania, Wahkiakum, Walla Walla, and Yakima. Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/frn/2005/70fr52731.pdf).	Activities within the ESU have affected habitat diversity and quantity, connectivity, and riparian function. Habitat in many upper reaches of most subbasins is relatively pristine. Elsewhere water quality and quantity have been degraded, LWD recruitment has been lost, and floodplain connectivity has reduced salmonid overwintering habitat in the larger rivers. Fish management, including introductions and persistence of non-native species continues to affect habitat in some locations (e.g., walleye and smallmouth bass) (UCSRB 2007). The most widespread ecological concerns continue to be degraded riparian condition, sedimentation, low levels of LWD, reduced habitat complexity, lack of side-channels, degraded water quality, and passage barriers (NMFS 2016o).
Snake River Spring/Summer-Run Chinook Salmon	10/25/1999 64 FR 57399	All Snake River reaches upstream to Hells Canyon Dam; all river reaches presently or historically accessible to Snake River spring/summer Chinook salmon within the Salmon River basin; and all river reaches presently or historically accessible to Snake River spring/summer	Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994). Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems. Both

ESU/DPS	Designation	Geographical Extent	Status of Critical Habitat
		Chinook salmon within the Hells Canyon, Imnaha, Lower Grande Ronde, Upper Grande Ronde, Lower Snake-Asotin, Lower Snake-Tucannon, and Wallowa subbasins.	hydropower and land use activities have had impacts on habitat in the mainstem Snake River above Lower Granite Dam. A total of 12 dams have blocked and inundated habitat, impaired fish passage, altered flow and thermal regimes, and disrupted geomorphological processes in the mainstem Snake River. These impacts have affected juvenile and adult salmon through loss of historical habitat, altered migration timing, elevated dissolved gas levels, juvenile fish stranding and entrapment, and increased susceptibility to predation. In addition, land use activities have affected tributary habitats, affecting water quality and diminishing habitat quality. The most widespread ecological concerns pertain to a lack of habitat quality/diversity, degraded riparian conditions, low summer flows, and poor water quality (i.e., increased water temperatures in late summer/fall) (NMFS 2016m).
Upper Willamette River Chinook Salmon	9/02/2005 70 FR 52630	Critical habitat is designated in the following states and counties: (i) OR—Benton, Clackamas, Clatsop, Columbia, Lane, Linn, Marion, Multnomah, Polk, and Yamhill. (ii) WA—Clark, Cowlitz, Pacific, and Wahkiakum. Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/frn/2005/70fr52731.pdf).	Food web changes, fish passage, reduced floodplain connectivity and function, reduced channel structure/complexity, altered channel morphology, degraded riparian conditions, reduced levels LWD recruitment, sedimentation, and degraded water quality (i.e., temperature, dissolved oxygen, turbidity, pH, toxics, etc.) have affected habitat conditions for this ESU (ODFW and NMFS 2011). Access to historical spawning/rearing areas restricted by dams in four historically most productive tributaries. Access confined to lowland reaches where land development, water temperatures, and water quality may be limiting. Pre-spawning mortality generally high in lower tributary reaches where water temperatures and fish densities are highest. Areas downstream of high head dams may be subject to high levels total dissolved gas. Access to historically high quality habitat above Cougar Dam continues to be limited by poor downstream juvenile passage for McKenzie River population. Loss of floodplain habitat (e.g., from levees and bank stabilization) and habitat-forming flows; reduced shallow water habitat, velocity refuge in winter in tributaries and lower Willamette River has degraded rearing habitat (NMFS 2016p).
Snake River Fall-Run	10/25/1999 64 FR 57399	Snake River to Hells Canyon Dam; Palouse River from its confluence with the Snake River upstream to Palouse	Hydropower and land use activities have had impacts on habitat in the mainstem Snake River above Lower Granite Dam. Twelve

ESU/DPS	Designation	Geographical Extent	Status of Critical Habitat
Chinook Salmon		Falls; Clearwater River from its confluence with the Snake River upstream to Lolo Creek; North Fork Clearwater River from its confluence with the Clearwater River upstream to Dworshak Dam; and all other river reaches presently or historically accessible within the Lower Clearwater, Hells Canyon, Imnaha, Lower Grande Ronde, Lower Salmon, Lower Snake, Lower Snake–Asotin, Lower North Fork Clearwater, Palouse, and Lower Snake–Tucannon subbasins.	dams have blocked and inundated habitat, impaired fish passage, altered flow and thermal regimes, and disrupted geomorphological processes in the mainstem Snake River. These impacts have affected juvenile and adult salmon through loss of historical habitat, altered migration timing, elevated dissolved gas levels, juvenile fish stranding and entrapment, and increased susceptibility to predation. While habitat loss is the primary limiting factor, a second major factor in the mainstem Snake River above Hells Canyon is highly degraded water quality. Agriculture, grazing, mining, timber harvest, and development activities have led to excessive nutrients, sedimentation, toxic pollutants, low dissolved oxygen, and altered flows. Habitat in this area currently too degraded to support anadromous fish (NMFS 2016m).
Puget Sound Chinook Salmon	9/02/2005 70 FR 52630	Critical habitat is designated in the following states and counties: WA—Clallam, Jefferson, King, Mason, Pierce, Skagit, Snohomish, Thurston, and Whatcom. Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/fr n/2005/70fr52731.pdf).	Timber harvest, agriculture, urbanization, nearshore/estuary/marine alteration, diking/floodplain modification, water diversion, and hydroelectric development have affected habitat conditions. In particular, extensive dredging, diking, and filling for flood control and development eliminated and degraded miles of habitat. Habitat has been simplified, caused by vegetation removal and construction along streambanks and shorelines. Major issues include blocked passage, high stream temperatures, lack of LWD, high coarse and fine sediment loads, channel instability, loss of wetlands and off-channel habitat, and low instream flows (NMFS 2007). Recent data demonstrates improvements for water quality and removal of forest road barriers but degradation in water quantity, marine shoreline habitat conditions, and impervious surface area. Data also indicate impaired water quality in both fresh and marine waters; continued lack of access to functional floodplains and marine shorelines; and impaired passage continue to dominate habitat concerns for this ESU (NMFS 2016l).
Hood Canal Summer-Run Chum Salmon	9/02/2005 70 FR 52630	Critical habitat is designated in the following states and counties: WA—Clallam, Jefferson, Kitsap, and Mason.	Timber harvest, agriculture, urbanization, nearshore/estuary/marine alteration, diking/floodplain modification, water diversion, and hydroelectric development have affected habitat conditions. In particular, extensive

ESU/DPS	Designation	Geographical Extent	Status of Critical Habitat
		Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/frn/2005/70fr52731.pdf).	dredging, diking, and filling for flood control and development eliminated and degraded miles of habitat. Habitat has been simplified, caused by vegetation removal and construction along streambanks and shorelines. Major issues include blocked passage, high stream temperatures, lack of LWD, high coarse and fine sediment loads, channel instability, loss of wetlands and off-channel habitat, and low instream flows (NMFS 2007). Many of the same concerns discussed in the Puget Sound Chinook salmon are concerns for this ESU, including degraded water quality, estuarine habitat, habitat complexity, riparian areas, LWD recruitment, stream substrate and flow, and floodplain connectivity and function (NMFS 2016l).
Lower Columbia River Coho Salmon	2/24/2016 81 FR 9252	Critical habitat is designated in the following states and counties: OR—Clackamas, Clatsop, Columbia, Hood River, Marion, and Multnomah. Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/frn/2005/70fr52731.pdf).	Degraded floodplain access impaired side channel development and wetland habitat, impacting rearing. Degraded riparian conditions and channel structure/form issues impact juvenile and adult habitat. Extensive channelization, diking, wetland conversion, stream clearing, and, in some subbasins, gravel extraction have severed access to historically productive habitats, simplified tributary habitats, and weakened watershed processes. The lack of LWD and appropriately-sized gravel has significantly reduced amount of suitable spawning/rearing habitat. Sedimentation is a primary limiting factor for all WA populations and a secondary for OR populations. Water quantity is either a primary or secondary limiting factor for all populations. Water quality—specifically, elevated water temperature, lack of functional riparian habitat, and water withdrawals—is a secondary limiting factor for all populations except the Lower Gorge (NMFS 2013a). Reduced complexity, connectivity, quantity, and quality of habitat for spawning, rearing, foraging, and migrating continues to be a concern. Loss of habitat from conversion to agricultural or urbanized uses continues to be of particular concern throughout the lower Columbia River region, especially the loss of habitat complexity in the lower tributary/mainstem Columbia River interface, and concomitant changes in water temperature (NMFS 2016i).

ESU/DPS	Designation	Geographical Extent	Status of Critical Habitat
Oregon Coast Coho Salmon	2/11/2008 73 FR 7816	Critical habitat is designated in the following states and counties: OR—Clackamas, Clatsop, Columbia, Hood River, Marion, and Multnomah. Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/fr n/2005/70fr52731.pdf).	Stream capacity and complexity has been reduced in Oregon coastal streams and lakes through disturbance, road building, splash damming, stream cleaning, and other activities. Beaver removal, combined with loss of LWD in streams, has also led to degraded stream habitat conditions (NMFS 2016r). The long-term decline in productivity reflects deteriorating conditions in freshwater habitat as well as extensive loss of access to habitats in estuaries and tidal freshwater. Many habitat changes have weakened natural watershed processes and functions, including loss of connectivity to floodplains, wetlands, and side channels; reduced riparian area functions (stream temperature regulation, LWD recruitment, sediment and nutrient retention); altered flow and sediment regimes; degraded water quality; and blocked/impaired fish passage (NMFS 2016k).
Southern Oregon/Northern California Coasts Coho Salmon	5/5/1999 64 FR 24049	Includes all river reaches accessible to listed coho salmon between Cape Blanco, Oregon, and Punta Gorda, California. Critical habitat consists of the water, substrate, and adjacent riparian zone of estuarine and riverine reaches (including off-channel habitats) in hydrologic units and counties identified in Table 6 at the referenced website. Accessible reaches are those within the historical range of the ESU that can still be occupied by any life stage of coho salmon. Inaccessible reaches are those above specific dams identified in Table 6 of the referenced website or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). (https://www.ecfr.gov/cgi-bin/text-idx?SID=8187dbea0f42971243b3be26b99d91d8&mc=true&node=pt50.10.226&rgn=div5)	Habitat degraded from historical conditions by timber harvest, development, agriculture, mining/gravel extraction, urbanization, and damming/diversion of water. Habitat impairments include: (1) Channel morphology changes; (2) substrate changes; (3) loss of instream roughness; (4) loss of estuarine habitat; (5) loss of wetlands; (6) loss/degradation of riparian areas; (7) declines in water quality; (8) altered stream flows; (9) fish passage impediments; and (10) elimination of habitat (NMFS 2014a). Habitat restoration and protection actions have been implemented to improve degraded habitat conditions and restore fish passage. While these efforts have been substantial and are expected to benefit the survival and productivity of the targeted populations, there is yet to be clear evidence demonstrating that improvements in habitat conditions have led to improvements in population viability (NMFS 2016n).
Snake River Sockeye Salmon	10/25/1999 64 FR 57399	Critical habitat consists of river reaches of the Columbia, Snake, and Salmon Rivers; Alturas Lake Creek; Valley Creek; and Stanley, Redfish, Yellow Belly, Pettit and Alturas Lakes (including their inlet and outlet creeks).	Water quality in all five lakes generally is adequate for juvenile sockeye, although zooplankton numbers vary considerably. Some reaches of the Salmon River and tributaries exhibit temporary elevated water temperatures and sediment loads that could restrict sockeye salmon production and survival (NMFS 2015). Construction and operation of water storage and hydropower projects in the Columbia River basin have altered

ESU/DPS	Designation	Geographical Extent	Status of Critical Habitat
			biological and physical attributes of the mainstem migration corridor. These alterations have affected juvenile migrants to a much larger extent than adult migrants. Both hydropower and land use activities have had impacts on habitat in the mainstem Snake River above Lower Granite Dam. A total of twelve dams have blocked and inundated habitat, impaired fish passage, altered flow and thermal regimes, and disrupted geomorphological processes in the mainstem Snake River. These impacts have affected juvenile and adult salmon through loss of historical habitat, altered migration timing, elevated dissolved gas levels, juvenile fish stranding and entrapment, and increased susceptibility to predation. In addition, land use activities, including agriculture, grazing, resource extraction, and development have adversely affected water quality and diminished habitat quality throughout this designation. Sockeye salmon are particularly vulnerable to increased water temperatures in late summer and fall, when adults of this species are migrating (NMFS 2016m). Species is supported by an aggressive hatchery program which includes the removal of most returning adults prior to them entering Redfish Lake.
Upper Columbia River Steelhead	9/02/2005 70 FR 52630	Critical habitat is designated in the following states and counties: (i) OR—Clatsop, Columbia, Gilliam, Hood River, Morrow, Multnomah, Umatilla, and Wasco. (ii) WA—Adams, Benton, Chelan, Clark, Cowlitz, Douglas, Franklin, Grant, Kittitas, Klickitat, Okanogan, Pacific, Skamania, Wahkiakum, Walla Walla, and Yakima. Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/frn/2005/70fr52731.pdf).	Diversions and dams, agriculture, stream channelization and diking, road and railway construction, timber harvest, and urban/rural development have led to loss of habitat complexity, off-channel habitat, and large, deep pools due to sedimentation and loss of pool-forming structure (UCSRB 2007). The most widespread ecological concerns continue to be degraded riparian condition, sedimentation, low levels of LWD, instream structural complexity, side channel and wetland conditions, degraded water quality, and anthropogenic barriers (NMFS 2016o).
Lower Columbia	9/02/2005 70 FR 52630	Critical habitat is designated in the following states and counties:	Loss and degradation of tributary habitat is one of the main limiting factors. Reduced access to floodplains has impacted

ESU/DPS	Designation	Geographical Extent	Status of Critical Habitat
River Steelhead		(i) OR—Clackamas, Clatsop, Columbia, Hood River, Marion, and Multnomah. (ii) WA— Clark, Cowlitz, Klickitat, Lewis, Pacific, Skamania, and Wahkiakum. Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/frn/2005/70fr52731.pdf).	side-channel and wetland habitat is limiting for juveniles for all summer populations and all winter populations, except the North Fork Lewis and Hood where these impacts are not as prevalent. In most cases, habitat has been impacted by extensive channelization, diking, wetland conversion, stream clearing, and gravel extraction, barring access to historically productive habitats and simplifying remaining habitats. Degraded riparian conditions and channel structure/form are also primary limiting factors for juveniles. The lack of LWD and appropriately-sized gravel in accessible tributary habitat has significantly reduced the amount of suitable spawning and rearing habitat. Sediment conditions are a limiting factor for juveniles in all Cascade winter populations; for Kalama, Washougal, East Fork Lewis, Wind, and Hood summer steelhead juveniles; and for juveniles from the Hood winter population (NMFS 2013a). Reduced complexity, connectivity, quantity, and quality of habitat used for spawning, rearing, foraging, and migrating continues to be a concern. Loss of habitat from conversion to agricultural or urbanized uses continues to be a particular concern throughout the lower Columbia River region, especially the loss of habitat complexity in the lower tributary/mainstem Columbia River interface, and concomitant changes in water temperature (NMFS 2016i).
Upper Willamette River Steelhead	9/02/2005 70 FR 52630	Critical habitat is designated in the following states and counties: (i) OR— Benton, Clackamas, Clatsop, Columbia, Linn, Marion, Multnomah, Polk, Tillamook, Washington, and Yamhill. (ii) WA— Clark, Cowlitz, Pacific, and Wahkiakum. Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/frn/2005/70fr52731.pdf).	Food web changes, fish passage, reduced floodplain connectivity and function, reduced channel structure/complexity, altered channel morphology, degraded riparian conditions, reduced levels LWD recruitment, sedimentation, and degraded water quality (i.e., temperature, dissolved oxygen, turbidity, pH, toxics, etc.) have affected habitat conditions for this ESU (ODFW and NMFS 2011). Critical habitat is negatively affected by lack of access to historical spawning habitat, especially in the North Santiam River. Habitat continues to be limited by continued development in the Molalla, Calapooia, and lower reaches of North and South Santiam Rivers. There is also a lack of high quality habitat below Detroit Dam on the North Santiam River; and lack of access to historical spawning/rearing habitat above Green Peter

ESU/DPS	Designation	Geographical Extent	Status of Critical Habitat
			Dam. Juvenile downstream passage at Foster Dam for the South Santiam River population also continues to be problematic (NMFS 2016p).
Middle Columbia River Steelhead	9/02/2005 70 FR 52630	Critical habitat is designated in the following states and counties: (i) OR—Clatsop, Columbia, Crook, Gilliam, Grant, Hood River, Jefferson, Morrow, Multnomah, Sherman, Umatilla, Union, Wallowa, Wasco, and Wheeler. (ii) WA—Benton, Clark, Cowlitz, Columbia, Franklin, King, Kittitas, Klickitat, Lewis, Pacific, Pierce, Skamania, Wahkiakum, Walla Walla, and Yakima. Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/fr n/2005/70fr52731.pdf).	Habitat quality and quantity has been impacted through removal of LWD from streams; removal of riparian vegetation; timber harvest, road construction, agricultural development, livestock grazing, urbanization, wetland draining, and gravel mining; alteration of channel structure through stream relocation, channel confinement and straightening; beaver removal; dams; and water withdrawal. While some streams and stream reaches retain highly functional habitat conditions, activities have degraded stream reaches across the DPS, leaving insufficient LWD in channels, insufficient instream complexity, and inadequate floodplain connectivity. Many streams lack sinuosity and suffer from excessive streambank erosion and sedimentation, as well as altered flow regimes and high summer water temperatures (NMFS 2009). Passage, low streamflows, warm water temperatures, remain habitat concerns. Efforts have been made to improve flow patterns below Pelton-Round Butte Selective Water Withdrawal and Fish Collection Facility; and fish passage has been opened up on approximately 170 miles of habitat in streams such as Whychus Creek, White Salmon River, and Deschutes River (NMFS 2016j).
Snake River Basin Steelhead	9/02/2005 70 FR 52630	Critical habitat is designated in the following states and counties: (i) ID—Adams, Blaine, Clearwater, Custer, Idaho, Latah, Lemhi, Lewis, Nez Perce, and Valley. (ii) OR—Clatsop, Columbia, Gilliam, Hood River, Morrow, Multnomah, Sherman, Umatilla, Union, Wallowa, and Wasco. (iii) WA—Asotin, Benton, Clark, Columbia, Cowlitz, Franklin, Garfield, Klickitat, Pacific, Skamania, Walla Walla, Wahkiakum, and Whitman. Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of	Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994). Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems. Both hydropower and land use activities have had impacts on habitat in the mainstem Snake River above Lower Granite Dam. A total of 12 dams have blocked and inundated habitat, impaired fish passage, altered flow and thermal regimes, and disrupted geomorphological processes in the mainstem Snake River. These impacts have affected juvenile and adult salmon through loss of historical habitat, altered migration timing, elevated dissolved gas levels, juvenile fish stranding and entrapment, and increased

ESU/DPS	Designation	Geographical Extent	Status of Critical Habitat
		the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/frn/2005/70fr52731.pdf).	susceptibility to predation. In addition, agriculture, grazing, resource extraction, and development have adversely affected water quality and diminished habitat quality throughout this designation. The most widespread ecological concerns continue to be the lack of habitat quality and diversity, degraded riparian conditions, low summer flows, and poor water quality (i.e., increased water temperatures in late summer/fall) (NMFS 2016m).
Puget Sound Steelhead	2/24/2016 81 FR 9252	Critical habitat is designated in the following states and counties: WA—Clallam, Jefferson, King, Kitsap, Mason, Pierce, Skagit, Snohomish, Thurston, and Whatcom. Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/frn/2005/70fr52731.pdf).	Timber harvest, agriculture, urbanization, nearshore/estuary/marine alteration, diking and floodplain modification, water diversion, and hydroelectric development have affected habitat conditions. In particular, extensive dredging, diking and filling for flood control and development beginning in the early 1900s eliminated and degraded miles of habitat. Habitat has been simplified, caused by vegetation removal and construction along streambanks and shorelines (NMFS 2007). The Biological Review Team identified degradation and fragmentation of freshwater habitat, with consequent effects on connectivity, as the primary limiting factors and threats. The following issues continue to limit habitat: Continued destruction and modification of steelhead habitat; reduced habitat quality through changes in river hydrology, temperature profile, downstream gravel recruitment, and reduced movement of LWD; continued urban development in the lower reaches of many rivers and tributaries causing increased flood frequency and peak flows during storms, and reduced groundwater-driven summer flows; altered stream hydrology resulting in gravel scour, bank erosion, and sediment deposition; dikes, riprap and channelization, reduced river braiding and sinuosity, and increased gravel scour and dislocation of rearing juveniles because of dikes, hardening of banks with riprap, and channelization (NMFS 2016l).
California Coastal Chinook Salmon	9/02/2005 70 FR 52630	Critical habitat is designated in the following states and counties: CA—Humboldt, Trinity, Mendocino, Sonoma, Lake, Napa, Glenn, Colusa, and Tehama.	All life stages are impaired by degraded habitat conditions. These impairments are due to lack of complexity and shelter formed by instream LWD, sedimentation, lack of winter refugia, low summer flows, reduced quality and extent of coastal estuaries and lagoons, and reduced access to historic spawning and rearing habitat. The major sources of these impairments are

ESU/DPS	Designation	Geographical Extent	Status of Critical Habitat
		Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/frn/2005/70fr52731.pdf).	roads, water diversions and impoundments, logging, residential and commercial development, severe weather patterns, and channel modification. Conditions and threats tend to worsen from south to north, largely attributed to historic effects of intensive logging practices on the availability of instream LWD, reduced habitat complexity and shelter, and sediment generated from poor road construction throughout the northern coastal forests of Humboldt and Mendocino counties (NMFS 2016q). The 5-year status review identifies that many surface waters are polluted as a result of agriculture, urban, and industrial site runoff – elevating levels of pesticides, sediment, nutrients, salts, pathogens, and metals into surface waters. Water quantity is also highlighted, with existing surface water rights in California over-appropriated roughly five times the natural mean annual runoff, accounting for nearly ten times natural surface water supplies (NMFS 2016f).
Central California Coast Steelhead	9/2/2005 70 FR 52630	Critical habitat is designated in the following states and counties: CA— Lake, Mendocino, Sonoma, Napa, Marin, San Francisco, San Mateo, Santa Clara, Santa Cruz, Alameda, Contra Costa, and San Joaquin. Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/frn/2005/70fr52731.pdf).	All life stages are impaired by degraded habitat conditions. These impairments are due to lack of complexity and shelter formed by instream LWD, sedimentation, lack of winter refugia, low summer flows, reduced quality and extent of coastal estuaries and lagoons, and reduced access to historic spawning and rearing habitat. The major sources of these impairments are roads, water diversions and impoundments, logging, residential and commercial development, severe weather patterns, and channel modification. Conditions are more degraded in the Santa Cruz Mountain and San Francisco Bay Diversity Stratum populations (NMFS 2016q). The 5-year status review identifies that many surface waters are polluted as a result of agriculture, urban, and industrial site runoff – elevating levels of pesticides, sediment, nutrients, salts, pathogens, and metals into surface waters. Water quantity is also highlighted, with existing surface water rights in California over-appropriated roughly five times the natural mean annual runoff, accounting for nearly 1000% of natural surface water supplies. Dams affect habitat throughout the DPS by blocking or restricting access, and by disrupting natural hydrologic patterns and impairing sediment transport, channel morphology, substrate

ESU/DPS	Designation	Geographical Extent	Status of Critical Habitat
			composition, and water quality (including temperature and turbidity) within downstream reaches (NMFS 2016h).
Northern California Steelhead	9/2/2005 70 FR 52630	Critical habitat is designated in the following states and counties: CA—Humboldt, Trinity, Mendocino, Sonoma, Lake, Glenn, Colusa, and Tehama. Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/fr n/2005/70fr52731.pdf).	All life stages are impaired by degraded habitat conditions. These impairments are due to lack of complexity and shelter formed by instream LWD, sedimentation, lack of winter refugia, low summer flows, reduced quality and extent of coastal estuaries and lagoons, and reduced access to historic spawning and rearing habitat. The major sources of these impairments are roads, water diversions and impoundments, logging, residential and commercial development, severe weather patterns, and channel modification. Conditions and threats tend to worsen from south to north, largely attributed to historic effects of intensive logging practices on the availability of instream LWD, reduced habitat complexity and shelter, and sediment generated from poor road construction throughout the northern coastal forests of Humboldt and Mendocino counties (NMFS 2016q). The 5-year status review identifies that many surface waters are polluted as a result of agriculture, urban, and industrial site runoff – elevating levels of pesticides, sediment, nutrients, salts, pathogens, and metals into surface waters. Water quantity is also highlighted, with existing surface water rights in California over-appropriated roughly five times the natural mean annual runoff, accounting for nearly 1000% of natural surface water supplies (NMFS 2016f).
California Central Valley Steelhead	9/2/2005 70 FR 52630	Critical habitat is designated in the following states and counties: CA— Tehama, Butte, Glenn, Shasta, Yolo, Sacramento, Solona, Yuba, Sutter, Placer, Calaveras, San Joaquin, Stanislaus, Tuolumne, Merced, Alameda, Contra Costa. Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/fr n/2005/70fr52731.pdf).	Habitat quantity and quality have declined due to: construction of levees and barriers to migration, modification of natural hydrologic regimes by dams and water diversions, elevated water temperatures, and water pollution from agriculture and industry. Major water project facilities, developed primarily the mid-1900s completely blocked the upstream migration to spawning and rearing habitats, altering flow and water temperature regimes downstream. Urban and agricultural development of the Central Valley led to the high demand for limited water supply resulting in reduced instream flows, increased water temperatures, and highly altered hydrology in the Sacramento-San Joaquin Delta, barriers to historic habitat, widespread loss of tidal marsh, riparian and floodplain habitat, poor water quality, and predation from introduced species such as striped bass. The amount of

ESU/DPS	Designation	Geographical Extent	Status of Critical Habitat
			steelhead habitat lost most likely is much higher than that for Chinook salmon, because steelhead were undoubtedly more extensively distributed (NMFS 2014b). Habitat loss and degradation is due to a combination of water development projects and operations that include, but are not limited to: (1) Impassable dams, water diversions, and hydroelectric operations on almost every major river in the Central Valley; (2) antiquated fish screens, fish ladders, and diversion dams on streams throughout the Sacramento River Basin; and (3) levee construction and maintenance projects that do not incorporate fish-friendly designs. Massive alterations to river channels from the gold mining era continue to impact aquatic habitats throughout much of the Central Valley. Several habitat improvement projects highlighted in the 5-year status review include, but are not limited to, the removal of Seltzer Dam, gravel augmentation, the installation of fish screens and fish ladders, and the Anadromous Fish Restoration Program funding of various restoration projects to improve habitat, survival, and passage of anadromous fish in Antelope Creek, Cottonwood Creek, and the Calaveras, Cosumnes, Merced, Mokelumne, Stanislaus, and Tuolumne Rivers (NMFS 2016a).
Central Valley Spring-run Chinook Salmon	9/2/2005 70 FR 52630	Critical habitat is designated in the following states and counties: CA—Tehama, Butte, Glenn, Shasta, Yolo, Sacramento, Solano, Colusa, Yuba, Sutter, Trinity, Alameda, San Joaquin, and Contra Costa. Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/frn/2005/70fr52731.pdf).	Habitat quantity and quality have declined due to: construction of levees and barriers to migration, modification of natural hydrologic regimes by dams and water diversions, elevated water temperatures, and water pollution from agriculture and industry. Major water project facilities, developed primarily the mid-1900s completely blocked the upstream migration to spawning and rearing habitats, altering flow and water temperature regimes downstream. Urban and agricultural development of the CV led to the high demand for limited water supply resulting in reduced instream flows, increased water temperatures, and highly altered hydrology in the Sacramento-San Joaquin Delta, barriers to historic habitat, widespread loss of tidal marsh, riparian and floodplain habitat, poor water quality, and predation from introduced species such as striped bass. Excluding the lower stream reaches that were used as adult migration corridors (and, to a lesser degree, for juvenile rearing), it has been estimated that at least 72 percent of the original Chinook salmon spawning and

ESU/DPS	Designation	Geographical Extent	Status of Critical Habitat
			holding habitat in the CV drainage is no longer available (NMFS 2014b). While some conservation measures have been successful in improving habitat conditions, fundamental problems with the quality of remaining habitat still remain and the habitat supporting this ESU remains in a highly degraded state. Loss of historic spawning habitat remains a major threat, as most of that habitat continues to be blocked by the direct or indirect effects of dams. Since CV spring-run Chinook salmon were originally listed in 1999, spawning habitat has been expanded very little compared to the hundreds of miles of habitat blocked by dams. Additional threats include, but are not limited to: (1) Operation of antiquated fish screens, fish ladders, diversion dams, and inadequate flows on streams throughout the Sacramento River Basin including on Deer, Mill, and Antelope Creeks; (2) levee construction and maintenance projects that have greatly simplified riverine habitat and have disconnected rivers from the floodplain; and (3) water delivery and hydroelectric operation on Butte Creek, Battle Creek, the mainstem Sacramento and Feather Rivers (NMFS 2016b).
Sacramento River Winter-Run Chinook Salmon	6/16/1993 58 FR 33212	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; all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Dey, and Carquinez. Streit; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge.	Habitat quantity and quality have declined due to: construction of levees and barriers to migration, modification of natural hydrologic regimes by dams and water diversions, elevated water temperatures, and water pollution from agriculture and industry. Major water project facilities, developed primarily the mid-1900s completely blocked the upstream migration to spawning and rearing habitats, altering flow and water temperature regimes downstream. Urban and agricultural development of the CV led to the high demand for limited water supply resulting in reduced instream flows, increased water temperatures, and highly altered hydrology in the Sacramento-San Joaquin Delta, barriers to historic habitat, widespread loss of tidal marsh, riparian and floodplain habitat, poor water quality, and predation from introduced species such as striped bass (NMFS 2014b). This ESU has been displaced from nearly its entire historical spawning habitat by the construction of Shasta and Keswick Dams. This population is outside of its historical spawning

ESU/DPS	Designation	Geographical Extent	Status of Critical Habitat
			distribution, in an artificially maintained habitat (i.e., cold water releases below Shasta Dam), making it vulnerable to drought and other catastrophes. Since 1994, many impacts have been addressed or reduced through regulatory and other mechanisms (e.g., Iron Mountain Mine clean up, Anderson-Colusa Irrigation District fish ladder, screening of water diversions, altered Central Valley Project water operations that improve passage and reduce predation, and construction of a temperature control device on Shasta Dam, etc.) (NMFS 2016e).
South-Central California Coast Steelhead	9/2/2005 70 FR 52630	Critical habitat is designated in the following states and counties: CA—Monterey, San Benito, Santa Clara, Santa Cruz, San Luis Obispo. Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/frn/2005/70fr52731.pdf).	Migratory habitat quality in Arroyo Grande Creek has been severely affected by the development and operation of Lopez Dam, agriculture, and flood-control practices. Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems throughout the entire critical habitat designation. There are 30 occupied watersheds within the freshwater and estuarine range of this ESU. Six watersheds received a low, 11 a medium, and 13 a high rating of conservation value to the ESU (NMFS 2013b). One of these occupied watershed units is Morro Bay, which is used as rearing and migratory habitat for steelhead populations that spawn and rear in tributaries to the Bay. (NMFS 2016c).
Southern California Coast Steelhead	9/2/2005 70 FR 52630	Critical habitat is designated in the following states and counties: CA—San Luis Obispo, Santa Barbara, Ventura, Los Angeles, Orange and San Diego. Detailed, textual descriptions of critical habitat for this ESU has been described in paragraphs (i) through (t) of the listing document: (https://www.westcoast.fisheries.noaa.gov/publications/frn/2005/70fr52731.pdf).	The long-term decline in Southern California Coast (SCC) steelhead productivity reflects deteriorating conditions in freshwater habitat as well as extensive loss of access to spawning habitat, estuaries and tidal freshwater. Many of the habitat changes resulting from land-use practices over the last 150 years that contributed to the ESA-listing of SCC steelhead continue to hinder recovery of the populations; changes in the watersheds due to land-use practices have weakened natural watershed processes and functions, including loss of connectivity to historical floodplains, wetlands and side channels; reduced riparian area functions (stream temperature regulation, wood recruitment, sediment and nutrient retention); and altered flow and sediment regimes (NMFS 2012). Several historical and ongoing land uses reduce stream capacity and complexity in Southern California coastal streams through diversions, road building, flood-control mechanisms, and other activities. (NMFS 2016d).

2.3 Action Area

"Action area" means all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02).

The action area for the proposed action is all USFS lands with ESA-listed salmon and steelhead species, Pacific Eulachon, or green sturgeon in Washington, Oregon, Idaho, and California. These lands are detailed in Figure 1. Because of the potential for downstream effects and additive effects within watersheds, the action area also encompasses the entire subbasin within which the USFS lands with ESA-listed species and designated critical habitat are located. It is also possible that effects may extend downstream of the subbasin boundaries (and off USFS lands) and impact rivers, coastal estuaries, and other waterbodies. These downstream areas can extend to the ocean and are also part of the action area.

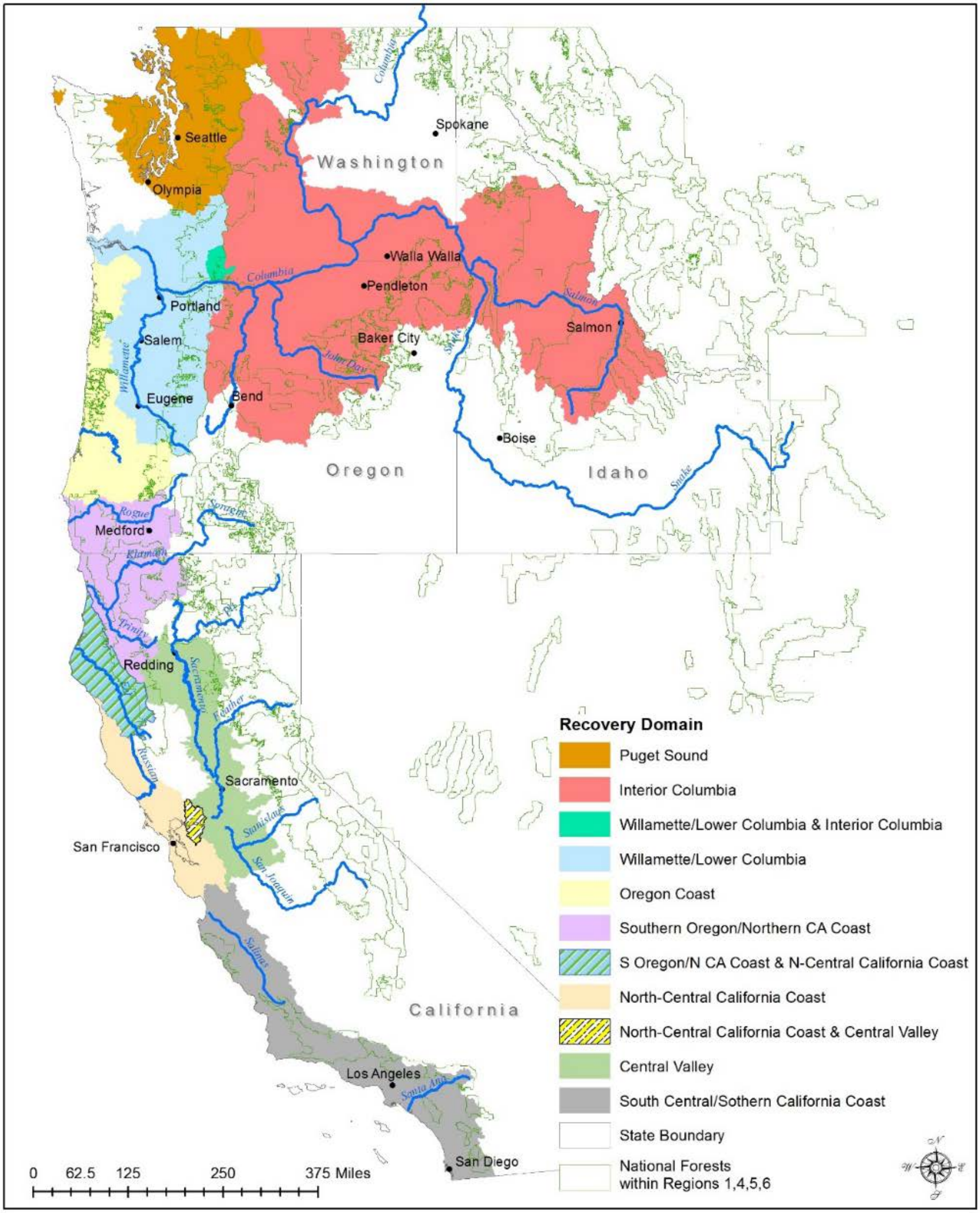

Figure 1. Action area map for proposed action. Major rivers are shown in blue.

2.4 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). For this section, the action area is divided into two regions: (1) Southwest Coast Region; and (2) Pacific Northwest Region.

Fire retardant has been used in the action area since it was first created. The overall effects of this use have been negative but, due to the USFS using less toxic formulations in recent years, the severity of these effects has been declining. In 2017, the USFS, with technical assistance from NMFS, implemented interim direction for specific forests with select Chinook and sockeye species. Aerial fire retardant avoidance buffers were widened from 300 feet to 600 feet with the intent of reducing the risk for intrusions at adult holding, spawning, and early egg incubation areas. However, these expanded avoidance areas are not part of the current proposed action and the risk of retardant intrusions in the most sensitive areas remains.

Since the 2011 Opinion, there have been several intrusions which have likely harmed, harassed, or killed ESA-listed anadromous species. Effects from these intrusions have been localized and have not affected large amounts of fish habitat. No dead fish have been found after these events. For safety reasons, there is often a period of time between when the intrusion occurs and when monitoring occurs. This delay reduces the likelihood of finding dead fish. However, it is possible that dead fish would be found in slack water habitats in some instances. Past intrusions in the action area are described in Table 4.

Table 4. Summary of misapplications or intrusions of aerial application of fire retardant by USFS in areas with NMFS ESA-listed species and/or designated critical habitat (DCH) 2012–2016 by recovery domain (derived from on-line misapplication reporting).

Recovery Domain	ESA Status	List of Aerial Application of Fire Retardant Misapplications or Intrusions and Description - NMFS ESA-Listed Species and/or DCH
Puget Sound Recovery Domain		
Hood Canal Summer-run Chum Salmon	T	
Ozette Lake Sockeye Salmon	T	
Puget Sound Chinook Salmon	T	
Puget Sound Steelhead	T	
Interior Columbia Recovery Domain		
Middle Columbia River Steelhead	T	*2015 Aug 16, Canyon Creek Complex Malheur National Forest (NF), Pine Creek* – 10 gallons of retardant in buffer; stream surveyed no dead fish; retardant drop site upstream 2,000 feet from DCH
		2015 Aug 31, OR-MAF 015292 Malheur NF – 10 gallons of retardant in buffer; Overholt Creek surveyed from drop site downstream 2 miles; juveniles and fry observed length of survey, no dead fish or macro invertebrates found
		2012 Aug 30 Parish Cabin Fire Malheur NF – 320 gallons of retardant in buffer; intermittent unnamed stream; surveyed area retardant drop site 2,500 feet upstream of DCH, no retardant in channel
Snake River Fall-run Chinook Salmon	T	
Snake River Spring/Summer-run Chinook Salmon	T	*2016 Aug 7, Dry Creek Fire Sawtooth National Recreation Area – Park Creek* – two intrusions on same stream; 6 gallons of retardant in buffer; estimate retardant travel 4,700 feet; DCH, no observed chinook but positive eDNA; stream surveys and monitoring after intrusions downstream 6,000 feet and 4,000 feet, no observed dead fish or macroinvertebrates; report with water quality results available
		2016 July 3, Buck Fire Boise NF – West Fork Bearskin Creek – 1,054 gallons of retardant in buffer, estimate retardant travel 4,000 feet; DCH, ~ 3.5 miles upstream of chinook presence; stream surveyed no dead fish; report with water quality results available
		2014 July 4, Hell Roaring Fire Sawtooth NRA – unnamed very small stream; 2.5 gallons of retardant in buffer, stream surveyed, DCH distant downstream
		2013 July 22, Thunder City Fire, Payette NF – unnamed headwater spring – less than 1-gallon of retardant in buffer; stream surveyed no dead fish or aquatic invertebrates
		2013 July 23, Road 210 Fire, Sawtooth NF – estimate retardant travel 4,700 feet; stream surveyed 7 miles downstream of drop; no dead fish found; initiated consultation; BO WCR-2015-1976 May 17. 2016

Recovery Domain	ESA Status	List of Aerial Application of Fire Retardant Misapplications or Intrusions and Description - NMFS ESA-Listed Species and/or DCH
Snake River Sockeye Salmon	E	*2013 July 23, Road 210 Fire, Sawtooth NF* - estimate retardant travel 4,700 feet; stream surveyed 7 miles downstream of drop; no dead fish found; initiated consultation; BO WCR-2015-1976 May 17, 2016
Snake River Steelhead	T	*2016 July 3, Buck Fire Boise NF – West Fork Bearskin Creek* – 1,054 gallons of retardant in buffer, estimate retardant travel 4,000 feet; no DCH or fish present; ~ 1.0 miles upstream of juvenile rainbow/steelhead presence; stream surveyed no dead fish; report with water quality results available
		2016 Aug 7, Dry Creek Fire Sawtooth National Recreation Area – Park Creek – two intrusions on same stream; 6 gallons of retardant in buffer; estimate retardant travel 4,700 feet; DCH, observed juvenile rainbow/steelhead; stream surveys and monitoring after intrusions downstream 6,000 feet and 4,000 feet, no observed dead fish or macroinvertebrates; report with water quality results available
		2014 July 4, Hell Roaring Fire Sawtooth NRA –unnamed very small stream; 2.5 gallons of retardant in buffer; stream surveyed , DCH distant downstream
		2013 July 22, Thunder City Fire, Payette NF - unnamed headwater spring – less than 1-gallon of retardant in buffer; stream surveyed no dead fish or aquatic invertebrates
		2013 July 23, Road 210 Fire, Sawtooth NF - estimate retardant travel 4,700 feet; stream surveyed 7 miles downstream of drop; no dead fish found; initiated consultation; BO WCR-2015-1976 May 17. 2016
Upper Columbia River Spring-run Chinook Salmon	E	
Upper Columbia River Steelhead	T	*2014 July* 30, Carlton Complex Fire, *Okanogan-Wenatchee NF* – NF Gold Creek – 300 gallons in buffer and 60 gallons in stream; estimate 0.3 miles of stream impacted; steelhead and DCH; surveyed and found live fish and invertebrates, and no dead fish
Willamette/ Columbia Recovery Domain		
Columbia River Chum Salmon	T	
Lower Columbia River Chinook Salmon	T	
Lower Columbia River Coho Salmon	T	
Lower Columbia River Steelhead	T	
Upper Willamette River Chinook Salmon	T	
Upper Willamette River Steelhead	T	
Oregon Coast Recovery Domain		
Oregon Coast Coho Salmon	T	

Recovery Domain	ESA Status	List of Aerial Application of Fire Retardant Misapplications or Intrusions and Description - NMFS ESA-Listed Species and/or DCH
Southern Oregon/Northern California Coast Recovery Domain		
Southern OR/Northern CA Coasts Coho Salmon	T	*2014 July 9, Happy Camp Fire, Klamath NF* – Klamath River at Kuntz Creek; 300 gallons in buffer and edge of stream; DCH, occupied coho habitat 2.3 miles downstream; surveyed and found no dead fish
		2015 Sept 19, South Complex Fire Shasta-Trinity NF – unnamed tributary to Eltapon Creek; 800 gallons in buffer; occupied coho and DCH 2 miles downstream
North-Central California Coast Recovery Domain		
California Coastal Chinook Salmon	T	
Central California Coastal Coho Salmon	E	
Central California Coastal Steelhead	T	
Northern California Steelhead	T	
Central Valley Recovery Domain		
California Central Valley Steelhead	T	*2016 Sept 30, Potato Fire Lassen NF* - intermittent un-named channel; DCH; 500 gallons of retardant in buffer; channel surveyed, no water and no fish
Central Valley Spring-run Chinook Salmon	T	*2016 Sept 30, Potato Fire Lassen NF* - intermittent un-named channel; DCH; 500 gallons of retardant in buffer; channel surveyed, no water and no fish
Sacramento River Winter-run Chinook Salmon	E	
South-Central /Southern California Coast Recovery Domain		
South-Central /Southern California Coast steelhead	T	
Southern California Steelhead	E	*2017 December 18, Thomas Fire Los Padres NF* – direct application into known occurrence and DCH, estimated 500–1000 gallons of retardant into 85-foot width of stream, onsite surveys and water quality samples obtained 12 days post intrusion. Live fish observed swimming above and below the intrusion site. Water quality sampling results for macro invertebrates and ammonia concentration still pending from USFS.

Note: Blank lines indicate no intrusions of Aerial Fire Retardant in streams with NMFS ESA-listed species or DCH between 2011 and 2016. "Estimate" refers to calculations made with Spill Calculator to estimate distance retardant may travel downstream for fish survey, or amount of retardant within 300-foot buffer. Contact with NMFS is documented in Reporting Database.

T = Threatened E = Endangered

The occurrence of past fires and retardant drops provide a baseline for considering where retardant may be used in the future (Figure 2). It is also important to note that climate change modeling (Section 2.2) indicates that both fire frequency and fire intensity are likely to increase over the term of this consultation.

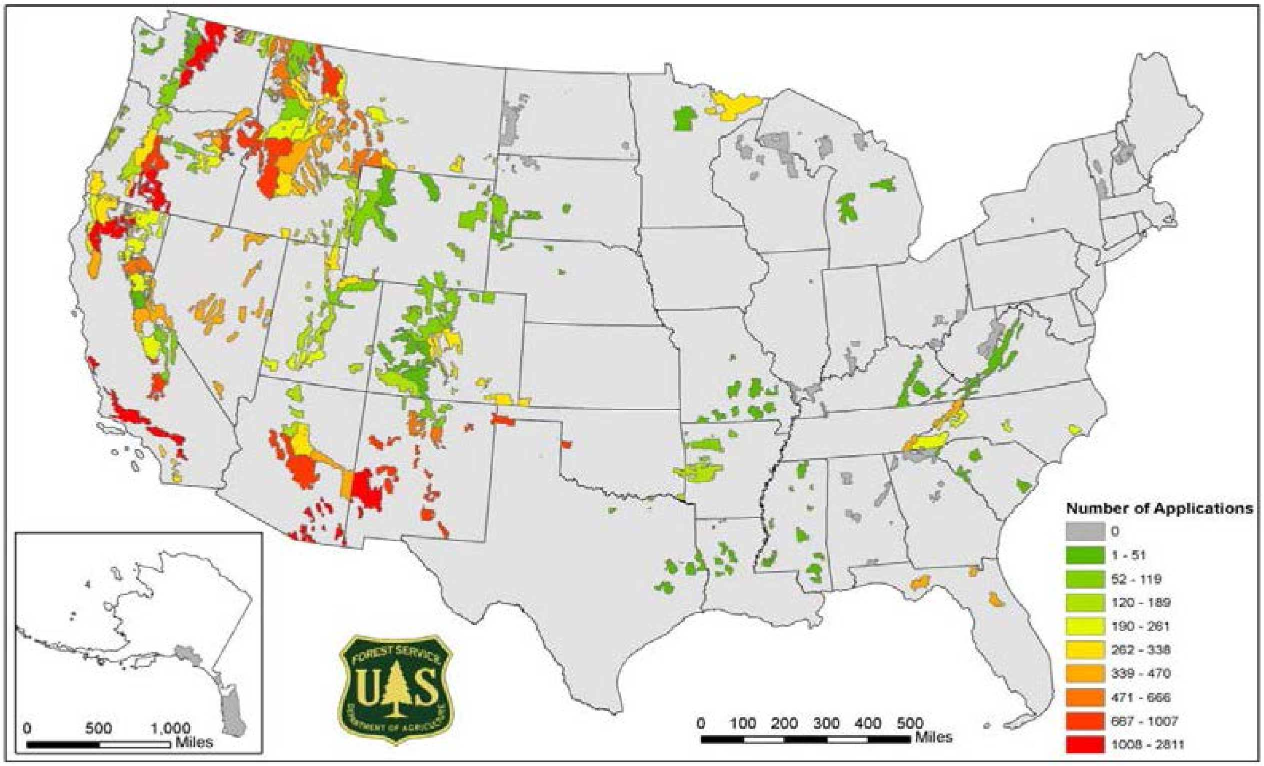

Figure 2. Aerial fire retardant applications in National Forest System lands, 2000–2010.

The probability of a misapplication or intrusion of retardant is very low and the likelihood that an intrusion will cause harm or death is even lower based on information about past aerial fire retardant drops. An examination of Table 5 indicates that out of 33,510 aerial retardant drops in the action area from 2012–2016, there were only 259 drops that entered avoidance areas. Of that 259, only 12 were into avoidance areas with ESA-listed species, and only four (Road 210, Carlton Complex, Overholt Creek, and Dry Creek Fires) were suspected of having caused adverse effects to ESA-listed aquatic species (based on USFS monitoring).

An example of an intrusion that would be representative of the majority of intrusion events would be the 210 Road Fire (Upper Salmon River basin). Part of the reason that this would be representative of other intrusions is that important resources, in this case a fish hatchery, were being threatened by the fire. The level of intrusion in terms of the amount of retardant that entered the avoidance area would also be representative of other intrusions. In the 210 Road Fire intrusion, there was no direct evidence of adverse effects to fish or macroinvertebrates. Monitoring was conducted 24 hours after the intrusion, which was as soon as staff realized the intrusion had occurred. Backwater areas, where dead fish would most likely collect, were examined from the intrusion site downstream for approximately 7 miles and no dead fish were found. This is important because adult salmon are readily located in the river after they spawn and die. It is likely that at least some dead juvenile fish carcasses would have collected in backwater areas. Live macroinvertebrates were found at a monitoring location 328 feet downstream from the intrusion and at a distance approximately 6.2 miles downstream. There was, however, evidence of slightly elevated ammonia levels at the intrusion site and immediately downstream (328 feet). At 6.2 miles downstream, ammonia concentrations had returned to background levels. The USFS also used the USGS Retardant Spill Calculator to model potential effects to ESA-listed species. The results of this monitoring and modeling indicated that in-river effects might have extended approximately 4,800 feet (approximately 0.9 miles) downstream. Although no fish mortality was directly observed, the USFS concluded that, based upon their modeling effort, adverse effects to Chinook salmon and steelhead likely occurred.

An example of worst-case intrusion is the Murderers Creek intrusion. In a modeled analysis of 267 gallons of fire retardant hitting the surface of a stream, peak ammonia concentrations reached 5,026 mg/L (Buhl and Hamilton 1998). This occurred in Murderers Creek, approximately 330 feet upstream of its confluence with the South Fork John Day River in Oregon. This created a fish kill that extended through Murderers Creek to approximately 1.7 miles downstream in the South Fork John Day River. However, the retardant used was Fire-Trol LCG-F, which is an extremely toxic retardant formulation that is no longer used. Part of the reason it is so toxic is that in addition to ammonia toxicity, Fire-Trol LCG-F contained sodium ferrocyanide. Calfee and Little (2003) note that sodium ferrocyanide is fairly non-toxic in the dark but when exposed to ultraviolet (UV) radiation (e.g., sunlight) it becomes highly toxic. This incident appears to be a worst-case scenario for retardant-caused mortality but it is important to take note that the sodium ferrocyanide likely had additional deleterious effects on the fish.

Table 5. Summary of Aerial Fire Retardant Drops in the Action Area 2012–2016.

Year	Total Number of Drops in the Action Area	Total Number of Drops in Avoidance Area (300-foot buffer) (Includes all waterways on National Forest System [NFS] lands, including mapped and dry intermittent streams[1])	Drops in Avoidance Area with Water Only (no ESA-listed species or DCH present)	Intrusion: Drops in Avoidance Area with NMFS' ESA-Listed Species or Designated Critical Habitat	Adverse Effects: Yes or No (see Table 4 for additional information)
2012	4,746	70	23	1	No
2013	6,788	50	29	2	Yes, Road 210 Fire
2014	4,642	30	12	3	Yes, Carlton Complex
2015	6,458	51	29	3	Yes, Overholt Creek Fire
2016	10,576	58	25	3	Yes, Dry Creek Fire
Total	33,510	259	118	12	4

[1]Retardant drop values are derived from dividing the 'total gallons applied on NFS lands' by an estimated airtanker volume. The 2011 Final Environmental Impact Statement, it was estimated that 2,500 gallons would represent a retardant drop (assuming that an airtanker would deliver the entire tank load). It was determined over the past couple years, that 1,800 gallons was a better estimator of gallons per drop.

The drop numbers presented in this table present this lower (1,800-gallon) value. In previous correspondence with NMFS, USFWS and briefing papers provided to staffs and agencies, some discrepancy in retardant drop numbers are possible due to this adjustment. Various factors come into play when estimating number of drops based on gallons delivered. Aircraft load capacities vary based on type of tank capacity and system. Also aircraft delivering retardant on specific fires can vary based on location and year. Therefore, number of drops are estimated values.

In Table 4, an analysis of the aerial retardant drops into avoidance areas from 2012–2016 indicates that no dead fish were found in any of these incidents. As mentioned above, dead fish often collect in slow water areas along stream margins and so it would be likely that dead fish would have been observed in some of these incidents. This would be the case with young or mature fish. The absence of dead fish suggests that few, if any, fish were killed in these intrusions. Additionally, quite of few of these intrusions were into stream channels that were upstream of occupied and/or critical habitat. This likely happens because of the very small size of these streams and the resulting difficulty in identifying them from the air.

2.4.1 Southwest Coast Region

The basins described in this section are encompassed by the state of California and parts of Oregon. Select watersheds described herein characterize the general ecology and natural history of the area, and the past, present and future human activities and their impacts on the area. Essentially, this region encompasses all Pacific Coast Rivers south of Cape Blanco, Oregon through southern California. The Cape Blanco area marks a major biogeographic boundary and has been identified by NMFS as a DPS/ESU boundary for Chinook and coho salmon, and steelhead on the basis of strong genetic, life history, ecological and habitat differences north and south of this landmark. Major rivers within the DPS/ESUs found south of Cape Blanco are the Sacramento, San Joaquin, Salinas, Klamath, Russian, Santa Ana and Santa Margarita Rivers.

2.4.1.1 Natural History

This region is the most geologically young and tectonically active region in North America. The Coast Range Mountains are folded and faulted formations, with a variety of soil types and nutrients that influence the hydrology and biology of the individual basins (Carter and Resh 2005). The region also covers the Klamath Mountains and the Sierra Nevada.

The climate is defined by hot dry summers and wet, mild winters, with precipitation generally decreasing in southern latitudes although precipitation is strongly influenced by topography and generally increases with elevation. Annual precipitation varies from less than 10 inches to more than 50 inches in the region. In the Sierra Nevada about 50 percent of the precipitation occurs as snow, as a result snowmelt strongly influences hydrological patterns in the area. Severe seasonal patterns of flooding and drought, and high interannual variation in total precipitation makes the general hydrological pattern highly predictable within a basin, but the constancy is low across years (Carter and Resh 2005). This likely increases the variability in the annual composition of the fish assemblies in the region. Characteristics of some major rivers are displayed in Table 6.

Table 6. Select Rivers in the Southwest Coast Region.

Watershed	Length (approx. miles)	Basin Size (square miles [mi^2])	Physiographic Provinces*	Mean Annual Precipitation (inches)	Mean Discharge (cubic feet per second [cfs])	Number of Fish Species (native)	Number of T&E Species**
Rogue River	211	5,154	CS, PB	38	10,065	23 (14)	11
Klamath River	287	15,679	PB, B/R, CS	33	17,693	48 (30)	41
Eel River	200	3651	PB	52	7416	25 (15)	12
Russian River	110	1439	PB	41	2331	41 (20)	43
Sacramento River	400	27,850	PB, CS, B/R	35	23,202	69 (29)	>50 T & E spp.
San Joaquin River	348	83,409	PB, CS	49	4,662	63	>50 T & E spp.
Salinas River	179	4,241	PB	14	448	36 (16)	42 T & E spp.
Santa Ana River	110	2,438	PB	13	60	45 (9)	54
Santa Margarita River	27	1,896	LC, PB	49.5	42	17 (6)	52

* Physiographic Provinces: PB = Pacific Border, CS = Cascades-Sierra Nevada mountains, B/R=Basin & Range, LC = Lower Coast.
** T = threatened, E = endangered

2.4.1.2 Human Activities and Their Impacts

Land use is dominated by forest in northern basins, and grass, shrub land, and urban uses dominate in southern basins (Carter and Resh 2005) see Table 7. Overall, the most developed watersheds in Table 7 are the Santa Ana, Russian, and Santa Margarita rivers. About 50 percent of coastal subbasin of the Santa Ana watershed is dominated by urban land uses where the population density is about 1,500 people per square mile (people/mi^2) and the most densely populated portion of the basin is near the city of Santa Ana where density reaches 20,000 people/mi^2.

Table 7. Land Uses and Population Density in Select Southwest Coast Regions.

Watershed	Land Use Categories (percent)				Density (people/$mi.^2$)
	Agriculture	Forest	Urban	Other	
Rogue River	6	83	<1	9 grass & shrub	32
Klamath River	6	66	<1	24 grass, shrub, wetland	5
Eel River	2	65	<1	31 grass & shrub	9
Russian River	14	50	3	31 (23 grassland)	162
Sacramento River	15	49	2	30 grass & shrub	61
San Joaquin River	30	27	2	36 grass & shrub	76
Salinas River	13	17	1	65 (49 grassland)	26
Santa Ana River	11	57	32	---	865
Santa Margarita River	12	11	3	71 grass & shrub	135

In many basins, agriculture is the major water user and the major source of water pollution to surface waters. In 1990 nearly 95 percent of the water diverted from the San Joaquin River was diverted for agriculture, and 1.5 percent diverted for livestock (Carter and Resh 2005). A study conducted by USGS in the mid-1990s on water quality within San Joaquin River basin detected 49 pesticides in the mainstem and three subbasins, 22 pesticides were detected in 20 percent of the samples and concentrations of seven exceeded water quality standards (Dubrovsky et al. 1998). Water chemistry in the Salinas River is strongly influence by intensive agriculture water hardness, alkalinity, nutrients (including nitrogen and phosphorus based fertilizers) and conductivity are high in areas where agricultural uses predominate. Agriculture can also add nutrients into receiving waters which can cause eutrophication issues. Eutrophication can reduce oxygen concentrations in water. However, this is primarily an issue for standing waters and not streams (Spence et al 1996).

Many of the rivers within the area have been modified by dams, water diversions and drainage systems for agriculture and drinking water, and some of the most drastic channelization projects within the nation. In all, there are about 1,400 dams within the State of California, more than 5,000 miles of levees, and more than 140 aqueducts (Carter and Resh 2005). While about 75 percent of the runoff occurs in basins in the northern half of the State, 80 percent of the water demand is in the southern half of the State. Two water diversion projects meet these demands—the federal Central Valley Project and the California State Water Project. The Central Valley Project, one of the world's largest water storage and transport systems, has more than 20 reservoirs and delivers about 7 million acre-feet each year to southern California. The State Water Project has 20 major reservoirs and holds nearly 6 million acre-feet of water, delivering about 3 million acre feet. Together these diversions irrigate about 4 million acres of farmland and deliver drinking water to about 22 million residents. These water diversions likely diminish the amount of available habitat for ESA-listed anadromous species.

Both the Sacramento River and the San Joaquin River watersheds are heavily modified, each with hundreds of dams. The Rogue, Russian, and Santa Ana rivers each have more than 50 dams, and the Eel, Salinas, and the Klamath River watersheds have between 14 and 24 dams. The Santa Margarita, considered one the last free flowing rivers in coastal southern California has nine dams in its watershed. All major tributaries of the San Joaquin River are impounded at least once and most have multiple dams or diversions. The Stanislaus River, a tributary of the San Joaquin River, has over 40 dams. As a result, the hydrograph of the San Joaquin River is seriously altered from its natural state, the temperature regime and sediment transport regime are altered, and such changes have had profound influences on the biological community within the basin—while the modifications generally result in a reduction of suitable habitat for native species, these changes frequently result in a concomitant increase of suitable habitat for nonnative species. The Friant Dam on the San Joaquin River is attributed with the extirpation of spring-run Chinook salmon within the basin, a run once estimated as producing 300,000 to 500,000 fish (Carter and Resh 2005).

2.4.1.3 The Risk of Fire in the Region

Peak fire season in the Southwest Coast Region occurs between April and October. Based on a review of more than 80,000 wildfires, Malamud et al. 2005 calculated the wildfire recurrence interval for large fires ($\geq$2,471 acres [10 square kilometers]) in the Mediterranean and Mediterranean Mountain ecoregions that encompasses most of this region, as every year to

3 years in the lowland or Mediterranean ecoregion, and less frequently in the Mediterranean Mountains – approximately every 9 to 17 years.

2.4.2 Pacific Northwest Region

This region encompasses portions of Washington, Oregon, and Idaho. The region is ecologically diverse, encompassing northern marine lowland forests, mountain forests, alpine meadows and Northern desert habitat. In this section, we focus on three primary areas that characterize the region, the Columbia River Basin and its tributaries, the Puget Sound Region, and the Coastal Drainages. The broader ecoregion divisions, as defined by Bailey (1980), within this region are the Marine, Marine Mountains, Temperate Desert, Temperate Steppe, and Temperate Steppe Mountains Divisions. Puget Sound and the coastal drainages are contained within the Marine Division, while the Columbia River watershed encompasses portions of all five ecoregions.

2.4.2.1 Columbia River Basin and its tributaries

Some of the information in this section applies to the entire Columbia River basin but the analysis is specific to those areas within the basin that are in the action area.

Natural History. The most notable of all basins within the region is the Columbia River. The Columbia River is largest river in the Pacific Northwest and the fourth largest river in terms of average discharge the United States. It drains an area over 258,000 square miles (making it the sixth largest in terms of drainage area). Its basin includes parts of Washington, Oregon, Nevada, Utah, Idaho, Wyoming, Montana, and British Columbia. The basin encompasses 13 terrestrial and three freshwater ecoregions, including arid shrub-steppes, high desert plateaus, temperate mountain forests, and deep gorges (Hinck et al. 2004; Kammerer 1990).

Major tributaries include the Snake, Willamette, Salmon, Flathead, and Yakima Rivers; smaller rivers include the Owyhee, Grande Ronde, Clearwater, Spokane, Methow, Cowlitz, and the John Day Rivers (see Table 8 for a description of select Columbia River tributaries). The Snake River is the largest tributary at more than 1,000 miles long; its headwaters originating in Yellowstone National Park, Wyoming. The second largest tributary is the Willamette River in Oregon (Hinck et al. 2004; Kammerer 1990). The Willamette River is the 19th largest river in the nation in terms of average annual discharge (Kammerer 1990). The basins drain portions of the Rocky Mountains, the Bitterroot Range, and the Cascade Mountain Range.

The average annual runoff at the mouth of the Columbia River is 265,000 cfs (Kammerer 1990). A saltwater wedge extends 23 miles upstream of the mouth with tidal influences extending up to 146 miles up-river (Hinck et al. 2004). The climate within the basin is a mix of arid, dry summers, cold winters, and maritime air masses entering from the west. It is not uncommon for air temperatures in the Rocky Mountains to dip below 0°F in mid-winter, but summer air temperatures can reach more than 100°F in the middle basin.

Table 8. Select Tributaries of the Columbia River.

Watershed	Length (approx. miles)	Basin Size (mi^2)	Physiographic Provinces*	Mean Annual Precipitation (inches)	Mean Discharge (cfs)	Number of Fish Species (native)	Number of ESA Listed Species**
Snake/Salmon River	870	108,495	CU, NR, MR, B/R	14	55,267	39 (19)	5 fish (4 T, 1 E), 6 (1 T, 5 E) snails, 1 plant (T)
Yakima River	214	6,139	CS, CU	7	3,602	50	2 fish (1 T, 1 E)
Willamette River	143	11,478	CS, PB	60	32,384	61 (~31)	5 fish (4 T, 1 E)

* Physiographic Provinces: CU = Columbia-Snake River Plateaus, NR = Northern Rocky Mountains, MR = Middle Rocky Mountains, B/R=Basin & Range, CS = Cascade-Sierra Mountains, PB = Pacific Border
** T = threatened, E = endangered

The river and estuary were once home to more than 200 distinct runs of Pacific salmon and steelhead, and represented adaptation to the local environment within a tributary or segment of a river. Salmonids within the basin include Chinook, chum, coho, sockeye salmon, steelhead and redband trout, bull trout, and cutthroat trout. Other fish species within the basin include sturgeon, eulachon, lamprey, and sculpin (Wydoski and Whitney 1979). The basin contained 65 native fish species and at least 53 nonnative fishes. The most abundant non-native fish is the American shad, which was introduced to the basin in the late 1800s (Wydoski and Whitney 1979).

Human Activities and Their Impacts. More than 50 percent of the United States' portion of the Columbia River Basin is in federal ownership (most of which occurs in high desert and mountain areas), 39 percent is in private land ownership (most of which occurs in river valleys and plateaus), and the remainder is divided among tribes, state, and local governments (Hinck et al. 2004). See Table 9 for a summary of land uses and population densities in several subbasins within the Columbia River watershed.

Table 9. Land Uses and Population Density in Select Tributaries of the Columbia River.

Watershed	Land Use Categories (percent)				Density (people/mi.^{2})
	Agriculture	Forest	Urban	Other	
Snake/Salmon River	30	10–15	1	54 scrub/rangeland/barren	39
Yakima River	16	36	1	47 shrub	80
Willamette River	19	68	5	--	171

The Interior Columbia Basin has been altered substantially by humans causing dramatic changes and declines in many native fish populations. In general, the basin supports a variety of mixed uses. Predominant human uses include logging, agriculture, ranching, hydroelectric power generation, mining, fishing, and urban uses.

The decline of salmon runs in the Columbia is attributed to loss of habitat, blocked migratory corridors, altered river flows and pollution, over harvest, and competition from hatchery fish. Critical ecological connectivity (mainstem to tributaries and riparian floodplains) has been disconnected by dams and associated activities such as floodplain deforestation and urbanization.

The most productive floodplains of the watershed are either flooded by hydropower dams or dewatered by irrigation diversions. Portions of this basin are also subject to impacts from cattle grazing and irrigation withdrawals.

Hydroelectric Power Systems

More than 400 dams exist in the basin ranging from large dams that store large amounts of water to small diversion dams for irrigation. Most major tributaries of the Columbia are totally or partially regulated by dams and diversions. More than 150 dams are major hydroelectric projects of which 18 are located on the mainstem Columbia River and its major tributary, the Snake River. The federal Columbia River System encompasses the operations of 14 major dams and reservoirs on the Columbia and Snake Rivers, operated as a coordinated system. The U.S. Army Corps of Engineers operates nine of 10 major federal projects on the Columbia and Snake Rivers, and Dworshak, Libby and Albeni Falls Dams. The Bureau of Reclamation (BOR) operates Grand Coulee and Hungry Horse Dams. These federal projects are a major source of power in the region, and provide flood control, navigation, recreation, fish and wildlife, municipal and industrial water supply, and irrigation benefits.

Development of the Pacific Northwest regional hydroelectric power system, dating to the early twentieth century, has had profound effects on the ecosystems of the Columbia River basin (Williams et al. 2000). These effects have been especially adverse to the survival of anadromous salmonids. The construction of the federal power system modified migratory habitat of adult and juvenile salmonids, and in many cases presented a complete barrier to habitat access. Both upstream and downstream migrating fish are impeded by the dams, and a substantial number of juvenile salmonids are killed and injured during downstream migrations. More than 55 percent of the Columbia River basin that was accessible to salmon and steelhead before 1939 has been blocked by large dams (NPPC 1986). Construction of Grand Coulee Dam blocked 1,000 miles of habitat from migrating salmon and steelhead (Wydoski and Whitney 1979). The single channel mainstem habitats of the lower Columbia and Willamette rivers are simplified, causing the loss of valuable shallow backwater areas for young fish to feed and grow.

Irrigation

Roughly 6 percent of the annual flow from the Columbia River is diverted for the irrigation of 7.3 million acres of croplands within the basin. The BOR has operated irrigation projects within the basin since the 1904. The BOR irrigation system delivers water to about 2.9 million acres of agricultural lands; 1.1 million acres of land are irrigated using water delivered by two structures, the Columbia River Project (Grand Coulee Dam) and the Yakima Project. Grand Coulee Dam delivers water for the irrigation of over 670,000 acres of crop lands, and the Yakima Project delivers water to nearly 500,000 acres of crop lands.

The vast majority of these agricultural lands are located along the lower Columbia River, the Willamette, Yakima, Hood, and Snake Rivers, and the Columbia Plateau (Hinck et al. 2004). The Yakima River basin is one of the most agriculturally productive areas in the United States (Fuhrer et al. 2004). Croplands within the Yakima basin account for about 16 percent of the total basin area of which 77 percent is irrigated. Today, agriculture represents the largest water use within the basin. More than 105,000 acre feet per day (more than 90 percent) is used for agricultural purposes. Irrigation reduces streamflow and water quantity is often a limiting factor for salmon and steelhead.

Agriculture

Agriculture and ranching increased steadily but slowly within the Columbia River basin from the mid to late 1800. By the early 1900s, agricultural opportunities began increasing at a much more rapid pace with creation of more irrigation canals and the passage of the Reclamation Act of 1902 (NRC 2004). Agriculture, ranching, and the related services employ more than nine times the national average, 19 percent of the households within the basin (NRC 2004)

Fish and macroinvertebrate communities exhibit an almost linear decline in condition as the level of agriculture intensity increases within a basin (Cuffney et al. 1997; Fuhrer et al. 2004). This loss is normally attributed to loss of streamflows and agricultural pollutants. A study conducted in the late 1990s examining 11 species of fish, including anadromous and resident fish collected throughout the basin for a suite of 132 contaminants, which included 26 pesticides revealed organochlorines, specifically hexachlorobenzene, chlordane and related compounds, and Dichlorodiphenyltrichloroethane (better known as DDT) and its metabolites, were the most frequently detected pesticides within fish tissues (Hinck et al. 2004). Agriculture can also add nutrients into receiving waters which can cause eutrophication issues. As mentioned above, eutrophication can reduce oxygen concentrations in water. However, this is primarily an issue for standing waters and not streams (Spence et al 1996).

Urban Areas and Industrial Activities

The largest urban area in the basin is the greater Portland metropolitan area, located at the mouth of the river. Portland's population exceeds 500,000 people, whereas the next largest cities, Spokane, Salem, Eugene, and Boise, have more than 100,000 people (Hinck et al. 2004). Overall, however the population within the basin is one-third the average, and while the basin covers about 8 percent of United States' land, only about 1.2 percent of the United States population lives within the basin (Hinck et al. 2004). Urban areas impact fisheries in a number of ways including pollutant discharges, water withdrawals for urban use, streambank hardening which reduces fish habitat, and blocked fish passage. The Columbia River through the Portland area is heavily industrialized by activities that include chemical plants and shipping terminals.

Discharges from sewage treatment plants, paper manufacturing, and chemical and metal production represent the top three permitted sources of contaminants within the lower basin according to discharge volumes and concentrations (Rosetta and Borys 1996). Non-point source discharges (e.g., urban stormwater runoff) account for more of the total pollutant loading to the lower basin for most organics and over half of the metals.

A study conducted in the late 1990s examining 11 species of fish (including anadromous and resident fish) was collected throughout the basin for a suite of 132 contaminants, including 51 semi-volatile chemicals, 26 pesticides, 18 metals, seven polychlorinated biphenyls (PCBs), 20 dioxins, and 10 furans. The study revealed PCBs, metals, chlorinated dioxins and furans (products of wood pulp bleaching operations), and other contaminants within fish tissues—white sturgeon tissues contained the greatest concentrations of chlorinated dioxins and furans (Hinck et al. 2004). Exposure to these chemicals is harmful to fish because they may cause reproductive problems, impaired growth, impaired homing, and death.

Logging

Timber harvest in the Pacific Northwest began in the mid-1800s and by the 1860s the timber industry was well established becoming, over time, one of the largest industries in the Columbia River Basin. Throughout the 1900s forest harvest continued, and the effects of logging became pervasive across the region. Early forest practices were particularly damaging to stream environments where they directly influenced vegetation within a watershed through the removal of trees during harvest, thinning, and road construction, and through manipulations of understory and ground vegetation (Spence et al. 1996).

Intense logging on tributary streams of major rivers cleared away riparian vegetation and led to erosion and sedimentation. The use of splash dams also contributed to the degradation of waterways and, as a result, to habitat for salmon and steelhead. The legacy of these dams still is visible on streams in western Washington and Oregon where the channels were carved wide by the repeated torrents (Spence et al. 1996). Road building to support logging operations also took a toll on riparian conditions, contributing to landslides that would block streams or deposit layers of silt, particularly in steep terrain. Landslides associated with road building contributed to flooding over time, as the logged hillsides were not able to hold as much rainwater and snowmelt. Slash and woody debris dumped into streams also affected fish and wildlife habitat by blocking access for fish (Spence et al. 1996).

In general, the effects of timber harvesting in the Columbia River Basin on stream ecosystems is complex. These activities can have a multitude of effects on streams including productivity, sediment and nutrient delivery, peak and base flows, stream temperature, and debris flows among many others. During the past 30 years with implementation of the Northwest Forest Plan and state forest practice regulations there has been a renewed effort to better protect and understand these relationships and reduce the effects of timber harvest on streams and therefore salmon and steelhead.

Hatchery Programs

There are several artificial propagation programs for salmon production within the Columbia River basin, many of which were instituted under federal law to mitigate the effects of lost natural production of salmon within the basin from the dams on fishing. The hatcheries are operated by federal, state, and tribal managers. For more than 100 years, hatcheries in the Pacific Northwest have been used to produce fish for harvest and replace natural production lost to dam construction, and have only minimally been used to protect and rebuild naturally produced salmonid populations (e.g., Snake River sockeye salmon). In 1987, 95 percent of the coho salmon, 70 percent of the spring Chinook salmon, 80 percent of the summer Chinook salmon, 50 percent of the fall Chinook salmon, and 70 percent of the steelhead returning to the

Columbia River basin originated in hatcheries (CBFWA 1989). More recent estimates suggest that almost half of the total number of smolts produced in the basin come from hatcheries (IEAB 2005).

The impact of artificial propagation on the total production of Pacific salmon and steelhead has been extensive. Hatchery practices, among other factors, are a contributing factor to the 90 percent reduction in natural coho salmon runs in the lower Columbia River of the past 30 years.

Mining Activities

Most of the mining in the basin is focused on minerals such as phosphate, limestone, dolomite, perlite, or metals such as gold, silver, copper, iron, and zinc. Mining in the region is conducted in a variety of methods and places within the basin. Alluvial or glacial deposits are often mined for gold or aggregate, and ores are often excavated from the hard bedrocks of the Idaho batholiths. Eleven percent of the nation’s output of gold has come from mining operations in Washington, Montana, and Idaho, and more than half of the nation’s silver output has come from a few select silver deposits with 30 percent coming from two deposits located in the Columbia River Basin (the Clark Fork River and Coeur d’Alene deposits) (Hinck et al. 2004).

Many of the streams and river reaches in the basin are impaired from mining and several abandoned and former mining sites are designated as superfund cleanup areas. According to the U.S. Bureau of Mines, there are about 14,000 inactive or abandoned mines within the Columbia River basin of which nearly 200 pose a potential hazard to the environment (Hinck et al. 2004).

Fishing

Archeological records indicate that indigenous people caught salmon in the Columbia River more than 7,000 years ago. One of the most well-known tribal fishing sites within the basin was located near Celilo Falls, an area in the lower river that has been occupied by The Dalles Dam since 1957.

Salmon fishing increased with better fishing methods and preservation techniques, such as drying and smoking, such that harvest substantially increased in the mid-1800s with canning techniques. Harvest techniques also changed over time, from early use of hand-held spears and dip nets, to river boats that used seines and gill-nets, eventually, transitioning to large ocean-going vessels with trolling gear and nets and the harvest of Columbia River salmon and steelhead off the waters of the entire west coast, from California to Alaska (IEAB 2005). During the mid-1800s, an estimated 10 to 16 million adult salmon of all species entered the Columbia River each year. Large harvests of returning adult salmon during the late 1800s ranging from 20 million to 40 million pounds of salmon and steelhead annually significantly reduced population productivity (IEAB 2005). The largest harvest of Chinook salmon ever recorded occurred in 1883 when Columbia River canneries processed 43 million pounds of salmon (Lichatowich 1999). Commercial landings declined steadily from the 1920s to a low in 1993, when just over one million pounds were harvested (IEAB 2005). Harvested and spawning adults reached

2.8 million in the early 2000s, of which almost half are hatchery produced (IEAB 2005). Most of the fish caught in the river are steelhead and spring/summer Chinook salmon, while ocean harvest consists largely of coho and fall Chinook salmon. Most ocean catches are made north of Cape Falcon, Oregon. Overall, fishing has had a deleterious effect on the species analyzed in this Opinion.

2.4.2.2 Puget Sound Region

Natural History. The Puget Sound watershed is defined by the crest lines of the Olympia Mountain Range (and the Olympic Peninsula) to the west and the Cascade Mountain Range to the east. As the second largest estuary in the United States, Puget Sound has about 1,330 miles of shoreline. It extends from the mouth of the Strait of Juan de Fuca east, including the San Juan Islands and south to Olympia, and is fed by more than 10,000 rivers and streams.

Habitat types that occur within the nearshore environment include eelgrass meadows, kelp forest, mud flats, tidal marshes, sub-estuaries (tidally influenced portions of river and stream mouths), sand spits, beaches and backshore, banks and bluffs, and marine riparian vegetation. These habitats provide critical functions such as primary food production, support habitat for invertebrates and juvenile and adult fishes, and provide foraging and refuge opportunities for birds and other wildlife.

Major rivers draining to Puget Sound from the Cascade Mountains include the Skagit River, the Snohomish River, the Nooksack River, the Puyallup/Green River, and the Lake Washington/Cedar River watershed. Major rivers from the Olympic Mountains include the Hamma Hamma, the Duckabush, the Quilcene, and the Skokomish rivers. Numerous other smaller rivers drain to the Sound, many of which are significant producers of salmonids despite their small size.

The Puget Sound basin is home to more than 200 fish species, representing more than 50 families; more than 140 mammals, of which less than a third are marine mammals. Salmonids within the region include coho salmon, Chinook salmon, sockeye salmon and kokanee, chum salmon, pink salmon, steelhead and rainbow trout, coastal cutthroat trout, bull trout, and Dolly Varden (Wydoski and Whitney 1979). Important commercial fishes include the five Pacific salmon species and several rockfish species. A number of introduced species occur within the region including brown trout, brook trout, Atlantic salmon, bass, tunicates (sea squirts), and a saltmarsh grass (spartina). Estimates suggest that more than 90 species have been intentionally or accidentally introduced in the region (Ruckelshaus and McClure 2007). At present over 40 species in the region are listed as threatened and endangered under the ESA.

Human Activities and Their Impacts. Land use in the Puget Sound lowland is composed of agricultural areas (including forests for timber production), urban areas (industrial and residential use), and rural areas (low density residential with some agricultural activity). In the 1930s, all of Western Washington contained about 15.5 million acres of “harvestable” forest land and by 2004 the total acreage was nearly half that surveyed more than 70 years earlier (PSAT 2007). Forest cover in Puget Sound alone was about 5.4 million acres in the early 1990s and about a decade later the region had lost another 200,000 acres of forest cover with some watersheds losing more than half the total forested acreage. The most intensive loss of forest cover has occurred in the State's Urban Growth Boundary, which encompasses specific parts of the Puget Lowland; in this area forest cover declined by 11.1 percent between 1991 and 1999 (Ruckelshaus and McClure 2007). Projected land cover changes indicate that trends are likely to continue over the next several decades with population changes coniferous forests are projected to decline as urban uses increase. These timber harvest activities have negatively affected fish habitat by reducing large woody debris habitat in streams, increasing stream temperatures, and altering natural streamflow patterns.

Much of the region's estuarine wetland losses have been heavily modified, primarily from agricultural land conversion and urban development (NRC 1996). Although most estuarine wetland losses result from conversions to agricultural land by ditching, draining, or diking, these wetlands are also experiencing increasing effects from industrial and urban causes. The loss of estuary habitat often negatively affects fish populations by diminishing juvenile salmon and steelhead rearing habitat.

The most extreme case of river delta conversion is observed in the Duwamish Waterway in Seattle. As early as the mid-1800s, settlers in the region began discussing the need for a ship canal that linked Lake Washington directly with Puget Sound. After several private and smaller attempts, by the early 1900s locks were built achieving this engineering feat. Over time the waterway has been heavily armored and diked, result in the loss of all tidal swamps, 98 percent of the tidal forests, marshes, shallows and flats and 80 percent of the riparian shoreline (Ruckelshaus and McClure 2007).

The Puget Sound Lowland contains the most densely populated area of Washington. The regional population in 2003 was an estimated 3.8 million people, with 86 percent residing in King, Pierce, and Snohomish Counties (Snohomish, Cedar-Sammamish Basin, Green-Duwamish, and Puyallup River watersheds), and the area is expected to attract four to six million new human residents in the next 20 years (Ruckelshaus and McClure 2007).

More than 100 years of industrial pollution and urban development have affected water quality and sediments in Puget Sound. Many different kinds of activities and substances release contamination into Puget Sound and the contributing waters. Positive changes in water quality in the region, however, are also evident. One of the most notable improvements was the elimination of sewage effluent to Lake Washington in the mid-1960s, which significantly reduced problems within the lake from phosphorus pollution and triggered a concomitant reduction in the cyanobacteria.

The USGS assessed water quality of streams, rivers and groundwater in the Puget Sound basin as part of the National Water-Quality Assessment Program between 1996 and 1998. This assessment focused on the quality of surface and ground waters and biological indicators such as fish status, algal status, and invertebrate status in relation to land use. A widespread detection of pesticide compounds was observed in surface waters of the Puget Sound basin (Bortleson and Ebbert 2000). Slightly more than half of the pesticide compounds (26 of 47 analyzed) were detected. The study found that large rivers in the Puget Sound basin were more likely to meet federal and state guidelines than were small streams (Ebbert et al. 2000). A total of 74 manmade organic chemicals were detected in streams and rivers, with different mixtures of chemicals linked to agricultural and urban settings including atrazine, prometon, simazine and tebuthiuron, carbaryl, diazinon, and malathion. Exposure to these chemicals is harmful to fish because they may cause reproductive problems, impaired growth, impaired homing, and death.

More than 20 dams occur within the region's rivers and overlap with the distribution of salmonids, and a number of basins contain water withdrawal projects or small impoundments that can impede migrating salmon. The resultant impact of these and land use changes (forest cover loss and impervious surface increases) has been a significant modification in the seasonal flow patterns of area rivers and streams, and the volume and quality of water delivered to Puget Sound waters. Several rivers have been hydromodified by other means including levees and revetments, and bank hardening for erosion control, and agricultural uses. The first dike built in the Skagit River delta was built in 1863 for agricultural development (Ruckelshaus and McClure 2007). Other basins like the Snohomish River are diked and have active drainage systems to drain water after high flows that top the dikes. Dams were also built on the Cedar, Nisqually, White, Elwha, Skokomish, Skagit and several other rivers in the early 1900s to supply urban areas with water, prevent downstream flooding and allow for floodplain activities (like agriculture or development), and to power local timber mills (Ruckelshaus and McClure 2007). The completion of removal of two dams in the Elwha River in 2014, formerly a short but very productive salmon river, opened up more than 70 miles of high quality salmon habitat. Estimates suggestion that nearly 400,000 salmon could begin using the basin within 30 years of the dams being removed (PSAT 2007).

About 800 miles of Puget Sound's shorelines are hardened or dredged (Ruckelshaus and McClure 2007). The area most intensely modified is the urban corridor (eastern shores of Puget Sound from Mukilteo to Tacoma); here nearly 80 percent has been altered, mostly from shoreline armoring associated with the Burlington Northern Railroad tracks. Levee development within the rivers and their deltas has isolated significant portions of former floodplain habitat that was historically used by salmon and trout during rising flood waters.

Mining has a long history in the State of Washington, and in 2004 the state was ranked 13th nationally in total nonfuel mineral production value and 17th in coal production (Palmisano 1993). Metal mining for all metals (e.g., zinc, copper, lead, silver, and gold) peaked in the State between 1940 and 1970 (Palmisano 1993). Today, construction sand and gravel, Portland cement, and crushed stone are the predominant materials mined. Where sand and gravel is mined from riverbeds (i.e., gravel bars and floodplains) it may result in changes in channel elevations and patterns, instream sediment loads, seriously altering instream habitat. In some cases, instream or floodplain mining has resulted in large-scale river avulsions. The effect of mining in a stream or reach depends upon the rate of harvest and the natural rate of replenishment, as well as flood and precipitation conditions during or after the mining operations.

Most of the commercial landings in the Puget Sound area are groundfish, Dungeness crab, shrimp, and salmon. Many of the same species are sought by Tribal fisheries, and by charter and recreational anglers. Nets and trolling are used in commercial and Tribal fisheries, whereas recreational anglers typically use hook and line, and may fish from boat, riverbank, and docks.

Entanglement of marine mammals in fishing gear is not uncommon and can lead to mortality or serious injury.

2.4.2.3 Oregon-Washington-Northern California Coastal Drainages

Natural History This region encompasses drainages originating in the Klamath Mountains, the Oregon Coast Mountains, and the Olympic Mountains--the Coast Range ecoregion where elevations range from sea level to about 4,000 feet. More than 15 watersheds drain the region's steep slopes including the Umpqua, Alsea, Yaquina, Nehalem, Chehalis, Quillayute, Queets, and Hoh Rivers. Numerous other small to moderately sized streams dot the coastline. Many of the basins in this region are relatively small—the Umpqua River drains a basin of 4,685 square miles and is a little over 110 miles long; and the Nehalem River drains a basin of 855 square miles and is almost 120 miles long—yet represent some of the most biologically diverse basins in the Pacific Northwest (Carter and Resh 2005; Kagan et al. 1999).

The region is part of a coastal, temperate rainforest system, characterized by a moderate maritime climate marked by long wet seasons with short dry seasons and mild to cool year-round temperatures. Average annual precipitation ranges from about 60 inches to more than 180 inches, much of which falls as rain, and supports a rich temperate forest. Vegetation is characterized by giant coniferous forests of Sitka spruce, western hemlock, Douglas fir, western red cedar, red alder, and black cottonwood

Human Activities and Their Impacts. The rugged topography of the western Olympic Peninsula and the Oregon Coastal Range has limited the development of dense population centers. For instance, the Nehalem River and the Umpqua River basins consist of less than 1 percent urban land uses. Most basins in this region have long been managed for timber production, and are still dominated by forestlands. Logging impacts to fish habitat have included the loss of large woody debris which was an important habitat-forming feature in these coastal ranges. Additionally, logging on steep slopes often resulting in landslides which severely impacted fish habitat. Modern logging practices have greatly reduced these effects; however, remnant effects from the past persist. In Washington State, roughly 90 percent of the coastal region is forested (Palmisano 1993). Approximately 92 percent of the Nehalem River basin is forested, with only 4 percent considered agricultural. Similarly, in the Umpqua River basin about 86 percent is forested land, 5 percent agriculture, and 0.5 percent are considered urban lands—with about half the basin under federal management (Carter and Resh 2005).

Compared to other areas in the greater Northwest Region, the coastal region has fewer dams and several rivers remain free flowing. The Umpqua River is fragmented by 64 dams (Carter and Resh 2005). According to Palmisano (1993) only about 30 miles of salmon habitat are permanently blocked by dams in the coastal streams of Washington.

Hatchery production presents risks to natural-origin salmon and steelhead in coastal Oregon, Washington and Northern California. These include genetic risks from hatchery-origin fish to natural-origin fish as a result of poor broodstock and rearing practices, risks of competition with and predation on naturally spawned populations, and incidental harvest of natural-origin fish in fisheries targeting hatchery-origin fish.

In the past, temporary splash dams were constructed throughout the region to transport logs out of mountainous reaches. The general practice involved building a temporary dam in the creek adjacent to the area being logged, the pond was filled with logs and when water behind the dam was released the floodwater would carry the logs to downstream reaches where they could be rafted and moved to market or downstream mills. Thousands of splash dams were constructed across the Northwest in the late 1800s and early 1900s. While the dams typically only temporarily blocked salmon habitat, in some cases they remained long enough to wipe out entire fish runs, the effects of the channel scouring and loss of channel complexity resulted in the long-term loss of salmon habitat (NRC 1996).

Most of the commercial landings in the region are groundfish, Dungeness crab, shrimp, and salmon. Many of the same species are sought by Tribal fisheries, and by charter and recreational anglers. Nets and trolling are used in commercial and Tribal fisheries, whereas recreational anglers typically use hook and line, and may fish from boat, riverbank, and docks. Entanglement of marine mammals in fishing gear is not uncommon and can lead to mortality or serious injury. These fisheries are regulated by the Pacific Fishery Management Council (PFMC) and, as appropriate, the NMFS so as to ensure sustainable harvest levels and recovery under the ESA.

Because the action area encompasses the entirety of the ranges of the listed species described above, climate change impacts in the action area over the long term are expected to be as described above for species status. However, given the short timeframe of the effects of this proposed action (2 years until reinitiation of the national fire retardant consultation), climate change impacts in the action area will be well represented by current conditions including the recent record of extreme weather events and increased fire frequency and magnitude.

2.5 Effects of the Action

Under the ESA, "effects of the action" means 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 still are reasonably certain to occur.

It is difficult to determine precisely the effects that might occur from an action that takes place over such a large action area. There is a wide degree of variability of conditions and habitats throughout Washington, Oregon, California, and Idaho. The intensity of fires can be highly variable depending on a host of factors that might include fuel availability, weather conditions, ignition sources, and timing of initial attack. The effects from the aerial application of retardant will depend on all these factors in addition to the type of retardant used, whether the retardant is delivered directly to the stream or simply the adjacent riparian area, or a whole host of other factors.

Effects from the proposed action to salmon, steelhead and critical habitat are most likely when retardant is delivered directly to the stream or to an area within 300 feet on each side of the waterway. Analysis of historical USFS records, particularly in anadromous waters in the Snake River basin (an area with high fire frequency and good records of past activities), indicates that this is an uncommon occurrence. However, when a stream has retardant delivered to it, adverse effects to ESA-listed species may occur; potentially killing fish in an affected stream reach (Van Meter and Hardy 1975). Leaching of retardant from the adjacent riparian area into the stream over time may have sublethal effects for a longer period of time.

Fire retardants interact with forest fire fuel (i.e. vegetation) and they work by fuel coating, fuel combustion modification, and fuel cooling. Retardant coverage level is a unit of measure used to describe the thickness of the chemical on the ground and is expressed in gallons per 100 square feet. There are general guidelines for coverage levels according to fuel type, and suggested coverage levels intended to be used as starting points only. Feedback from crews on the ground is essential in determining the effectiveness of drops and whether the coverage should be lighter or heavier. The primary component of retardant that affects fish is ammonia.

It is not practicable to quantify the number of fish that might be adversely affected by any given intrusion due to uncertainty about what stream(s) will be affected, the number of fish/life stage(s) that might be present at any given time, and the variability in conditions (fire intensity, wind, etc.) that would change the amount of retardant that enters the stream. Miles of occupied critical habitat, however, are generally a reasonable approach as to how great an effect an intrusion would have on a given population. A small population with a correspondingly small amount of occupied habitat would be more impacted by the same sized intrusion than would a larger population with a larger amount of habitat.

The ESA-listed anadromous species in the action area are most likely to be exposed to intrusions of aerial fire retardant in areas with higher fire frequencies. As noted above, these areas are largely in California and the Interior Columbia River basin. The lowest likelihood of an intrusion is in coastal areas in Oregon and Washington.

2.5.1 Avoidance Area Mapping

Avoidance area mapping is a key element of the proposed action in avoiding adverse effects on ESA-listed aquatic species because it indicates to pilots the areas that they need to avoid in the application of aerial fire retardant. Avoidance area mapping for waterways was completed in 2011 and has been updated annually or as needed. As directed within the 2011 ROD and the current proposed action, the USFS will annually coordinate with NMFS local offices to ensure that the mapped avoidance areas on NFS lands incorporate the most up-to-date species and habitat information. This includes additional mapping requirements including increased buffer area or needs to protect species.

The likelihood that the types of effects discussed below will occur will be minimized by the effects minimization or avoidance measures identified in the proposed action, particularly the mapping of avoidance areas. Mapping of avoidance areas and the sharing of these maps with pilots has proven to be effective in anadromous portions of the action area as evidenced in the low rate of misapplication of retardant during the time period in which the maps were available.

2.5.2 Delivery of Retardant to Waterways (overview of chemical interactions and fish response)

2.5.2.1 Direct Entry into the Waterway

Several characteristics of the application site determine the initial concentration of retardant in the stream, and the likelihood of fish or their habitat being exposed to the retardant. Narrow, deep streams have a much lower initial concentration of retardant (therefore, a shorter mortality zone for aquatic species) than shallow, wide streams assuming equivalent flows, because there is less surface area to intercept the retardant (Norris and Webb 1989). Streams with dense overstory vegetation are less affected by retardant because the vegetation intercepts much of the retardant. Where less overstory vegetation exists, it is likely that more retardant will enter the water.

Smaller width streams are more likely to be impacted by a retardant strike because they are harder to see from the air. However, smaller streams are likely to have more overhanging vegetation which lessens the likelihood of much retardant hitting the stream (i.e. a 2- to 3-foot wide stream that has overhanging grasses might only have 1-foot of exposed stream).

2.5.2.2 Aerial Drift

Drift can also be a factor in direct delivery to streams. How much fire retardant drifts depends on the height and speed of the aircraft at the time of the drop, wind direction, and wind speed. Fire retardants include a gum thickening agent to raise the viscosity to between 100 centipoise (cps) and 1,800 cps to reduce drift (USFS 2005). These products create larger and more cohesive droplets that are less prone to drift. Fire retardant mixtures that contain clay have particles in the range of 2 to 3 millimeters (mm) where guar gum-thickened retardant solutions have particles that vary from 3.5 to 5 mm depending on the type of gum used in the mixture (Gimenez et al. 2004). The amount of retardant delivered to streams through drift, however, is much less than what would be delivered in the instance of a direct hit.

In drop tests for fire retardant application with air tankers, testing occurs with wind speeds of 0 to 10 miles per hour (mph). Drops from elevations of 100 to 300 feet resulted in retardant drift ranging from 5 to 70 feet (USFS drop testing, MTDC 2011). Generally, fire retardant is used at low wind speeds for more precise placement of retardant. Drops are allowed in winds up to 30 mph (USFS 2016); with higher-speed winds, there is more potential for drift of the fire retardant and greater likelihood of fish and habitat exposure to fire retardant chemicals.

2.5.2.3 Surface Runoff and Leaching

Delivery of retardant to streams can occur via surface run-off or leaching. Both occur from precipitation events after application of the retardant. Run-off is where overland flow carries water and soil directly to waterbodies. Leaching is where water moves through soil dissolving and removing materials.

Delivery of retardant to streams via surface runoff or leaching can occur when retardant is applied both outside and inside the 300-foot buffer around avoidance areas. Retardant applied outside of the 300-foot waterway buffer may reach surface water and have adverse effects to aquatic organisms; however, it is highly unlikely that this would occur (Norris et al. 1978; Crouch et al. 2006). The likelihood of adverse effects decreases with proximity to the stream. Adverse effects are more likely to occur for applications within the 300-foot buffer and much more likely to occur when retardant strikes within 50–100 feet of streams. The level of toxicity depends on the surface or soil type (i.e., rock, sand, soils with high or low organic matter, etc.), persistence in the environment, timing of a rainfall event, and the amount of retardant on the ground. Little and Calfee (2005) found that the substrate upon which the chemicals are applied is important when assessing the resultant environmental persistence. In a study where fire chemicals (including D75-R) were weathered on non-porous surfaces at recommended application levels, fire retardants remained toxic for more than 21 days. Additional tests showed the persistence of toxicity was dependent on soil type and quality, and that toxicity was often eliminated on soils with high organic content (Little and Calfee 2005). Although the highest toxicity was in formulations that included cyanide (which is no longer used), D75-R (also no longer used) caused up to 20 percent mortality in fathead minnows (*Pimephales promelas*), depending on soil surface, after 21 days of weathering (Little and Calfee 2005). Because of the large area covered by the proposed action, it is likely that various soil types and geomorphology will result in a variable the risk the fire retardant reaching the stream via this pathway across the action area.

In one study, an amount of retardant that would approximate one thousand gallons of mixed fire retardant was applied parallel to and within 10 feet of one stream in Oregon. A result showed no immediate increase in un-ionized ammonia (NH_3) concentrations where retardant was applied parallel to the stream (Norris et al. 1978). During a year of monitoring after application of the retardant to near-stream ground, soluble nitrogen forms and phosphorus levels in stream water were similar to the untreated, control watersheds (Norris et al. 1978; Norris et al. 1991). Section 2.5.2.4, Chemical Response of Retardants in Water, gives more detail on these different chemicals.

Runoff from any soil that contains retardant could potentially cause small spikes in ammonia concentration with subsequent rainfall events. However, this would only be the case if the runoff came in the form of overland flow through the riparian area (Crouch et al. 2006). This is unlikely because riparian areas generally do not burn with the intensity that upland areas do. This greatly reduces the risk of overland flows occurring in riparian areas. Post-fire water quality monitoring (time periods ranged from a few days to up to 1- year for sampling) for streams near four wildfires showed that application of fire retardant near streams, but not into streams, had minimal effects on surface water quality (Crouch et al. 2006).

Ammonia and phosphorus from burning of wood and other organics were found in streams in burned areas where retardant was not used, at concentrations similar to those found in areas where fire retardant was used (Crouch et al. 2006). However, due to the wide range of soil types throughout the action area, the likelihood of retardant delivery to streams from surface runoff and leaching will vary widely. Overall, based on Crouch et al. (2006), it is unlikely that fire retardant delivery from leaching or surface runoff will cause more than minimal sublethal effects to fish.

2.5.2.4 Chemical Response of Retardants in Water

When fire retardants initially enter a stream, there is an immediate spike in ammonia concentration in the receiving stream. For instance, when Phos-Chek 259-F (no longer produced – stocks will be depleted in 2018 or 2019) hits the surface of the water, it is 22.9 percent ammonia (Buhl and Hamilton 2000). The peak of the spike and area affected depends on many factors, such as volume of retardant to hit the water, volume of water to dilute the retardant, and turbulence of the stream.

In a modeled analysis of 267 gallons of fire retardant hitting the surface of a stream, peak ammonia concentrations reached 5,026 mg/L (Buhl and Hamilton 1998). This occurred in Murderers Creek, approximately 330 feet upstream of its confluence with the South Fork John Day River in Oregon. This created a fish kill that extended through Murderers Creek to approximately 1.7 miles downstream in the South Fork John Day River. However, the retardant used was Fire-Trol LCG-F, which is an extremely toxic retardant formulation that is no longer used. Part of the reason it is so toxic is that in addition to ammonia toxicity, Fire-Trol LCG-F contained sodium ferrocyanide. Calfee and Little (2003) note that sodium ferrocyanide is fairly non-toxic in the dark but when exposed to ultraviolet (UV) radiation (e.g., sunlight) it becomes highly toxic. This incident appears to be a worst-case scenario for retardant-caused mortality but it is important to take note that the sodium ferrocyanide likely had additional deleterious effects on the fish.

When the volume of retardant hitting the stream is doubled, the modeled zone of mortality is extended 10 times farther downstream (Norris et al. 1991). This is not only the ammonia concentration caused directly by the fire retardant but, in a natural situation during a fire, ammonia levels in the water column will also be elevated due to smoke adsorption (Gresswell 1999). To further complicate what would actually occur during a wildfire, the application of fire retardants increases the amount of smoke produced by the fire (Kalabokidis 2000), which ultimately leads to more ammonia in the system.

When fire retardant enters a stream and causes the initial spike in ammonia, it immediately begins to form a chemical equilibrium between un-ionized ammonia (NH_3), which is the more toxic form (see below under Section 2.5.2.5), and ionized ammonia (NH_4^+). The chemical balance between these two forms of ammonia is determined by pH, temperature, and total ammonia concentration. In most streams, the pH is sufficiently low such that NH_4^+ predominates. However, in highly alkaline waters, NH_3 concentrations increase and can reach toxic levels. Most research analyzes the lethal levels of NH_4^+, the least toxic form that will be present in the river, however, several studies have analyzed NH_3 in streams.

Norris et al. (1978) showed no immediate increase in NH_3 concentrations where retardant was applied parallel to the stream. Results of applications directly into water showed maximum concentrations of NH_3 ranging from 0.02 to 0.32 mg/L, approximately 150 feet downstream from the application point, at time intervals between 2 and 22 minutes after application (Norris et al. 1978). Time to dilution to one percent of maximum concentration, at 150 feet downstream, ranged from 10 minutes to almost 4 hours. The dilution ranged from 4 percent to 29 percent at 650 feet downstream of the application points, and one percent to three percent at 2,600 feet downstream; times ranged from 10 to 24 minutes. The differences in concentrations were due to factors of velocity and mixing turbulence of the stream flows. Retardant that was applied to the ground on either side of the streams was largely prevented from entering water, contributed little or no NH_3 to streams due to untreated strips of ground as narrow as 10 feet wide alongside streambanks (Norris et al. 1978).

Norris et al. (1978) applied Phos-Chek directly to a California stream but the maximum application used was 0.5 mg/L (an application level less than what would likely occur during normal operations in fire suppression). In the natural environment, after 30 minutes, the ammonia (NH_3) concentration had been reduced by 90 percent at the point of entry, but there was no determination of whether there could be similar expectations in the speed of dilution of extremely large introductions of retardant or under actual fire conditions with heat, smoke, and ash. The highest concentrations of ammonia were detected 148 feet downstream of the point of contact and had dissipated to one percent of their peak concentration after almost 4 hours (Buhl and Hamilton 1998). After 1-year, there were still detectable, albeit slight, changes to the stream's water chemistry (Norris et al. 1978). Discernable levels of ammonia were detected 1.7 miles downstream when an amount of retardant that was believed to be smaller than what could occur in a retardant intrusion was placed in the stream (Norris et al. 1978). Simulations run by Norris and Webb (1989) showed ammonia concentrations could remain at lethal levels between 0 and 6.2 miles downstream, depending on stream characteristics and the size of the retardant load. However, the modeled stream that indicated lethal effects 6.2 miles downstream was an outlier in the research; a more typical distance downstream in the modeling effort would range from less than 1-mile to approximately 2.5 miles. It is important to note, however, that these distances were modeled using a synthesis of other models which were developed in the 1970s. A more reasonable estimate of downstream effects would be based on actual field data found in the Murderers Creek intrusion which is described above. This is because the Murderers Creek data are actual field data as opposed to outdated, modeled information. In Murderers Creek, lethal downstream effects were observed 1.7 miles downstream. Due to its higher toxicity, sodium ferrocyanide is no longer used. As described above, sodium ferrocyanide is highly toxic when exposed to sunlight. In the instance of the Murderers Creek intrusion, it is likely that the distance downstream that toxic effects occurred would have been much less had a retardant without sodium ferrocyanide (i.e., less toxic) been used.

In another modeling effort, Van Meter and Hardy (1975) found that concentrations of retardant high enough to kill 10 percent of the fish population were measurable over 4 miles downstream. However, one of the assumptions used was that the retardant would be dropped in a direction that would be aligned with the stream course and not be perpendicular to the stream course, a highly unlikely scenario. Based on monitoring data from the recent history of intrusions after the signing of the 2011 Opinion, (e.g., 210 Road Fire intrusion in 2015), it is most likely that an intrusion would be perpendicular to the stream with only a portion of the load hitting the water.

2.5.2.5 Fish Response

This section summarizes the available information regarding fire retardant toxicity on salmonid fish species (Table 10). The magnitude of mortality and the distance over which it occurs will vary with characteristics of the application, the site, and quantity of stream flow. Other factors, such as water chemistry and sunlight, can also affect toxicity of some of the retardants.

Chemical components of the retardant Phos-Chek D75-R, and presumably all members in the Phos-Chek family, include NH_3 and total ammonia. The NH_3 is neutrally charged (Emerson et al. 1975) and easily crosses the gill membranes of fish. Because of this, it is considered the most toxic form of ammonia. A primary function of the gills is to rid the body of waste material in the form of ammonia. If enough NH_3 is in the surrounding water, ammonia will diffuse into the organism, creating a buildup of ammonia. Ammonia build up can occur to such an extent that it becomes lethal to the organism.

Table 10. Summary of Toxicity Studies Conducted on Fish.

Species	Retardant	96 hour LC_{50} (Mg/L)
Rainbow Trout	Phos-Chek 259	94–250
Rainbow Trout	Phos-Chek 259-F	168
Chinook Salmon	Phos-Chek 259-F	122–186
Rainbow Trout	Phos-Chek D75R**	142–194
Rainbow Trout	Phos-Chek D75-F**	184–271
Rainbow Trout	Phos-Chek D75-F**	170–280
Rainbow Trout	Phos-Chek D75-F**	170–-280
Coho Salmon	Phos-Chek 259	94–250
Chinook Salmon	Phos-Chek LC-95A	524–799
Rainbow Trout	Un-ionized ammonia*	0.20

*NH_3 is one of the major ingredients of all fire retardant and the most toxic form to fish (Fontenot et al. 1998).
**These fire retardants were phased out and are no longer manufactured; previous inventory was applied during fire season 2011, and no application of these products has occurred since.

Backer et al. (2004) found the effects of fire retardants on fish could be greater than the effects of fire on fish. Fish response does not only depend on the amount of retardant to hit the water and variables within the stream, but also on interactive effects among the various ingredients in the retardant or on the interaction of retardant effects coupled with the effects of the nearby fire to the stream. Johnson and Sanders (1977) found that most mortality of rainbow trout individuals occurs in the first 24 hours of exposure to retardant.

Dietrich et al. (2014) evaluated the toxicity of Phos-Chek LC-95A and 259F fire retardants to ocean- and stream-type Chinook salmon and their potential to recover before seawater entry. Their results demonstrated that both types of Chinook salmon smolts that survived previous exposure to Phos-Chek fire retardants had significantly reduced seawater survival, with the exception of stream-type Chinook salmon smolts exposed to Phos-Chek 259F. Individual Chinook salmon were most sensitive to the cumulative effects of Phos-Chek exposure at the smolt stage, with no delayed effects observed when retardant exposures occurred as presmolts and time to recover before seawater entry was available. Since the delayed effects of fire retardant exposure increased the cumulative mortality, Phos-Chek LC-95A was more toxic to Chinook salmon than the acute LC_{50}s (i.e., the toxicity of the surrounding medium that will kill half the exposed population) would suggest.

As discussed above, fire retardants, and the ammonia plume that develops when retardants enter a stream, do not persist above the lethal concentrations described above for long periods of time, usually up to 4 hours at most. Buhl and Hamilton (1998) showed that when 267 gallons of fire retardant enters a stream, the ammonia concentration reaches 5,026 mg/L. At these levels, mortality would be nearly immediate. However, downstream, as the plume is diluted, longer exposure to the LC_{50} levels described above can be lethal. Buhl and Hamilton (1998) provide a case study of a 1995 Fire-Trol LCG-F intrusion in which 23,000 fish were killed and, although the retardant contained sodium ferrocyanide, the cause of mortality was determined to be ammonia concentrations. However, as noted above, Calfee and Little (2003) showed that sodium ferrocyanide becomes highly toxic in the presence of sunlight (UV radiation).

As previously described, the intrusion which Buhl and Hamilton (1998) evaluated occurred in Murderers Creek approximately 330 feet above its confluence with the South Fork John Day River. The fish kill from this incident extended through Murderers Creek to approximately 1.7 miles downstream in the South Fork John Day River. This incident appears to be the worst-case example of a fish kill resulting from an intrusion of fire retardant. As described above, sodium ferrocyanide is highly toxic when exposed to sunlight. In the instance of the Murderers Creek intrusion, it is likely that the distance downstream that toxic effects occurred would have been much less had a retardant without sodium ferrocyanide (i.e., less toxic) been used.

Ecological risk assessments of wildland fire-fighting chemicals (Labat Environmental 2017) have recently been updated to include newly approved retardants and are available at: https://www.fs.fed.us/rm/fire/wfcs/. The current list of qualified retardants currently used on NFS lands and their associated fish toxicities (i.e., LC_{50}s) are provided in Table 11. The 2011 Opinion assessed three chemical bases and stated new formulations could be approved without the need for reinitiation if they are less toxic that 100 mg/L (LC_{50}).

Table 11. Updated list of approved long-term fire retardants and associated fish toxicity values.

Retardant	LC_{50} (Lower values indicate greater toxicity)		Comments
	Soft Water	Hard Water	
Phos-Chek MVP-Fx	2,024 mg/L		Approved 2014
Phos-Chek LC-95A-Fx	399 mg/L		Approved 2016
Phos-Chek LC-95A-R	386 mg/L		
Phos-Chek LC-95-W	465 mg/L	1,115 mg/L	
Phos-Chek LC-95A-F	225 mg/L	778 mg/L	
Phos-Chek MVP-F	2,454 mg/L	2,690 mg/L	Approved 2014
Phos-Chek 259-Fx	860 mg/L		Approved 2016
Retardants listed below were included in the 2011 BA but are no longer used			
Phos-Chek P100-F	1,494 mg/L	1,932 mg/L	No longer produced, stores expected to be depleted in 2018
Phos-Chek 259-F	148 mg/L	168 mg/L	No longer produced, stores expected to be depleted in 2018

2.5.3 Sublethal Effects to ESA-listed Anadromous Salmonids

Sublethal effects will result from short-term or transient exposures to retardant. The extent of the sublethal impacts will extend downstream farther than lethal impacts because ammonia concentrations below lethal limits will persist farther downstream. Sublethal effects may also occur when small amounts of retardant are delivered to a stream with high flow volumes or when retardant misapplications result in small concentrations of retardant ingredients and degradation products that runoff or leach into salmon-bearing waters over time.

Laboratory studies show that rainbow trout exposed to NH_3 levels over 0.1 mg/L developed skin, eye, and gill damage. Other reactions to sublethal levels of ammonia are reduced hatching success; reduced growth rate; impaired development; injury to gill tissue, liver, and kidneys; and the development of hyperplasia (an abnormal increase in the number of cells in an organ or a tissue). Hyperplasia in fingerling salmonids can result from exposure of ammonia levels as low as 0.002 mg/L for 6 weeks. Considering the research in California (Norris et al. 1978) that showed detectable levels of ammonia for an entire year following retardant introduction, it is possible that hyperplasia could be a concern for ESA-listed salmonids. The presence of ammonia in the water can also lead to suppression of normal ammonia excretion and a buildup of ammonia on the gills. Fire retardants may also inhibit the upstream movement of spawning salmon, because, as small concentrations of ammonia have been found to injure the gills, lowering adenosine triphosphate base levels in the gills and sodium levels in the blood, and impairing the ability of juveniles to later adjust to seawater.

2.5.4 Macroinvertebrates Response to Retardant Toxicity

Macroinvertebrates are a key food source for fish. The loss of numbers and populations of macroinvertebrates might affect the viability of the food web upon which salmonids depend.

The U.S. Environmental Protection Agency (1986) reported that macroinvertebrates are more tolerant to ammonia than fish. Adams and Simmons (1999) reported that mayflies (*Ephemeroptera*) and stoneflies (*Plecoptera*) in Australia were not affected by Phos-Chek D75-F. McDonald et al. (1997) reported that the D75-F 96-hr LC_{50} for *Hyalella azteca* (an amphipod crustacean) was 53 mg/L in soft water and 394 mg/L in hard water.

In a study in Arizona, mayflies were consistently more sensitive to Phos-Chek D75-F than stoneflies (Poulton et al. 1997). The LC_{50} for mayflies exposed to Phos-Chek D75-F for 3 hours was 1,033 mg/L (Poulton et al. 1997). This concentration is similar to the field concentration that would result from drift or runoff but is almost 10 times lower than the concentration expected if an accidental drop occurred directly in the water. Phos-Chek D75-F exposures to mayflies, stoneflies, trout, Daphnia, and fathead minnows indicated that mayflies and stoneflies were much less sensitive to Phos-Chek when compared to trout (Poulton et al. 1997).

Most toxicity studies for macroinvertebrates have been conducted with Phos-Chek D75-F. This formulation is only one of the five formulations being used by the USFS and was phased out during the 2011 fire season. There is a need for further studies of the effects to macroinvertebrates from all fire retardant formulations. Nitrates and nitrites could contribute to the toxicity of retardants but did not appear to influence the toxicity of Phos-Chek D75-F to daphnids. McDonald et al. (1997) found that nitrate-nitrogen concentrations in the Phos-Chek toxicity tests were 75 to 160 times less than those reported to be toxic to freshwater invertebrates. Nitrite-nitrogen concentrations in a Phos-Chek D75-F toxicity study on crayfish were also 30 times less than the crayfish 96-hour LC_{50} (Gutzmer and Tomasso 1985).

Macroinvertebrate species may respond to disturbance (retardant concentrations) by allowing themselves to enter the water column and "drifting" away from the disturbance. Drift of *Ephemeroptera*, *Plecoptera*, and *Trichoptera* during the first Phos-Chek D75-F exposure period returned to zero drift at the lower dose but did not return to zero drift in the second exposure at the higher dose (Poulton et al. 1997). The rate of Phos-Chek degradation instream was accelerated in areas with elevated organic matter (Poulton et al. 1997). Half-life for long-term fire retardants instream was 14 to 22 days. Overall, Poulton et al. (1997) determined that Phos-Chek D75-F is not highly mobile. Because insect drift is high in response to retardant exposure, and retardant may persist in the area to which is applied, it is possible that macroinvertebrate recolonization in affected areas may be delayed.

In spite of uncertainties resulting from a lack of research on Phos-Chek formulations other than D-75-F, due to their relatively similar chemical compositions (ammonia being the toxic element common to all), NMFS assumes that adverse effects to macroinvertebrates are likely to result from retardant intrusions into streams. As noted above, these effects are likely to be less severe to macroinvertebrates than what would be expected with ESA-listed salmonids. However, some reduction in forage for fish is likely.

2.5.5 Ecological Considerations for Retardant Toxicity

Responses of organisms tested in controlled laboratory systems do not necessarily provide reasonable predictors of organisms' responses to similar chemicals in the wild, although in most cases these are the only data available to conduct an evaluation. Reaction to various substances establishes a starting point around which to predict the response under various scenarios.

The conditions simulated in a laboratory test are unlikely to resemble "worst-case field conditions." It is possible that field conditions might lessen effects. In laboratory tests, species are generally isolated from confounding factors so that researchers are able to isolate the species responses to the chemical (or stressor) under study. Lab studies do not replicate typical environmental conditions where intraspecific (within species) or interspecific (between species) competition for food or shelter occurs. Water velocities, water temperature, and dissolved oxygen (DO) are not representative of fluctuating conditions in a natural aquatic environment, (particularly during a wildfire) and generally, there are no other chemical stressors present.

While there has been a fair amount of research conducted in laboratory environments, the response of aquatic species to an accidental fire retardant drop in the natural environment with additional stressors, such as low DO, ash, increased water temperatures, and other conditions expected as the result of a nearby fire, has not been well studied. Most aquatic species are particularly sensitive to elevated temperatures and are not tolerant of water with low DO. There have been several studies done on the interactive effects of ammonia and DO, all showing the

LC_{50} concentration for NH_3 ammonia for rainbow trout decreases as DO levels decrease. Alabaster et al. (1983) showed that at 10 parts per million (ppm) DO, rainbow trout die at concentrations of NH_3 of 0.2 mg/L; but, when the DO fell to 3.5 ppm, the lethal concentration of NH_3 was only 0.08 mg/L. Thurston et al. (1981) showed that when DO dropped from 8.5 ppm to 5 ppm, rainbow trout became 30 percent less tolerant of NH_3.

Gresswell (1999) showed that smoke in the air is absorbed by water and increases the ammonia concentrations in rivers even without an accidental application of retardant. Crouch et al. (2006) showed that in burning watersheds, prior to treatment with retardants, there is increased ammonia, phosphorous, and total cyanide. Because there is a greater background level of ammonia during a fire, the cumulative ammonia levels created by an accidental drop are higher than are experienced in a controlled setting. Therefore, a natural stream requires more dilution to reach non-toxic levels.

Ash and guar gum (a component in retardant) have both been identified as respiratory inhibitors in water. Ash has been identified as the cause of fish kills during wildfires and volcanic eruptions (Newcombe and Jensen 1996), while guar gum would further exacerbate the effects of increased ammonia concentrations. Buhl and Hamilton (1998) stated, “these results indicate that although ammonia is a major toxic component in D75-F, other components in the formulation may have had a significant influence on the toxicity of D75-F to Chinook salmon.”

2.5.6 Mixing and Transporting Retardants

Retardant is normally stored and mixed at an airtanker base, or in some instances, onsite near a fire incident. When retardant is mixed at the incident site using a portable mixing station, water sources are a municipal water source or a large lake or reservoir. The amount of water used does not cause any water depletion issues of waterbodies or adverse effects to ESA-listed species. In addition, standards are in place for all pumps to have screens to prevent fish kills.

Spills during transportation, both on the ground and aerially, have occurred in the past and will likely continue to occur in the future. The USFS has a Transportation and Handling Plan (Plan) that addresses spill prevention and containment when moving or using fire retardant. The Plan requires that special precaution be taken to contain potential spills while airtankers operate on the ground. Areas where retardant is loaded must have containment and treatment systems to handle leaks, spills, and/or wash-down water used to wash aircraft that may contain metals from the aircraft, fuel, hydraulic fluid, and oils. As of 2011, liquid bulk tankers have been and will continue to be sealed to prevent leaks or spills.

As far as we are aware, there has not been an intrusion into anadromous habitat during mixing or transporting retardants. It is possible that there could be a truck accident which causes an intrusion; due to the highly unpredictable nature of this type of incident, this would likely be covered under an emergency consultation. The safeguards for mixing at incident sites are sufficient to reduce the risk of intrusions to very low levels. In the event an intrusion did occur, the effects would likely be similar to those analyzed below.

2.5.7 Indirect Effects

Fire retardants are nitrogen-based. When they hit the water and break down, retardants eventually become nitrogenous nutrients (Norris et al. 1978). Eutrophication can be a problem in many slack water areas along the course of a river. In rivers with large agricultural or urban development, excess nitrogen and phosphorus may have already created water quality problems, even without having more nutrients accidentally introduced (Smith et al. 1999). The most likely places that are impacted by eutrophication and the biotic organisms that grow in poor water quality are reservoirs. Eutrophication in reservoirs impairs light penetration, submerged vegetation, and nursery habitat. However, the ESA-listed species under consideration in this Opinion primarily use stream (i.e., lotic) habitats which are much less likely to exhibit eutrophication. The higher gradient reaches of many streams in the upper reaches of the action area do not have a plethora of slack water habitats. Downstream, in the slower water reaches, the volume of water flowing will greatly dilute the amount of nitrogen being delivered from intrusions.

2.5.8 Effects on ESA-listed Species

Forest fires produce heat and smoke that reduces DO, increases stream temperature, increases ammonia, adds other pollutants such as the toxin cyanide, and ashes that clog fish gills. Therefore, extinguishing fires can benefit fish, but it can also be detrimental from the lethal and sublethal effects of fire retardant intrusions into the waterways.

During the 2018 fire season, the USFS temporarily implemented 600-foot buffers around particularly sensitive stream reaches. An example of such a reason would be spawning areas for species that spawn during the fire season. The presence of a larger buffer width signaled the airplane pilot of the presence of a highly important area. However, these wider buffer widths are not included in the current proposed action and the following effects analysis will instead rely on the smaller, 300-foot buffer widths in those areas.

A review of aerial retardant reports shows that most misapplications would not be expected to cause adverse effects to anadromous species. There are several reasons for this but they largely have to do with the retardant entering the avoidance zone but missing the water or the misapplication striking a dry channel. It will be important to make this distinction when understanding the potential effects from the aerial retardant program.

This analysis considers miles of occupied habitat for different populations to analyze effects. We assume an even distribution of fish across occupied habitat. We do this because of the highly variable nature of these species' habitats and the resulting high degree of variability in fish distributions throughout those habitats. It is not practicable to conduct a more specific analysis due to the vast expanses of land being analyzed and the variability referenced above. Additionally, the number of intrusions is used for the analysis because of the concern of there being multiple intrusions into a smaller portion of the species habitat that has high densities of fish. These measures provide a good measure for effects that might occur, however, because as the length of stream that is affected increases, so will the resulting harm, harassment, or death of the listed species. At times in the following analysis we will talk about a certain percentage (i.e., 20 percent) of a population and at other times we will refer to a percentage of occupied designated critical habitat. Because we are assuming an equal distribution of fish across their occupied habitat, the two terms are intended to be synonymous. As a note, the value of 20 percent was selected because it is large enough to help ensure an adequate representation of effects while at the same time being small enough to conservatively analyze effects in a manner that is protective of the species.

As is detailed below, if an intrusion occurs in occupied habitat it is reasonably certain that individual fish will suffer harm or death. The number of fish, however, that would be harmed or killed is highly variable due to factors such as amount of retardant dropped into a given stream, the type of retardant used, the density of fish at the intrusion location, etc.

The remaining portions of this effect this analysis are organized by geographic region; California, Coastal Oregon and Washington, and Interior Columbia River.

2.5.8.1 Effects of Fire Retardant on California Species

The species analyzed below are: California Coastal Chinook salmon, Central California Coastal steelhead, Northern California steelhead, California Central Valley steelhead, Central Valley Spring-run Chinook salmon, Sacramento River Winter-run Chinook salmon, South-Central /Southern California Coast steelhead, and Southern California steelhead.

The only fire retardant approved for use in California is the least toxic formulation: MVP-Fx. Recent toxicology research showed zero to less than 1 percent mortality for exposure to rainbow trout from MVP under all test conditions. These test conditions included variations in time of exposure, water hardness, and water temperature (USGS 2017). Thus, in the event of an intrusion in California, it is much less likely that fish will be killed by retardant. It is also probable that sub-lethal effects would be less. However, if a large enough intrusion occurs in habitat that is densely occupied, it is reasonably certain that individual fish will suffer harm or death.

The most severe intrusion event in California from 2012–2017 happened on the Thomas Fire. The Thomas Fire was an extremely large fire that occurred in 2017. The intrusion was a direct application into designated critical habitat with known occurrences of Southern California steelhead. In spite of an extremely large volume of retardant entering the stream, live fish were observed swimming both above and below the intrusion site. Due to the volume of retardant, the biologist completing the report felt it likely that ammonia levels would have been elevated to lethal levels.

In spite of the low toxicity of the MVP formulation, concerns persist, especially given the small size of occupied habitat for some of the California populations. This small size of habitat typically corresponds to a small population size. However, one consideration to keep in mind is that with the really small areas, especially those with less than 10 miles total of occupied critical habitat that these populations occupy, the likelihood of an intrusion is greatly reduced (simply as a function of there simply being less habitat exposed to potential intrusion). Table 12 shows those populations with smaller areas.

Table 12. Populations with less than 10 miles of designated critical habitat and populations with 10–19 miles of designated critical habitat.

Eco-Region	Populations with <10 Miles DCH	Populations with 10–19 Miles DCH
Northern California	Kekawka Creek, Bixby Creek, Salmon Creek, Willow Creek, Arroyo Hondo, Canada de la Gaviata, Mission Creek, Montecido Creek, Tecolote Canyon, Upper Mainstem Eel River	Big Sur River, Little Big Sur, San Carpoforo Creek, San Mateo Canyon

It is also important to remember the multiple year life cycles exhibited by anadromous salmonids. For example, steelhead exhibit a variable life cycle length ranging 3–6 years (i.e., a generation). Intrusions are not likely to occur more than once during any given 6-year life cycle (i.e., a generation), simply because once an area is burned there is likely not enough fuel remaining for another wildfire to occur in years of close succession. This is most important for populations that occupy small areas. For those populations that occupy large areas, it is possible that there could be fires in subsequent years because they could be in unburned areas where the population resides. It is highly likely, therefore, that only 1- of any generation of a given small steelhead population would be affected by an intrusion. This further diminishes the overall impact of aerial retardant on these populations. Similarly, Chinook salmon exhibit a 4- to 5-year life cycle, and coho salmon generally exhibit a 3-year life cycle. Therefore, overall risks of impacts to their populations are also correspondingly reduced given their shorter life cycle.

Even if an intrusion were to cause adverse effects to a small population, those with less than 10 miles of occupied critical habitat, these effects would essentially be spread out over the number of years that correspond to that generation (i.e., species life cycle). This is because the complex structure of the salmonid life cycle has evolved to deal with periodic impacts every several generations. One mechanism by which this can occur is through phenotypic plasticity. Chinook salmon can spend up to 5 years at sea, and steelhead can spawn more than once; this wide variation in age at maturity provides ample opportunity for other year classes to compensate for a decimated cohort. Variable age at maturity provides an effective resilience mechanism for any large-scale disturbance that affects a given year class; if events are not too frequent, other year classes can compensate for high mortality in certain cohorts. However, when large-scale impacts occur multiple times within each salmonid generation, they can exceed the capability of salmonids to compensate through evolution or phenotypic plasticity (Waples et al. 2009). Events that happen frequently, such as floods, can reduce the resilience of salmonid populations. However, as mentioned above, wildfires do not often return to a previously burned area for a number of years – typically a time period that exceeds the above referenced life cycle periods. This is because of a lack of fuel remaining in the area. In addition, even if another wildfire occurred during the same generation in an area occupied by one of these smaller California populations, that does not necessarily mean that another intrusion would necessarily occur.

There are a number of species in California with extremely small populations that could potentially be a concern due to their limited habitat. In the Northern California steelhead, the Kekawka Creek population only occupies 9 miles of habitat. In the South Central California Coast steelhead, the Big Sur River, Bixby Creek, Little Sur River, Salmon Creek, San Carpoforo Creek, and Willow Creek populations occupy 11, 5, 16, 1, 15, and 5 miles of habitat, respectively. In the Southern California Coast steelhead, the Arroyo Hondo, Canada de la Gaviota, Mission Creek, Montecito Creek, San Mateo Canyon, and Tecolote Canyon populations occupy 4, 4, 6, 6, 16, and 6 miles of habitat, respectively. In the Southern Oregon Northern California Coho salmon ESU, the Upper Mainstem Eel River population occupies 4 miles of habitat and the Wilson Creek population occupies 7 miles of habitat. Any intrusion, or series of intrusions within any species-specific generation, that impacted more than 20 percent of these populations would be of special concern. The value of 20 percent of the population, as represented by 20 percent of their occupied critical habitat, was selected because it is large enough to help ensure an adequate representation of effects while at the same time being small enough to conservatively analyze effects in a manner that is protective of the species.

The intrusions that have happened in California in the recent past (2012–2017) have been the Happy Camp Fire, the South Complex Fire, the Potato Fire, and the Thomas Fire (Table 4). In the case of the Happy Camp and South Complex fires, the retardant was delivered 2.3 and 2.0 miles upstream of occupied habitat, respectively, and USFS personnel determined that the retardant had not had a deleterious effect on salmon or steelhead. Given the large distances to anadromy, this is a reasonable conclusion. These fires had the potential to impact the Southern Oregon/ Northern California coho salmon. The Potato Fire had the potential to impact the California Central Valley steelhead and the Central Valley Spring-run Chinook. However, the retardant was delivered to an intermittent channel that was dry at the time and did not contain any fish. The only intrusion that had potential to impact fish was on the Thomas Fire. Live fish were observed both upstream and downstream of the intrusion site and there were no dead fish observed. However, due to the large amount of retardant that was estimated to have been dropped into the stream, it is likely that at least some steelhead were killed.

These data demonstrate that intrusions of retardant are rare in California. This is in spite of the fact that California has experienced extreme fire behavior in recent years, both in terms of number of fires and size of fires. As mentioned above, climate change will lead to increased fire frequency and intensity so the extreme fire behavior is likely to remain the same or worsen. However, even when a misapplication does occur, it is rare that fish are affected. Even if a misapplication happens in occupied fish habitat, adverse effects are expected to be minimal due to the very low toxicity of the MVP formulations used in California. Also, the species that would be affected by a retardant intrusion all have multiple year life cycles which serves to cushion the adverse impact that an intrusion might have. Regardless, if a large enough intrusion occurs in habitat that is densely occupied, it is reasonably certain that individual fish will suffer harm or death.

2.5.8.2 Effects of Fire Retardant on Coastal Oregon and Washington Species

This analysis considers species located in the coastal regions of Oregon and Washington, which include: Lower Columbia River Chinook salmon; Upper Willamette River Chinook salmon; Upper Willamette River steelhead; Puget Sound Chinook salmon; Puget Sound steelhead; Hood Canal Summer-run chum salmon; Lower Columbia River coho salmon; Lower Columbia River steelhead; and Oregon Coast coho salmon.

As discussed above, the retardants used in Oregon and Washington are more toxic than the formulations used in California. The following analysis has been adjusted accordingly. Since monitoring began in 2012, there have been no intrusions in the Coastal Oregon and Washington region. These are generally wetter forest types (i.e., temperate rainforest) and they are likely to exhibit reduced fire behavior. These wetter conditions are more pronounced as one moves from the California/Oregon border north into Washington and further north to Alaska. Some of these populations, for example the Upper Willamette River steelhead, have large expanses of habitat farther inland from the coast and the temperate rainforest effect is reduced. However, these are still very wet habitat types relative to what is found in the rest of the Oregon and Washington and, for this reason, anticipated effects to these species differ from others in Oregon and Washington, and are analyzed separately in this section of the Opinion.

It is probable that there will not be any intrusions into the Coastal Oregon and Washington areas given that no intrusions has occurred since monitoring began in 2012. However, an intrusion cannot necessarily be ruled out. It is also possible, but even more unlikely, that several intrusions could occur in any given year. Intrusions that impact the same population over a period of years are even less likely because wetter forest types reduce the fire risk, and fires do not tend to burn in the same areas until there has been sufficient time for vegetative regrowth to occur and provide fuel. However, if a large enough intrusion occurs in habitat that is densely occupied, it is reasonably certain that individual fish will suffer harm or death.

Additionally, as described above, the effects of an intrusion on even a small population, having less than 10 miles of occupied critical habitat, would essentially be distributed over a number of years corresponding to that species life cycle. Salmon have evolved to deal with periodic impacts every several generations (Waples et al. 2009), as discussed in more detail in the prior section.

Since there have been no documented intrusions to populations in this area to date, NMFS anticipates that it is unlikely that there will be more than one intrusion on these populations and having more than two intrusions would be even more unlikely. There are only a few populations in Coastal Oregon and Washington that have especially small areas (less than 10 miles of occupied designated critical habitat) that they inhabit. These are detailed in Table 13. Those populations with small habitat sizes would be even more unlikely to suffer an intrusion since the area they inhabit is so limited.

Table 13. Populations with less than 10 miles of designated critical habitat and populations with 10–19 miles of designated critical habitat.

Eco-Region	Populations with <10 Miles DCH	Populations with 10–19 Miles DCH
OR/WA Coastal	Netarts Bay, Snoqualmie River, Canyon Creek, North Fork Skykomish River, Tolt River	Big (near Alsea) Creek, Bob Creek, Cummins Creek, Devils Lake, Rover Creek, Sand Creek, Tenmile Creek, Vingie Creek, Washington Upper Gorge Tributaries and White Salmon River, Deer Creek, South Fork Nooksack River, Strait of Juan de Fuca Tributaries

Retardant formulations in Oregon and Washington include the LC and 259 retardants. These are more toxic than the MVP formulation and the distance downstream that might be affected is thereby greater (Table 11). It is really not feasible to estimate a distance downstream that might be lethally affected due to different water quality characteristics between streams, differing water volumes in streams, different toxicities between formulations within the LC and 259 classes, etc. Nevertheless, it is reasonably certain that some level of mortality would occur in these streams in the unlikely case of an intrusion occurring.

As explained above, if there were multiple intrusions to any one of these populations, it most likely would be in a single year. Due to the lack of fuels following a fire, and wetter forest types characteristic of this area, it is unlikely that there would be multiple intrusions in successive years. In populations with large areas of habitat, it is possible that some areas within that habitat would be unburned after a fire. In those cases, it is possible that there could be multiple fires in successive years and it is possible that there could be intrusions over multiple years. However, in this case, the adverse effects from the multiple intrusions would be cushioned by the large amount of habitat and reduced amount of habitat that would be affected by any given event. This would allow for recovery of a population from the effects of an intrusion due to the effect of having multiple year classes from which new recruits may be drawn. Additionally, salmonid species exhibit some degree of straying from their natal streams which is a valuable life history strategy to offset natural disasters and help ensure genetic diversity.

2.5.8.3 Effects of Fire Retardant on Hood Canal Summer Chum Salmon

Hood Canal chum salmon spawn in tributaries of the Hood Canal and in Olympic Peninsula streams between the Hood Canal and Dungeness Bay. Spawning occurs at low elevation, within several miles of estuarine/saltwater habitat (i.e., Hood Canal and Puget Sound). Most of the spawning streams are relatively small (typically less than 100 feet wide) and heavily forested, making them more difficult to see from the air and therefore susceptible to fire retardant intrusions. There does not appear to be any currently occupied habitat on USFS land. However, four streams, the Big Quilcene, Dosewallips, Duckabush, and Hamma Hamma Rivers, have occupied habitat within 2 miles downstream from USFS land. All of these streams are within the Hood Canal population area. The Eastern Strait of Juan de Fuca population would not be affected by the proposed action because there is no USFS land present or downstream.

Hood Canal Chum salmon migrate into spawning streams from mid-August through late October and most spawning occurs in September and October. Juveniles emerge from the gravels from January through May and immediately begin moving downstream toward the estuaries. Although juveniles may rear for days to weeks in essential transitional habitats (e.g., tidal channels, mudflats, marshes, eelgrass meadows), they are typically out of freshwater streams by summer. Because juveniles emerge in winter and spring and migrate to the ocean before summer, they are unlikely to be present when aerial retardant is used, which typically occurs in the summer months. However, a portion of the adult run could be present during the latter part of the fire season, and some redds could be established, when aerial retardant might be used, and could therefore be adversely affected. Climate change is likely to result in warmer temperatures but more precipitation, on the Olympic Peninsula, which may change length of the fire season, but probably only to a very small extent over the course of this consultation.

Although Hood Canal chum salmon could potentially be adversely affected by an aerial retardant intrusion, actual adverse effects due to the proposed action are unlikely. The four streams, with occupied habitat within 2 miles downstream from USFS land, drain into the Hood Canal from the east side of the Olympic Peninsula. Depending on location (rainfall is extremely location dependent on the Olympic Peninsula), this area receives an average of 39 to 62 inches of precipitation per year. Consequently, wildland fires are not as common, and are typically not as severe, as in other parts of the Pacific Northwest. Furthermore, all of the occupied habitat in these streams are within a few miles downstream from proposed or designated wilderness areas, which are, in turn, adjacent to the Olympic National Park. Wildland fires in such areas often do not threaten valuable forest resources or structures, and are often managed with no, or very limited, aerial application of fire retardant. Given the wet climate, and proximity to wilderness and National Park System lands, chance of an aerial retardant intrusion affecting occupied Hood River chum salmon habitat, is very small. Additionally, there have been no intrusions of fire retardant in the Puget Sound Recovery Domain for the 2012–2016 reporting period (USFS 2018).

Although unlikely, an intrusion of fire retardant could affect Hood Canal chum salmon habitat. Assuming that adults return to freshwater at a constant rate throughout the spawning season, approximately half of the adult run could be present in freshwater during the latter part of the fire season, and could therefore be vulnerable to a fire retardant intrusion. Eleven streams currently support Hood Canal chum salmon spawning (PSTRT 2007) and, under a worst case scenario, two of those streams could be affected by fire retardant intrusions. Assuming even distribution among spawning streams and assuming that half of spawners are present during the fire season, the proposed action could adversely affect 9 percent of adult spawners. Rearing juvenile chum salmon are not expected to be present in freshwater habitat during the fire season and are therefore unlikely to be affected (two streams affected divided by eleven streams with spawners = 0.18, divided by two because only half of adults would be present = 0.09, or 9 percent expressed as a percentage). An aerial retardant intrusion could lead to harm and/or death to individual chum salmon.

2.5.8.4 Effects of Fire Retardant on Interior Columbia Basin Species

Fire behavior in the Interior Columbia is often severe and the USFS uses the more toxic fire retardant formulations – the LC and 259 formulations (Table 11). The Interior Columbia basin also exhibits more extreme fire behavior than coastal Oregon or Washington, which leads to more frequent and larger-sized fires. Given the drier climate and larger distribution of populations in this area, it is possible that there could be as many as four aerial retardant intrusions on a population in a given year. We used four intrusions because this is a conservative estimate based on recent fire history where two intrusions occurred on a population during one smaller fire in Idaho. The species in the Interior Columbia that this Opinion will look at are Snake River fall Chinook salmon, Snake River sockeye salmon, Snake River spring/summer Chinook salmon, Upper Columbia River spring Chinook salmon, Snake River Basin steelhead, Middle Columbia River steelhead, and Upper Columbia River steelhead.

Snake River Fall Chinook Salmon. All life stages of Snake River fall Chinook salmon are present during the fire season in the Snake River basin. Adults enter the Columbia around when fire season begins and spend the fire season in the Snake, Salmon, Grande Ronde, and Clearwater Rivers before spawning at the end of the fire season. Fry emerge at the start of the next fire season and some juveniles grow and rear in the river through fire season. The biggest threat is from an intrusion event when adults are making their upstream spawning migration or are holding in large mainstem rivers during the summer.

Fall Chinook salmon use larger river systems such as the Snake, Clearwater, and the lower Grande Ronde and Salmon Rivers. These larger rivers are easier to see from the air, thus minimizing the risk of an intrusion. This is reflected in the fact that, over the last eight fire seasons, there have not been any intrusions into fall Chinook habitat. Also, because fall Chinook salmon use larger rivers, there will be more assimilative capacity due to larger water volumes. It is possible that an intrusion upstream of fall Chinook habitat could cause sublethal effects (sublethal due to dilution). It is also likely that many of these possible intrusions will occur to a waterbody located a large distance upstream of Snake River fall Chinook salmon habitat (because USFS land is generally upstream of the larger rivers), resulting in little or no effect to the species or their critical habitat due to downstream dilution processes.

Given the proposed action and assuming a worst-case scenario, it is possible Snake River fall Chinook salmon habitat could receive several intrusions during any given fire season. Given that there has not been an intrusion in fall Chinook habitat in the last 8 years, it is highly unlikely that there would be more than four intrusions in any given year. It is possible that the intrusions could be lethal to individual fish; however, the distance downstream that the retardant would remain toxic would be very short due to the rapid dilution that occurs in large rivers, like those that are part of the fall Chinook habitat. Another factor that would further cushion potential effects on the viability of the species is the phenotypic plasticity, discussed in Section 2.5.9.1, by which effects from episodic events are essentially spread out over the time period of a generation.

Snake River Sockeye Salmon. During the fire season in the Snake River basin, primarily adult Snake River sockeye salmon will be at risk because most juvenile fish out-migrate in the spring when the risk of fire is very low. The biggest threat from an intrusion is during adult upstream migration and spawning.

Sockeye salmon use the larger mainstem reaches of rivers for migration (i.e., Columbia, Salmon, and Snake Rivers). The possibility of adverse effects from an intrusion in these waters is reduced due to the greater assimilative capacity of larger water volumes in the Snake River and the lower Salmon River Basins. It is also unlikely that an intrusion will occur directly into the Snake River or lower Salmon River because these large rivers are highly visible to pilots from the air.

Spawning areas are restricted to a few well known and highly visible lakes in the Upper Salmon River basin. Because the lakes are so visible, it is unlikely that an intrusion into spawning habitat would occur. Additionally, the risk of an intrusion into one of these lakes harming sockeye is reduced due to the hatchery trapping program which removes most, if not all, fish before they return the lakes (NMFS 2015)

Flows in the upper Salmon River basin can be relatively small until the confluence of the Salmon River and the Yankee Fork Salmon River. At this point flows are greatly increased which will substantially dilute any retardant delivered downstream of this confluence. Sockeye are present in the Salmon River upstream of the Yankee Fork Salmon River until the confluence with Redfish Lake Creek – the point at which they move enter the lake and are captured for the hatchery program. This will substantially reduce the likelihood exposure to a lethal intrusion downstream of this confluence. It also limits the length of stream where sockeye might be exposed to a lethal intrusion.

One intrusion into sockeye habitat was on the 210 Road fire, and lethal effects to sockeye likely occurred in this instance. Due to the short distance of the Salmon River that is were exposed to fire retardant, it is likely that only a very few, if any, sockeye adults were affected. Due to the sockeye salmon life history, no other life stages would have been affected by the intrusion.

Nevertheless, based on recent history of intrusions in sockeye habitat, it is possible that sockeye salmon could experience several intrusions a year. The intrusions would most likely occur in mid-July through mid-September (i.e., during the fire season), and the most likely location for lethal effects would be in the Upper Salmon River above its confluence with the Yankee Fork. This is because of the aforementioned dilution effect that occurs at the mouth and downstream of the Yankee Fork.

Sockeye salmon are supported by an intensive hatchery program. Sockeye salmon do not exhibit much staging behavior but rather tend to keep steady progress in their upstream migration. This limits an individual's potential exposure to a retardant intrusion because they do not tend to stop and rest in pool areas where they would be exposed. Returning sockeye salmon are comprised of both 4- and 5-year old fish, so the effects of an intrusion would be distributed between two cohorts. From 2010 to 2014, sockeye salmon returns to the Upper Salmon have ranged between 257 and 1,579, with a mean return of 916 fish (NWFSC 2015). The return period in the Upper Salmon generally ranges from the first week in August to middle of September (Peterson et al. 2014). Figure 3 shows 2015 sockeye returns at Lower Granite Dam being well distributed temporally. These data indicate that there is a wide range of time during which a limited number of sockeye return. This suggests that the returning adults would be well-distributed spatially. Since the returning adults are spatially and temporally distributed, it would be highly unlikely that more than a few returning adults would be lethally affected should one or more intrusions occur in a given year. Finally, in years where there are low returns and river conditions will harm upstream migration, hatchery trapping programs at Lower Granite Dam will be implemented, as occurred in 2015. This helps cushion the species against effects such as aerial retardant intrusions.

Sockeye returns are temporally well distributed. As shown in Figure 3, in 2015 the main body of returns at Lower Granite Dam tend to start around June 23 and continued through approximately August 10.

Sockeye are typically trapped at the Redfish Lake Creek Trap or at the Sawtooth Fish Hatchery and moved to a hatchery for spawning. In year of good returns, some fish are released into Redfish Lake for spawning. In years such as 2015, when river conditions were bad due to high temperatures, sockeye are also trapped at Lower Granite Dam. In 2015, 417 sockeye were counted at Lower Granite Dam; 51 were captured at the Lower Granite Trap, 39 were captured at the Redfish Lake Trap, and six were captured at the Sawtooth Fish Hatchery (http://fishandgame.idaho.gov/public/fish/?getPage=29). Trapping helps protect the returning adults when conditions for upstream migration, especially hot water temperatures in the migratory corridor, are likely to result in low returns to spawning habitat. These measures all work together to help minimize the risk of catastrophic effects on the species.

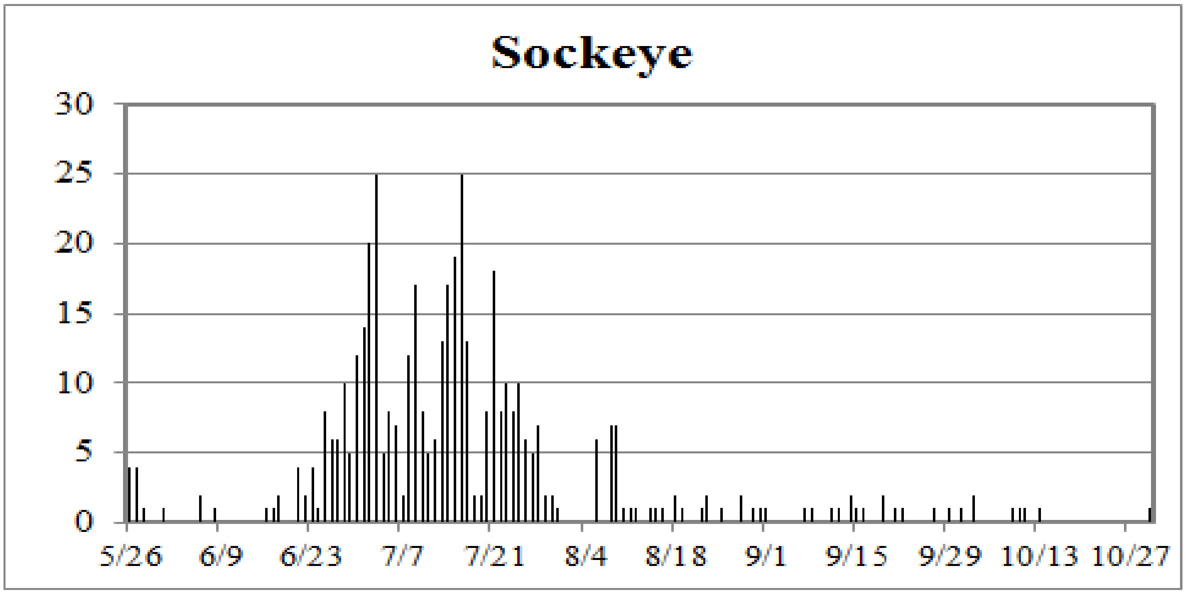

Figure 3. Numbers of Snake River sockeye salmon at Lower Granite Dam, by day, in 2015.

Snake River Spring/Summer-Run and Upper Columbia River Spring Chinook Salmon. During the fire season all life stages of Chinook salmon are present. Because the spawning period for spring/summer Chinook in early August overlaps with what is often the peak of the fire season, the biggest threat to the species is from an intrusion while adults are holding or spawning, or when eggs are incubating in a local spawning area. The proposed action includes 300 foot buffers.

In order to conservatively analyze potential effects to species occupying as large a geography as Snake River spring/summer and Upper Columbia River spring Chinook salmon, NMFS assumed that there could be up to four intrusions into a given Chinook salmon population in any given year. The highest number of intrusions into a given population's habitat in previous years has been two. In order to ensure that our effects analysis conservatively evaluates potential risk to these populations, we use four intrusions in our analysis. Non-use of adversely affected habitat for more than 1-year is unlikely due to temporal and spatial variability of adult spawning Chinook salmon (i.e., variable age of spawners and straying from natal habitat). Retardant that enters streams is quickly diluted (Buhl and Hamilton 1998) and retardant that is applied near streams but not into the stream has minimal effects on water quality (Crouch et al. 2006). This indicates that habitat in the affected stream(s) would soon be suitable for recolonization. Where affected habitat is close to unaffected occupied habitat, recolonization by rearing juvenile salmon would likely occur in less than 1-year.

It is not practicable to quantify the number of fish that might be adversely affected by any given intrusion due to uncertainty about what stream(s) will be affected, the number of fish/life stage(s) that might be present at any given time, and the variability in conditions (fire intensity, wind, etc.) that would change the amount of retardant that enters the stream. Miles of occupied critical habitat for interior Chinook populations, however, are generally large (often at the scale of subbasins - 4th field hydrological unit codes). The exception to this is the Sulphur Creek population which only has 18 miles of occupied habitat. An intrusion that did occur in occupied habitat would only affect a small percentage of the overall habitat and, therefore, would only affect a small percentage of the number fish present.

Chinook salmon have evolved under and adapted to a dynamic environment, an environment subject to natural disturbances and the mosaic pattern that these disturbances tend to create. Broad spatial distribution of Chinook salmon across populations and the ESU, combined with the 4- to 5-year life cycle of the species, are adaptations that help buffer the species from these local disturbances. For these reasons, it is unlikely that even multiple intrusions into a given population would greatly reduce the viability of that population. The exception to this in the case of Snake River spring/summer Chinook salmon is the Sulphur Creek population. It is unlikely that this population will be impacted by multiple retardant strikes in a given year due to the small geographic area they occupy. Since Chinook have a 4- to 5-year life cycle, any retardant impacts that affected more than 20 percent of the Sulphur Creek population within any specific generation, however, would be a cause for concern. As discussed in earlier, the value of 20 percent of the population, as represented by 20 percent of their occupied critical habitat, was selected because it is large enough to help ensure an adequate representation of effects while at the same time being small enough to conservatively analyze effects in a manner that is protective of the species.

Finally, the Upper Columbia River spring Chinook salmon is heavily supported by hatcheries and any intrusions which negatively affected one of the populations could be at least partially offset by hatchery supplementation.

Snake River Basin, Middle Columbia River, and Upper Columbia River Steelhead. During the fire season, most spawning will have already occurred and adults are not likely to be present. Therefore, the biggest threat to these species is from an intrusion in a high density rearing area.

As mentioned above, straying from natal habitat and variation in age at maturity can be a “hedge” against habitat instability (Keefer and Caudill 2014). Non-use of adversely affected habitat for more than 1-year is unlikely due to noticeably alter the temporal and spatial variability of adult spawning steelhead (i.e., variable age of spawners and straying from natal habitat).

If an intrusion occurs in occupied habitat it is reasonably certain that individual fish will suffer harm or death. However, it is difficult to quantify the number fish that might be adversely affected by an intrusion due to uncertainty about fish density, the stream(s) affected, and the variability in conditions that change the amount of retardant entering the stream. The average amount of occupied habitat for Snake River Basin steelhead is over 300 miles (ranging from a low of 69 miles for the Secesh River population, to a high of 833 miles for the Upper Grande Ronde River population). The average amount of occupied habitat for the Middle Columbia River steelhead is 395 miles (ranging from 149 miles for the Fifteenmile Creek population to 1,046 miles for the John Day River Lower Mainstem Tributaries population). The average amount of habitat for the Upper Columbia River steelhead is 195 miles (ranging from 74 miles for the Entiat River population to 312 miles for the Wenatchee River population). The size of the habitats for these populations suggests that impacts from even multiple intrusions (up to and including four) would be cushioned because of the smaller percentage of occupied habitat that would be affected in any 1-year.

As described above, anadromous fish have evolved under and adapted to a dynamic environment, subject to natural disturbances and the mosaic pattern that these disturbances tend to create. Broad spatial distribution of steelhead across populations and the DPS, combined with the 4- to 5-year life cycle of the species, are adaptations that help buffer the species from these local disturbances.

2.5.9 Effects on Salmonid Critical Habitat

The PBF most likely to be affected by the proposed action is water quality (in all habitat sites) due to chemical contamination from fire retardants. To a much lesser degree, safe passage (in migration corridors) and forage (in rearing sites) could be negatively affected by the intrusion of fire retardant.

The effects of fire retardant on water quality have been described above. Fire retardant increases concentrations of ammonia in the water column; depending on concentrations, ammonia can be toxic to fish. The distance downstream that this toxicity persists is highly variable and is dependent on the retardant formulation used, the volume of streamflow, the amount of retardant introduced into the stream, etc. An intrusion of retardant into a stream may impact water quality to levels that cause both lethal and sublethal effects. However, these negative effects on water quality do not persist for long periods of time; usually up to four hours at most.

Fire retardant may have negative effects on aquatic macroinvertebrates which are an important food source for juvenile salmonids. Macroinvertebrates may respond to retardant by “drifting” in the current away from the retardant. There is also some evidence that macroinvertebrates are less sensitive to retardant than are salmonids. Nevertheless, it is likely that there will be some reduction of forage from a retardant intrusion. This reduction, however, would be short-lived as water quality will quickly return to normal and insects from other parts of the stream will recolonize the affected area.

Retardant intrusion could negatively affect migratory habitat by reducing water quality and slowing salmonid movements. However, these impacts would be small, temporally and geographically spaced, and of short duration. Retardant is diluted as it moves in a downstream direction and so the area that would be affected would be relatively small (depending on the factors mention in the water quality discussion). The length of time that migratory habitat would be impacted would also be short for the same reasons described above.

2.6 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.

The possibility of change within the action area is limited due to the short time duration of this action (2 years). Some continuing non-federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the rangewide status of the species and critical habitat (Section 2.2).

Non-federal actions, which are summarized in the baseline section, are likely to continue affecting ESA-listed fish species. The cumulative effects in an action area this large in size and composed of diverse land uses are difficult to analyze. Considering the broad geographic landscape included in the action area, the uncertainties associated with nonfederal actions are difficult to predict. Whether those effects will increase or decrease in the future is not known; however, based on the human population and growth trends in the Pacific Northwest and California, effects of non-federal actions are likely to increase as the population continues to grow.

In general, we expect trends in habitat quality in the action area to generally remain flat with gradual declines or improvements in some areas depending on spatial scale (e.g., site, reach, watershed, basin), level of development (i.e., forest, rural, suburban, urban), and variation in levels of economic activity in different geographic regions (e.g., valley, coastal). At best, these trends will increase population abundance and productivity for the species affected by this consultation. In most instances, we expect cumulative effects will have a minor, negative effect on population abundance trends. Similarly, we expect the quality and function of critical habitat PBFs generally to express a minor negative trend over time as a result of the cumulative effects, with the possibility of a gradual positive or negative trend depending on the balance between economic activity and habitat protection and restoration.

2.7 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 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's Opinion as to whether the proposed action is likely to:

(1) Reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminishes the value of designated or proposed critical habitat for the conservation of the species.
Although the effects may vary depending on local conditions, climate change will affect all of the species under consideration in this Opinion. Fire frequencies and intensities are both likely to increase. Climate change will likely alter inland hydrologic regimes and ocean conditions in ways that may negatively affect the species considered in this Opinion. However, given the 2-year timeframe of this Opinion, it is highly unlikely that changes in habitat due to climate change will be realized.

Also, as described in Section 2.6, we expect cumulative effects will have a minor, negative effect on population abundance trends. Similarly, we expect the quality and function of critical habitat PBFs generally to express a minor negative trend over time as a result of the cumulative effects. There is, however, a possibility of a gradual positive trend depending on the balance between economic activity, and habitat protection and restoration.

2.7.1 California Species

Within California, CC Chinook, CCC steelhead, NC steelhead, CCV steelhead, CV spring-run Chinook, S-CCC steelhead, and SONCC coho salmon are listed as threatened, while Sacramento winter-run Chinook, and SC steelhead are listed as endangered. Primary limiting factors for these listed-fish include degraded estuarine, nearshore marine, and stream habitats. The primary factor that could be affected by the proposed action is inland water quality through the intrusion of fire retardant into action area streams. However, as referenced in the effects analysis above, the retardant formulation used in California is of very low toxicity and intrusion events in California are rare. Sacramento River Winter-run Chinook are even less likely to be affected, as occupied designated critical habitat for this species is more than 7 miles downstream from USFS lands and it is extremely unlikely that retardant from an intrusion would travel that far downstream.

There are a number of populations that only occupy small areas which makes them vulnerable to retardant intrusions. However, due to the small areas that are occupied, the likelihood of a retardant intrusion into their habitat is correspondingly small. Also, due to the small areas these populations occupy, the likelihood of repeat intrusions in subsequent years is reduced; in part, because of the lack of fuel (i.e., vegetation) that would remain after a fire. It is also important to note that these species have multiple year life cycles. As discussed in detail in the effects analysis above, this has the effect of spreading out effects over a number of years that correspond to the species' life cycle.

Even given the uncertain, but likely negative effects of cumulative effects, it is unlikely that adding the effects of the proposed action will appreciably reduce the survival and recovery chances of these ESA-listed species.

Likewise, implementation of the proposed action might temporarily degrade water quality if an intrusion occurs. However, there is a low likelihood of an intrusion in California and the retardant formulation is of low toxicity. Additionally, the effects of an aerial retardant intrusion are short-lived, usually four hours or less. Due to the short-lived nature of the impact, the low toxicity of the retardant formulations used in California, and the low likelihood of an intrusion, it is unlikely that the proposed action will appreciably diminish the value of the designated critical habitat for these species.

2.7.2 Coastal Oregon and Washington Species

2.7.2.1 Chinook, Steelhead, Sockeye, and Coho Salmon

Within coastal Oregon and Washington, the Lower Columbia River Chinook salmon, Upper Willamette River Chinook salmon, Upper Willamette River steelhead, Puget Sound Chinook salmon, Puget Sound steelhead, Lower Columbia River coho salmon, Lower Columbia River steelhead, and Oregon Coast coho salmon are listed as threatened. Primary limiting factors for these listed-fish include degraded estuarine, nearshore marine, and stream habitats. The primary factor that could be affected by the proposed action is inland water quality through the intrusion of fire retardant into action area streams.

As referenced above, there has not been an intrusion of fire retardant into this habitat occupied by these species since monitoring started in 2012. Given this history, and the preponderance of wetter forest types, it is unlikely that there will be an intrusion on these species' habitat (due to lack of fires) and even less likely that there will be multiple intrusions. As described in the effects analysis, the effects of an intrusion on even a small population would be distributed over a number of years corresponding to the impacted species life cycle. Additionally, salmonid species exhibit some degree of straying from their natal streams which is a valuable life history strategy to offset natural disasters and help ensure genetic diversity. Because of this, effects from an intrusion would be unlikely to have a meaningful effect on the population.

Even given the likely negative effects of cumulative effects, it is unlikely that adding the effects of the proposed action will appreciably reduce the survival and recovery chance of these species.

Likewise, implementation of the proposed action might temporarily degrade water quality if an intrusion occurs. However, based on historical records of retardant applications and the wetter vegetation types characteristic of this area, there is a very low likelihood of an intrusion in Coastal Oregon and Washington. Additionally, the effects of an aerial retardant intrusion are short-lived, usually four hours or less. Due to the short-lived nature of the impact and the low likelihood of an intrusion, it is unlikely that the proposed action will appreciably diminish the value of the designated critical habitat for these ESA-listed species.

2.7.2.2 Chum Salmon

The Hood Canal Summer-run chum salmon and Columbia River chum salmon ESUs are both listed as threatened under the ESA. Limiting factors for the Hood Canal chum salmon include: Quality of spawning/incubation habitat (LWD, channel complexity, riparian habitat quality, channel stability, etc.); quality of early rearing habitat in subestuary and estuary deltas (tidal channels, mudflats, marshes, eelgrass beds, etc.); and quality of adult migration habitat in natal streams (water temperature and flow). The proposed action will not affect any of these limiting factors, but could temporarily degrade water quality in spawning/incubation habitat, which could adversely affect prespawning adults, spawning adults, and incubating eggs. No other life stages of Hood Canal chum salmon would be in the action area during the fire season.

Hood Canal chum salmon spawning/incubation habitat is in a relatively wet part of the Pacific Northwest and is largely downslope from designated wilderness and National Park Service land. Consequently, use of aerial fire retardant near summer run chum salmon spawning/incubation habitat is relatively rare and chance of an intrusion is, therefore, low. Because Hood Canal chum salmon are only present in the action area from mid-August through the following spring, only intrusions from mid-August through the end of the fire season could adversely affect individuals. Also, because only a small portion of occupied Hood Canal chum salmon habitat is in the action area, the proposed action could only affect a small portion of one of the two extant populations. Hood Canal chum salmon abundance was low, usually less than 2,000 returns, from the early 1980s through the late 1990s. Since the early 2000s, the Hood Canal and the Strait of Juan de Fuca populations, respectively, have consistently had more than 6,000 and 10,000 spawners annually. The current abundance of Hood Canal chum salmon suggests that either population could withstand some limited adverse effects.

Even given the uncertainty and the likely negative impact of cumulative effects, it is unlikely that implementation of the proposed action will appreciably reduce the survival and recovery of either of the chum salmon ESU. This is because: (1) Chance of an intrusion in occupied chum salmon habitat is low; (2) a small portion of Hood Canal chum salmon are in the action area during the fire season; (3) an intrusion could only affect a very small portion of occupied habitat in the ESU; and (4) both populations of Hood Canal chum salmon currently number in the thousands. Likewise, due to the short-lived nature of the potential impact from a fire retardant intrusion, the low likelihood of an intrusion occurring in designated critical habitat, and the small proportion of designated critical habitat that could be affected, it is unlikely that the proposed action will appreciably diminish the value of the designated critical habitat for Hood Canal chum salmon.

2.7.3 Interior Columbia River Basin Species

2.7.3.1 Steelhead

Three steelhead species occur in the Interior Columbia River basin, all listed as threatened species under the ESA. These include the Snake River Basin, the Upper Columbia River, and the Middle Columbia River steelhead DPSs.

Snake River Basin steelhead are widely distributed throughout the basin and have 26 populations. Miles of occupied critical habitat range from a low of 69 miles for the Secesh River population to 833 miles for the Upper Grande Ronde River population. Although it is possible that there could be multiple intrusions in this species' occupied critical habitat, both within a single year and over a period of years, the effects of these intrusions will be spread over a widely- distributed population. There would only be a small percentage of the occupied critical habitat affected in either a single year or multiple years. The main limiting factors which are affecting this species are hydropower impacts, hatchery impacts, degraded freshwater habitat, and harvest effects. The only one of these that could be affected by the proposed action is water quality and this effect will be small and short-lived due to dilution.

Middle Columbia River steelhead are also widely distributed throughout the basin and have 14 populations. Miles of occupied critical habitat range from a low of 149 miles for the Fifteenmile Creek population to a high of 1,046 miles for the John Day River Lower Mainstem Tributaries population. As mentioned in the previous paragraph, effects from intrusions, in both single and multiple years, would be distributed both spatially and temporally. This will have the effect of reducing impacts on the affected population. The main limiting factors affecting this species are hydropower impacts, hatchery impacts, degraded freshwater habitat, and harvest effects. The only one of these that could be affected by the proposed action is water quality and this effect will be small and short-lived due to dilution.

Upper Columbia River steelhead have four populations. Miles of occupied critical habitat range from a low of 74 miles for the Entiat River population to a high of 312 miles for the Wenatchee River population. Once again, effects from intrusions would be spread out both temporally and spatially. The limiting factors which are largely affecting this species are hydropower impacts, hatchery impacts, degraded freshwater habitat, and harvest effects. The only one of these that could be affected by the proposed action is water quality and this effect will be small and short-lived due to dilution.

In most instances, we expect cumulative effects will have a minor, negative effect on population abundance trends.

For steelhead, returning fish are a mix of 4- and 5-year olds and this will lessen the impact of an intrusion on any cohort. Fish will also be able to recolonize after an intrusion(s) from nearby streams. Steelhead numbers are increasing and this is reflected in number of both hatchery and natural-origin fish. Thus while the proposed action may have temporary adverse effects on the abundance of a few populations of steelhead, this effect is expected to be small and the affected populations are expected to quickly recovery lost abundances. The proposed action is not likely to appreciably reduce the survival and recovery of these ESA-listed species.

Critical habitat PBFs for these ESA-listed steelhead which could be affected by the proposed action are primarily water quality and food. As discussed above, any effects to these PBFs by the proposed action will be very small, temporary, and mostly limited to the habitat for the individual population affected. Because the effects on critical habitat at the designation scale will be temporary and small, the proposed action would not likely appreciably diminish the value of the designated critical habitat for any of these steelhead species.

2.7.3.2 Sockeye Salmon

Snake River sockeye salmon are listed as endangered under the ESA, using larger mainstem rivers (i.e., Columbia, Snake, and Salmon Rivers) for migration until they reach their spawning locations in the Upper Salmon River basin. Because of the large size of the mainstem rivers, an intrusion into migratory habitat will be quickly diluted to sublethal levels, although there could potentially be a small level of lethal effect if the species is present at the time of retardant contact with water. Sockeye also exhibit a life history strategy that combines 4- and 5-year old fish in each spawning run. This also tends to limit the effects on any given cohort. The numbers of sockeye have generally increased over time but this is heavily driven by hatchery inputs. In this case, hatchery stocks provide an additional margin of safety by serving as a buffer against potential effects that might occur in the wild. In summary, adverse effects on sockeye would likely be sublethal and temporary, and multiple cohorts and continued hatchery production would provide a hedge against diminished productivity in any one cohort. Thus while the proposed action may have temporary adverse effects on the abundance of sockeye, this effect is expected to be small and the ESU is expected to recover quickly. The proposed action is not likely to appreciably diminish the survival and recovery of the ESU.

In most instances, we expect cumulative effects will have a minor, negative effect on population abundance trends.

Designated critical habitat for sockeye salmon is primarily restricted to larger mainstem rivers and lakes in the Upper Salmon River basin. The effects described in effects section note that the PBFs of critical habitat that might be affected by the proposed action are water quality and forage. Effects to water quality will be short-lived and highly diluted by these large mainstem rivers. Macroinvertebrates are more resistant to the effects of retardant than salmon or steelhead and quickly recolonize after an event. Any effects to water quality and forage will not measurably alter baseline conditions in the action area. For these reasons, the proposed action is not likely to appreciably diminish the value of designated critical habitat for conservation of sockeye salmon.

2.7.3.3 Chinook Salmon

Snake River fall-run Chinook, Snake River spring/summer Chinook, and Upper Columbia River spring Chinook salmon all occur in the Interior Columbia basin. Upper Columbia River spring Chinook salmon are listed as endangered while Snake River fall-run and spring/summer Chinook salmon are listed as threatened.

In most instances, we expect cumulative effects will have a minor, negative effect on population abundance trends. Likewise, climate change will likely have a small, negative effect over time. Both cumulative.

Due to the large size of rivers that Snake River fall Chinook salmon utilize, any intrusion into their habitat would likely be quickly diluted to sublethal levels, though there might be a small level of lethal effect if the species is present at the time of retardant contact with water. The primary limiting factors for this ESU are hydropower system impacts, hatchery-related effect, harvest-related effects, and alteration of freshwater habitat due to upriver dams and water management; none of these factors would be altered by the proposed action. Snake River fall Chinook salmon primarily spawn at 4 and 5 years of age which will limit the effects of an intrusion(s) on any given cohort. Finally, fall Chinook salmon spawn over a very large area including three major tributaries and the occurrence of multiple intrusions limited to specific stream segments would only affect a small percentage of the population. The draft Recovery Plan for fall Chinook (80 FR 67386) notes recent increases in fish returns which supports that the limited number of Chinook that might be affected by the proposed action would not preclude or delay recovery of the species. Thus while the proposed action may have temporary adverse effects on the Snake River fall Chinook population, this effect is expected to be small and the population is expected to recover quickly. The proposed action is not likely to appreciably diminish the survival and recovery of the ESU.

Snake River spring/summer Chinook salmon are widely distributed and have 28 populations; and the Upper Columbia River spring-run Chinook salmon ESU has three populations. The limiting factors which are largely affecting this species are hydropower impacts, hatchery impacts, degraded freshwater habitat, and harvest effects. The only one of these that could be affected by the proposed action is water quality, and both lethal and sublethal water quality effects will be small and short-lived due to dilution. Returning fish are a mix of 4- and 5-year olds and this will lessen the impact of an intrusion(s) on a cohort of the affected population. Fish will also be able to recolonize after an intrusion(s) from nearby streams. Snake River spring/summer Chinook and Upper Columbia River spring Chinook numbers are increasing and this is reflected in number of both hatchery and wild fish. In the case of Upper Columbia River ESU, hatchery stocks provide an additional margin of safety by serving as a buffer against potential effects that might occur in the wild. Thus while the proposed action may have temporary adverse effects on the abundance of a few populations in these ESUs, the effects are expected to be small (due to small stream lengths affected), temporally and spatially separated (due to the short duration of toxic concentrations and the likely large distances between intrusions), and the affected populations are expected to recover quickly. The proposed action is therefore not is not likely to appreciably diminish the survival and recovery of either ESU.

Designated critical habitat for fall Chinook salmon is restricted to larger mainstem rivers. The effects described in effects section note that the PBFs of critical habitat that might be affected by the proposed action are water quality and forage. Effects to water quality will be short-lived and highly diluted by the large volume of water in these rivers. Macroinvertebrates are more resistant to the effects of retardant than salmon or steelhead and quickly recolonize after an event. Any effects to water quality and forage will not measurably alter baseline conditions in the action area. For these reasons, the proposed action is not likely to appreciably diminish the conservation value of designated critical habitat for fall Chinook salmon.

Critical habitat PBFs for Snake River Spring/summer and Upper Columbia River spring-run Chinook salmon which could be affected by the proposed action are primarily water quality and food. As discussed above, any effects to these PBFs by the proposed action will be very small, temporary, temporally and spatially separated, and mostly limited to the habitat for the individual population(s) affected. Because the effects on critical habitat at the population scale will be temporary and small, the proposed action is not likely to appreciably diminish the conservation value of the designated critical habitat.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and their designated critical habitat, the environmental baseline within the action area, the effects of the proposed action, effects of interrelated and interdependent activities, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of:

Chinook Salmon: California Coastal; Central Valley Spring-run; Lower Columbia River; Puget Sound; Sacramento Winter-run; Snake River Fall-run; Snake River Spring/summer; Upper Columbia River Spring-run; and Upper Willamette River.

Steelhead: Puget Sound; Central California Coast; Central Valley; Lower Columbia River; Mid-Columbia River; Northern California; Snake River Basin; South-Central California Coast; Southern California; Upper Columbia River; and Upper Willamette River.

Chum: Hood River Canal Summer-run.

Coho Salmon: Lower Columbia River; Oregon Coast; and Southern Oregon/Northern California Coast.

Sockeye Salmon: Snake River

NMFS also concludes that the action will not destroy or adversely modify designated critical habitat for all the above referenced species.

2.9 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 actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the federal agency or applicant (50 CFR 402.02). 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 ITS.

2.9.1 Amount or Extent of Take

In the Opinion, NMFS determined that incidental take is reasonably certain to occur because: ESA-listed species are present in the action area, aerial retardant is likely to be delivered to streams in which those species are present, and aerial retardant can have effects that range from harassment and harm to death. Harassment could potentially occur if water quality was reduced due to the sudden presence of a large amount of retardant and fish were forced to relocate to other, less suitable habitat. Harm could occur if the fish were not able to relocate and the toxicity was such that their ability to survive was substantially reduced. Death could occur if the amount of retardant that the fish was exposed to was lethal.

Due to the wide variety of conditions that are present throughout the action area, it is not practicable to quantify the actual amount of take that could occur. These conditions include: (1) high variability in number of fish that could be present in any given stream reach; (2) high degree of variability in existing water quality conditions that might affect the toxicity of the retardant; (3) differing toxicities of the different retardant formulations; (4) variability in the amount of retardant that might be delivered to a particular stream; (5) the large size of the action area; and (6) the high degree of variability in landscape conditions.

When determining an amount of take that will occur under the proposed action is not practicable, we use a take surrogate that is causally linked to the mechanism of take. The incidental take surrogate for take is the (1) stream length of occupied designated critical habitat and (2) number of intrusions. These take surrogates are causally related to the amount of take anticipated because the smaller the area of occupied designated critical habitat or the greater the number of intrusions, the greater the opportunities for fire retardant to interact with listed species and cause take. Additionally, as the length of stream affected increased or the number of intrusions increased, the amount of take would increase.

An intrusion is the delivery of aerial fire retardant into critical habitat containing the ESA-listed species listed in the above Opinion. As mentioned above in the effects analysis, we have assumed an equal distribution of ESA-listed fish throughout their habitat because it is a conservative method to estimate effects. The length of stream that would be needed to calculate a percentage of occupied habitat for a smaller population is a good estimate of what an intrusion's effects might be on that population. Likewise, the number of intrusions into a larger population that might have a more clumped population distribution is a conservative measure of potential effects that might occur if there were multiple intrusions into a more highly occupied area. For this proposed action, NMFS will use different measures of these surrogates, depending on the amount of the occupied designated critical habitat for the affected population.

For populations with less than 10 miles of occupied designated critical habitat, those listed in the below table, as few as two intrusions in a given year could affect more than 20 percent available habitat. Provided there were no subsequent intrusions affecting the same year classes, the population would be expected to maintain its capacity for survival and recovery. However, if affected populations are also affected in subsequent years (i.e., multiple year classes in a single generation), that capacity could be substantially reduced. Therefore, for populations with less than 10 miles of occupied designated critical habitat, NMFS will consider the extent of take exceeded if any of the following occur: (1) More than 20 percent of the population's habitat is affected by one or more intrusions in any given year; or (2) any population is affected by intrusions occurring in multiple year-classes of a single generation. For example, if an intrusion occurred during the egg stage of a year class and a subsequent intrusion occurred during the adult return stage of the same year class, in a population with less than 10 miles of designated critical habitat, then reinitiation would be necessary. The USGS Spill Calculator shall be used to estimate the length of stream that the intrusion has impacted.

For populations with 10–19 miles of occupied designated critical habitat, see the Table 14 below, NMFS will consider the extent of exceeded if more than 20 percent of a population's occupied designated critical habitat is impacted by one or more lethal (as determined by USFS field personnel) intrusions in a given year. The USGS Spill Calculator shall be used to estimate the length of stream that the intrusion has affected. The USFS shall use their established field monitoring protocols to determine if an intrusion was lethal. Exceeding this limit would constitute an exceedance of anticipated take and would trigger the re-initiations provisions of this Opinion.

Table 14. Populations, by Eco-Region, with less than 10 and between 10–19 miles of designated critical habitat.

Eco-Region	Populations with <10 Miles Designated Critical Habitat	Populations with 10–19 Miles Designated Critical Habitat
Northern California	Kekawka Creek, Bixby Creek, Salmon Creek, Willow Creek, Arroyo Hondo, Canada de la Gaviata, Mission Creek, Montecido Creek, Tecolote Canyon, Upper Mainstem Eel River, Wilson Creek	Big Sur River, Little Big Sur, San Carpoforo Creek, San Mateo Canyon
Oregon/Washington Coastal	Netarts Bay, Snoqualmie River, Canyon Creek, North Fork Skykomish River, Tolt River	Big (near Alsea) Creek, Bob Creek, Cummins Creek, Devils Lake, Rover Creek, Sand Creek, Tenmile Creek, Vingie Creek, Washington Upper Gorge Tributaries and White Salmon River, Deer Creek, South Fork Nooksack River, Strait of Juan de Fuca Tributaries
Interior Columbia		Sulphur Creek

For populations with greater than 20 miles of occupied designated critical habitat (including chum salmon), the extent of take will be based on the number of lethal (as determined by USFS field personnel) intrusions in a given year or the amount of occupied designated critical habitat affected. If 20 percent or more of a population's total occupied designated critical habitat is affected by one or more lethal intrusions in a given year, NMFS will consider the extent of take to have been exceeded. The USGS Spill Calculator shall be used to estimate the length of stream that the intrusion has affected. If there are greater than four lethal intrusions in a given year (i.e., five or more), the extent of take will be exceeded. The USFS shall use their established field monitoring protocols to determine if an intrusion was lethal.

2.9.2 Effect of the Take

In the Opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat for the subject species.

2.9.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02).

Section 4(d) of the ESA directs NMFS to issue regulations to conserve species listed as threatened. This applies particularly to "take," which can include any act that kills or injures fish, and may include habitat modification. The ESA prohibits take of species listed as endangered, but some take of threatened species that does not interfere with survival and recovery may be allowed. To date, NMFS has not issued a 4(d) rule to prohibit Pacific eulachon take. To the extent these RPMs and associated terms and conditions go beyond monitoring, they are voluntary with respect to Pacific eulachon until a 4(d) rule for this species goes into effect.

The USFS shall:

1. Identify and map avoidance areas on USFS lands within the entire action area to minimize incidental take.

2. Implement measures to avoid aerially applying fire retardant in avoidance areas to minimize incidental take.

3. Implement a program of monitoring and reporting to determine if the extent of take described above has been exceeded.

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the USFS or any applicant must comply with them in order to implement the RPMs (50 CFR 402.14). The USFS or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the USFS does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement RPM# 1, avoidance area mapping:

   a. Intermittent streams that are designated as critical habitat for the ESA-listed species in this Opinion shall be mapped as avoidance areas. Any such stream that has open water at the time of retardant use shall be mapped as an avoidance area with a 300-foot buffer.

   b. Avoidance area maps shall be made available at multiple scales in either hard copy or digital versions, as needed for firefighting operations and for basin-scale analyses and reporting purposes.

   c. Avoidance area mapping with zoom capability shall be made available and publicly accessible on the internet.

   d. In the Interior Columbia River basin, avoidance areas that received 600-foot buffers during the 2018 fire season, shall be mapped with 600-foot buffers until retardant formulations that have a toxicity that is equal to or less than the MVP formulations are the only retardants used in the Interior Columbia River basin.

e. In California, avoidance areas shall be mapped with 600-foot buffers for populations of endangered species that have less than 20 miles of critical habitat.

f. If there is an intrusion or multiple intrusions into the avoidance area on a small population with less than 10 miles of occupied critical habitat, the USFS shall map the avoidance area with 600-foot buffers and those buffers will remain for a period of time equivalent to the affected species' life history generation.

2. The following terms and conditions implement RPM# 2, operations:

   a. Prior to fire retardant application, all pilots shall be briefed on the locations of all avoidance areas on the unit and the width of the buffers around the avoidance areas, and provided with either electronic or hard copy maps of them.

   b. Prior to aerial application of fire retardant, the pilot shall initially make a "dry run", if operationally feasible, over the intended application area to identify avoidance areas and waterways in the vicinity of the wildland fire.

   c. When approaching mapped avoidance areas, the pilot shall terminate the application of retardant approximately 300 feet or 600 feet, depending on the applicable buffer width before reaching the mapped avoidance area or waterway.

   d. When flying over a mapped avoidance area, pilots shall wait a minimum of 1-second after crossing the far border of a mapped avoidance area before applying retardant.

   e. Pilots shall make adjustments for airspeed and ambient conditions, such as wind speed, to avoid the aerial drift of retardant into the avoidance area.

   f. All loading zones for retardant into aircraft shall also be equally prepared to load plain water instead. This alternative should be readily available so there is a non-toxic alternative load available if a drop within an avoidance zone becomes necessary to maintain a crucial fire containment line.

3. The following terms and conditions implement RPM# 3, monitoring and reporting:

   a. The USFS shall monitor for any misapplication of retardant into avoidance areas as described in the U.S. Forest Service Implementation Guide. In the case of small (less than 300 acres) remote (no road access) fires, this monitoring may be conducted by aircraft.

   b. All observed intrusions shall be reported to NMFS by telephone or email within 48 hours. An initial draft intrusion report, including map, photographs, and explanation of circumstances will be delivered to NMFS in hard copy or digital version within 2 weeks of first observation.

i. For California intrusions the reports shall be forwarded as follows. For the Arcata, Humboldt, Klamath, Rogue River-Siskiyou, Shasta-Trinity, and Six Rivers National Forests the reports shall be forwarded to Don Flickinger, Donald.flickinger@noaa.gov. For the Los Padres and Cleveland National Forests the reports shall be forwarded to Brittany Struck, Brittany.struck@noaa.gov. For the Mendocino National Forest the reports shall be forwarded to Tom Daugherty, tom.daugherty@noaa.gov. For all National Forests with streams that drain into the California Central Valley, the reports shall be forwarded to Neal Mcintosh, neal.mcintosh@noaa.gov. For Oregon and Washington intrusions the reports shall be forwarded to Justin Yeager, Justin.yeager@noaa.gov. For Idaho intrusions the reports shall be forwarded to Nikki Leonard, Nikki.leonard@noaa.gov. A copy of all reports shall also be forwarded to Jason Kahn, Jason.kahn@noaa.gov.

c. Intrusion monitoring shall be conducted as follows:

i. Monitoring shall be prompted by any occurrence of retardant within the applicable 300-foot or 600-foot riparian buffer on either side of a stream.

ii. If USFS personnel determine that the intrusion did not cause take, no further monitoring is necessary. For such intrusions, the USFS shall report to NMFS that an intrusion did occur and provide a rationale as to why take did not occur.

iii. If the USFS determines that an intrusion was lethal, the USFS shall utilize the USGS Spill Calculator to determine how much occupied designated critical habitat was affected. The result from the Spill Calculator will then be compared to the total occupied critical habitat to determine if the amount of take has been exceeded.

d. Annual report. The USFS shall submit a report for each calendar year to NMFS not later than June 1 of the following calendar year. The report shall include: (1) The final details of all intrusions during the calendar year; (2) a description of progress toward implementation of all terms and conditions and conservation recommendations of this document during the calendar year; (3) any new information regarding the effects of aerial retardant on listed fish; and (4) any modifications to the proposed action that may have effects, beneficial or not, to ESA-listed anadromous fishes. The report shall also include any other pertinent information. Copies of the report shall be forwarded to the NMFS staff referenced above in Term and Condition 3.b.i..

e. NOTICE: If, in the course of intrusion monitoring by USFS personnel, a steelhead or salmon becomes sick, injured, or killed as a result of project-related activities, and if the fish would not benefit from rescue, the finder should leave the fish alone, make note of any circumstances likely causing the death or injury, location and number of fish involved, and take photographs, if possible. If the fish in question appears capable of recovering if rescued, photograph the fish (if possible), transport the fish to a suitable location, and record the information described above. Adult fish should generally not be disturbed unless circumstances arise where an adult fish is obviously injured or killed by proposed activities, or some unnatural cause. The finder must contact NMFS Law Enforcement at (206) 526-6133 as soon as possible. The finder may be asked to carry out instructions provided by Law Enforcement to collect specimens or take other measures to ensure that evidence intrinsic to the specimen is preserved.

2.10 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. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02). For this consultation the conservation measures are as follows:

1. The USFS should transition to exclusive use of retardants that have toxicities equal to or less than the MVP formulations.

2. The USFS should fund additional studies on the effects to macroinvertebrates from all fire retardant formulations.

The USFS should notify NMFS if it, or another entity, carries out these recommendations so that we will be kept informed of actions that minimize or avoid adverse effects and benefit listed species or their designated critical habitats.

2.11 Reinitiation of Consultation

This concludes formal consultation for Aerial Application of Fire Retardant on National Forest System Land within the Jurisdiction of the National Marine Fisheries Service West Coast Region in California, Oregon, Washington, and Idaho.

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 taking specified in the ITS is exceeded; (2) new information reveals effects of the agency action that may affect 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 on the listed species or critical habitat that was not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

2.12 “Not Likely to Adversely Affect” Determinations

Southern Resident killer whale

On November 18, 2005, NMFS listed the SRKW DPS as endangered under the ESA (70 FR 69903). The SRKW DPS (*Orcinas orca*) is composed of a single population that ranges as far south as central California and as far north as Southeast Alaska. Although the entire DPS has the potential to occur along the outer coast at any time during the year, occurrence along the outer coast is more likely from late autumn to early spring. The SRKWs have been repeatedly observed feeding off the Columbia River plume in March and April during peak spring Chinook salmon runs (Krahn et al. 2004; Zamon et al. 2007; Hanson et al. 2008; and Hanson et al. 2010). For this reason, the eastern Pacific Ocean, where SRKW overlap with Chinook salmon from the Columbia River basin is also included in the action area due to potential impacts on the whale’s prey base.

The final listing rule identified several potential factors that may have resulted in the decline or may be limiting recovery of SRKW including: quantity and quality of prey, toxic chemicals which accumulate in top predators, and disturbance from sound and vessel traffic. The rule further identified oil spills as a potential risk factor for the small population of SRKW. The final recovery plan includes more information on these potential threats to SRKW (73 FR 4176).

NMFS designated critical habitat for the SRKW DPS on November 29, 2006 (71 FR 69054). Designated critical habitat for SRKW includes approximately 2,560 square miles of Puget Sound, excluding areas with water less than 20 feet deep relative to extreme high water. The SRKWs spend considerable time in the Georgia Basin from late spring to early autumn, with concentrated activity in the inland waters of Washington State around the San Juan Islands, and typically move south into Puget Sound in early autumn (NMFS 2008b). While these are seasonal patterns, SRKW have the potential to occur throughout their range (from Central California north to the Queen Charlotte Islands) at any time during the year.

Southern Resident killer whales consume a variety of fish species (22 species) and one species of squid (Ford et al. 1998; Ford et al. 2000; Ford and Ellis 2006; Hanson et al. 2010; Ford et al. 2016), but salmon are identified as their primary prey. Southern Residents are the subject of ongoing research, including direct observation, scale and tissue sampling of prey remains, and fecal sampling. Scale and tissue sampling from May to September indicate that their diet consists of a high percentage of Chinook salmon (monthly proportions as high as >90 percent) (Hanson et al. 2010; Ford et al. 2016). The diet data also indicate that the whales are consuming mostly larger (i.e., older) Chinook salmon. Deoxyribonucleic acid (DNA) quantification methods are also used to estimate the proportion of different prey species in the diet from fecal samples (Deagle et al. 2005). Ford et al. (2016) confirmed the importance of Chinook salmon to the Southern Residents in the summer months using DNA sequencing from whale feces. Salmon and steelhead made up to 98 percent of the inferred diet, of which almost 80 percent were Chinook salmon. Coho salmon and steelhead are also found in the diet in spring and fall months when Chinook salmon are less abundant. Specifically, coho salmon contribute to over 40 percent of the diet in late summer, which is evidence of prey shifting at the end of summer towards coho salmon (Ford et al. 1998; Ford and Ellis 2006; Hanson et al. 2010; Ford et al.

2016). Less than 3 percent each of chum salmon, sockeye salmon, and steelhead were observed in fecal DNA samples collected in the summer months (May through September). Prey remains and fecal samples collected in inland waters during October through December indicate that Chinook and chum salmon are primarily contributors to the whales' diet (NWFSC unpubl. data). Observations of whales overlapping with salmon runs (Wiles 2004; Zamon et al. 2007; Krahn et al. 2009), and collections of prey and fecal samples have also occurred in the winter months. Preliminary analysis of prey remains and fecal samples sampled during the winter and spring in coastal waters indicated that the majority of prey samples were Chinook salmon (80 percent of prey remains and 67 percent of fecal samples were Chinook salmon), with a smaller number of steelhead, chum salmon, and halibut (NWFSC unpubl. data). The occurrence of K and L pods off the Columbia River in March suggests the importance of Columbia River spring-run stocks of Chinook salmon in their diet (Hanson et al. 2013) at that time of year. Chinook salmon genetic stock identification from samples collected in winter and spring in coastal waters included 12 U.S. west coast stocks, and over half of the Chinook salmon consumed originated in the Columbia River (NWFSC unpubl. data) for the K and L pods (primarily fall-run stocks). Based on genetic analysis of feces and scale samples, Chinook salmon from Fraser River stocks dominate the diet of Southern Residents in the summer (Hanson 2011).

The proposed action will not have any direct effects on SRKW; however, it may indirectly affect the quantity of prey available to them. As described in the above Opinion and ITS, the proposed action may result in the periodic loss of Chinook salmon. The ocean range of Snake River spring/summer Chinook salmon (Weitkamp 2010) overlaps with the known range and designated critical habitat of SRKW. The periodic loss of Chinook salmon from various brood years could reduce the SRKW's available prey base when the affected broods would otherwise have been present in the Pacific Ocean.

Take of Chinook salmon from aerial application of fire retardant in the WCR could potentially affect thousands of rearing juveniles in any given year, a small percentage (about one percent) of which would have reached maturity and otherwise have been available as prey for SRKWs (Tuomikoski et al 2013). The adverse effects on juveniles might locally affect individual populations of Chinook salmon, however, these effects will be very small when compared to the total numbers of Chinook salmon prey contributed from other unaffected basins that are available to SRKWs across the Columbia and the range of its critical habitat. Given the total quantity of prey available to SRKWs from the remaining occupied stream reaches, the reduction in prey due to aerial retardant applications will be extremely small in any given year. The above Opinion did not identify any potential for the action to influence the quality (size) and/or quality (contaminant levels) of Chinook salmon. NMFS finds that the proposed action will not have anything more than minimal effects on productivity, diversity, or distribution of ESA-listed Chinook salmon, and therefore the effects to the quantity of prey available to the whales in the long term across their vast range is expected to be very small. For these reasons, the proposed action will have an insignificant effect on SRKW, and therefore, NMFS concurs that the proposed action may affect, but is not likely to adversely affect SRKW. Likewise, because so few of the SRKW prey will be affected by the action, the effect to the prey base PBF is insignificant.

Columbia River chum salmon

Adult Columbia River chum salmon enter the Columbia River from mid-October through November and spawn from early November through late December. Juveniles migrate down the Columbia River to the estuary from March through May. Spawning currently occurs in the mainstem Columbia River, within 10 miles downstream from Bonneville Dam, and in a handful of tributary streams between Bonneville Dam and the Pacific Ocean. Designated critical habitat for Columbia River chum salmon includes the lower 168 miles of the mainstem Columbia River and the lower portions of a number of Columbia River tributary tributaries. Much of the critical habitat is currently unoccupied.

Columbia River chum salmon spawn in the mainstem Columbia River where, due to dilution capacity of the large water volume, adverse effects from a fire retardant intrusion are unlikely. They also spawn in side channels and in relatively small tributary streams where adverse effects could occur. However, because they spawn in late fall through early winter and outmigrate in the spring, they are not likely to be present when fire retardant is used during the fire season. Therefore, it is unlikely that Columbia River chum salmon will be exposed to fire retardants, and the risk of adverse effects on Columbia River Chum salmon due to fire retardant intrusions is discountable. NMFS concurs that the proposed action may affect, but is not likely to adversely affect Columbia River chum salmon.

Green sturgeon

The southern DPS of green sturgeon spawns in the mainstem Sacramento River and probably in some of the larger tributaries. As with anadromous salmonids, spawning is currently confined to reaches downstream from impassible mainstem dams. Although spawning is currently limited to the Sacramento River drainage, adults and sub-adults also utilize habitat along coastal California, Oregon, Washington, and British Columbia to rear, grow, and migrate. These “non-spawning” habitats include rivers where green sturgeon could be exposed to fire retardants.

We were unable to find information on the effects of fire retardant on sturgeon and we were able to find only one study of the effects of ammonia on sturgeon (Fontenot et al. 1998). Fontenot et al. (1998) reported tolerance of shortnose sturgeon (*Acipenser brevirostrum*) to both total ammonia and to the more toxic un-ionized ammonia. They also indicated that shortnose sturgeon are less tolerant to total ammonia, but substantially more tolerant to un-ionized ammonia than salmonids. Because shortnose sturgeon are substantially more tolerant to un-ionized ammonia than salmonids, we presume that they are at least as tolerant of fire retardant as salmonids. Due to taxonomic similarity, we presume that green sturgeon are similar to shortnose sturgeon regarding ammonia, and fire retardant tolerance. We therefore presume that green sturgeon are at least as tolerant of fire retardant as salmonids.

Except for the Sacramento River, green sturgeon belonging to the southern DPS[2] are typically only found in the lower reaches of mainstem rivers. These reaches are wide, and thus relatively easy to see from the air, making them less likely to be affected by aerial retardant intrusions (i.e.,

[2] Green sturgeon have been documented in reaches of the Eel River in which base flows are often less than 50 cfs, but genetic analysis identified all of those as belonging to the northern DPS.

they are highly visible thus easier to avoid). These river reaches also have water volumes sufficient to quickly dilute even the largest possible intrusions below concentrations that would adversely affect aquatic life. Thus for this part of their distribution, the effects of an intrusion would be insignificant.

Green sturgeon in the Sacramento River are confined to reaches below mainstem dams, which are unlikely to be adversely affected by fire retardant intrusions. Because green sturgeon are primarily found in river reaches in which adverse effects due to fire retardant intrusions would rarely occur, the risk of adverse effects on green sturgeon in the Sacramento River, due to the proposed action, is discountable.

Green sturgeon designated critical habitat, in freshwater, is confined to reaches below mainstem dams in the Sacramento River drainage. These reaches are unlikely to be exposed to fire retardant intrusions. In coastal bays and estuaries, green sturgeon designated critical habitat includes: the San Francisco Bay Estuary and Humboldt Bay in California; Coos, Winchester, Yaquina, and Nehalem bays in Oregon; Willapa and Grays Harbor in Washington; and the Lower Columbia River Estuary from the mouth to River Mile 46. Adverse effects due to a fire retardant intrusion in one of these areas is possible, which could affect water quality. However, because these water bodies are large, thus having large dilutive capacities, adverse effects of a fire retardant intrusions on green sturgeon designated habitat would likely be insignificant. Thus, NMFS concurs that the proposed action may affect, but is not likely to adversely affect the southern DPS of green sturgeon or their critical habitat because the effects are discountable (Sacramento basin) or insignificant (the rest of its distribution).

Pacific eulachon

Within the United States, the southern DPS of Pacific eulachon (eulachon) ranges from the Canadian border south to the Mad River (just north of Eureka, CA). Most eulachon spawning occurs in the lower mainstem Columbia River where exposure to a fire retardant intrusion is unlikely. The lower Columbia River is a large river thus relatively easy to avoid. However, eulachon also spawn in Columbia River tributaries and in the lower reaches of a number of coastal rivers, where chances of exposure are greater, albeit still small.

Adult eulachon enter freshwater and spawn from December through May, the eggs hatch in 3 to 4 weeks, and the very small larvae (4–8 mm long) are quickly swept out to the ocean. All life stages of eulachon are typically out of freshwater by the end of June, and fire season in the coastal areas where eulachon reside rarely starts before the end of June. Because eulachon utilize areas in which exposure to fire retardant intrusions are unlikely, and they are only present when fire retardant is not likely to be used, the risk of adverse effects on eulachon, due to the proposed action, are discountable.

Similarly, it is unlikely that critical habitat in the lower mainstem Columbia River will be exposed to a fire retardant intrusion are extremely unlikely. The likelihood of exposure to critical habitat in Columbia River tributaries and in the lower reaches of a number of coastal rivers is greater, albeit still small. However, intrusions in designated critical habitat are only expected to occur when the habitat is very likely to be unoccupied. The adverse effects of fire retardant intrusions on eulachon habitat are temporary, lasting hours to days, and the adverse effects would be gone by the time eulachon return to spawn. It is therefore unlikely that the proposed action would have more than insignificant effects on eulachon designated critical habitat.

Thus, NMFS concurs that the proposed action may affect, but is not likely to adversely affect the southern DPS of Pacific eulachon or their critical habitat because the effects are discountable (species) or insignificant (critical habitat).

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

Section 305(b) of the MSA directs federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (Section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by the USFS and descriptions of EFH for Pacific coast salmon (PFMC 2014) contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

The EFH for the Pacific coast salmon fishery means those waters and substrate necessary for salmon production needed to support a long-term sustainable salmon fishery and salmon contributions to a healthy ecosystem. To achieve that level of production, EFH must include all those streams, lakes, ponds, wetlands, and other currently viable waterbodies and most of the habitat historically accessible to salmon. Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other waterbodies currently, or historically accessible to salmon except areas upstream of certain impassable man-made barriers (as identified by the PFMC),and longstanding, naturally-impassable barriers (i.e., natural waterfalls in existence for several hundred years. The PFMC has designated EFH for Chinook, coho, and Puget Sound Pink salmon (PFMC 2014). The proposed action and action area for this consultation are described in Section 1.3 of this document. The action area includes areas designated as EFH for spawning, rearing, and migration life-history stages of Chinook, Puget Sound pink salmon, and coho salmon.

Within the designated EFH, the PFMC has designated habitat areas of particular concern (HAPCs) which play a particularly important ecological role in the fish life cycle or that are especially sensitive, rare, or vulnerable (PFMC 2014). There are four HAPCs within the action area: complex channels and floodplain habitats; thermal refugia; estuaries, and spawning habitat. None of these HAPCs have been mapped.

Complex channels consist of meandering, island-braided, and pool-riffle channels; and – in steeper more constrained channels – high levels of LWD. Complex floodplain habitats consist of wetlands, oxbows, side channels, sloughs and beaver ponds. Thermal refugia provide important holding and rearing habitat for adults and juveniles. Thermal refugia that provide areas to escape high water temperatures are critical to Chinook and coho salmon survival, especially during the hot, dry summers that occur on the eastside of the Cascade Mountains.

Chinook, pink, and coho salmon spawn in a broad range of habitats. Depths can range from a few centimeters to several meters deep, and in small tributaries to large river systems. Spawning habitat consists of the combination of gravel, depth, flow, temperature, and DO that provides for successful spawning and egg incubation and fry emergence. Chinook, pink, and coho spawning habitat is typically low gradient reaches (<3 percent) with clean cobble and gravel, few fines, and high inter-gravel flow. Impacts to any of these factors can make the difference between a successful spawning event and failure.

3.2 Adverse Effects on Essential Fish Habitat

The proposed action and action area are described in the above Opinion. The action area includes habitat which has been designated as EFH for various life stages of coho, pink, and Chinook salmon. The effects of the proposed aerial fire retardant activities on anadromous fish habitat were described in the habitat effects section of the preceding Opinion. Briefly, rare accidental aerial applications of fire retardant to fish bearing waters and adjacent riparian avoidance areas will periodically and temporarily contaminate EFH in small, widely scattered places, with chemicals that make habitat unsuitable for Chinook, coho, and pink salmon and their prey for less than 1-year prior to returning to background.

3.3 Essential Fish Habitat Conservation Recommendations

1. The USFS should develop and deploy automated systems in aircraft used for fire retardant application that precisely discontinue application when the aircraft passes over avoidance areas. Such systems, employing global positioning system and computer-controlled shutoff valves, would supplement manual shutoff by pilots and greatly reduce probability of accidental intrusions.

2. The USFS should work with NMFS, local, state, and tribal personnel to identify key spawning or staging areas and ensure that pilots are made aware of these locations prior to aerial application of retardants.

3. Prior to aerial application of fire retardant, the pilot should initially make a “dry run” over the intended application area to identify avoidance areas and waterways in the vicinity of the wildland fire.

4. When approaching mapped avoidance areas, the pilot should terminate the application of retardant approximately 300 feet before reaching the mapped avoidance area or waterway.

5. When flying over a mapped avoidance area, pilots should wait one second after crossing the far border of a mapped avoidance area before applying retardant.

6. Pilots should make adjustments for airspeed and ambient conditions such as wind speed to avoid the application of retardant within avoidance areas in order to avoid drift into protected areas.

7. Pilots should attend training to maintain necessary certifications to fly for the USFS fire program, which includes training on applying the operational guidelines.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in Section 3.2, above, approximately 64,000 acres of designated EFH for Chinook salmon. This estimate is calculated by an approximate average width of Chinook EFH of 100 feet (0.02 miles), times approximately 5,000 stream miles of EFH in the action area, equals 100 square miles, times 640 acres per square mile equals 64,000 acres.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in Section 3.2, above, approximately 26,000 acres of designated EFH for coho salmon. This estimate is calculated by an approximate average width of coho EFH of 100 feet (0.02 miles), times approximately 2,000 stream miles of EFH in the action area, equals 40 square miles, times 640 acres per square mile, equals approximately 26,000 acres. Based on 284 miles of pink salmon habitat, approximately 3,635 acres that would be protected.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the USFS must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS’ EFH Conservation Recommendations unless NMFS and the federal agency have agreed to use alternative timeframes for the federal agency response. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5 Supplemental Consultation

The USFS must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH Conservation Recommendations (50 CFR 600.920(l)).

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The DQA specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these DQA components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this Opinion is the USFS. Other interested users could include cooperating firefighting entities. Individual copies of this Opinion were provided to the USFS. The format and naming adheres to conventional standards for style.

4.2 Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

4.3 Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this Opinion and EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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APPENDIX A

NMFS 2011 Opinion

Proposed Action

National Marine Fisheries Service

Endangered Species Act Section 7 Consultation

Biological and Conference Opinion

Agencies:	United States Department of Agriculture, Forest Service
Activities Considered:	The aerial application of long-term fire retardants on all Forest Service lands
Consultation Conducted by:	Endangered Species Act Interagency Cooperation Division of the Office of Protected Resources, National Marine Fisheries Service

Approved by: ____

Date: November 7, 2011____

Section 7(a)(2) of the Endangered Species Act (ESA), as amended requires each federal agency to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species (16 U.S.C. 1531 et seq.). When the action of a federal agency "may affect" a threatened or endangered species or critical habitat that has been designated for them, that agency is required to consult with either the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS) (together, "the Services"), depending upon the species that may be affected by the action.

This document represents NMFS' biological and conference opinion (Opinion) on the U.S. Forest Service's (USFS) proposal to aerially apply long-term fire retardants to all USFS lands. Long-term fire retardants are required to be composed of ammonium phosphate or diammonium phosphate along with "inert" ingredients, which range from guar gums, thickeners, clay, ash, or other substances added to the fertilizer/water mixture for various reasons. The purpose of this consultation is to evaluate the effectiveness of the proposed aerial retardant application guidelines, the results of increased monitoring between 2008 and present, and to analyze any risks associated with accidental input. This is both a programmatic and a national consultation, assessing the effects of aerially applied fire retardants generally on the environment and the statistical probabilities that listed resources are affected on a national scale. Other actions taken in response to a fire including the application of foams or other fire fighting chemicals were not proposed as part of the federal action. Subsequent consultations that "tier" off of this programmatic consultation, specifically emergency consultations, when warranted, would analyze the site specific effects of fire retardants, as well as foams and other fire fighting activities authorized, funded, or carried out by the USFS.

This Opinion has been prepared in accordance with section 7(a)(2) of the ESA of 1973, as amended (16 U.S.C. 1531 et seq.) and implementing regulations at 50 CFR 402. However, consistent with a decision rendered by the Ninth Circuit Court of Appeals on August 6, 2004, we did not apply the regulatory definition of "destruction or adverse modification of critical habitat" at 50 CFR 402.02. Instead, we relied on the statutory provisions of the ESA to complete our analysis of the effects of the action on designated critical habitat. Essential Fish Habitat (EFH) consultations, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)(16 U.S.C. 1801, et seq.) and implementing regulations at 50 CFR 600, are conducted at a regional level. The MSA section at the end of this document explains the process of the EFH consultation.

This Opinion is based on our review of the Aquatics Report, previous environmental assessments (EAs), and supporting documentation; the draft recovery plan for Sacramento winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Southern California steelhead, California Central Valley steelhead, ; the U.S. recovery plan for Pacific salmonids, Puget Sound Chinook salmon, Upper Columbia River (UCR) spring Chinook salmon, UCR steelhead, Middle Columbia River steelhead, Hood Canal chum salmon, shortnose sturgeon, smalltooth sawfish; white papers; primary literature; past and current research, both published and unpublished; the documents that were used to list green sturgeon and smalltooth sawfish as threatened and endangered species (respectively); and monitoring reports from prior fires and misapplications of fire retardants.

Consultation History

On September 30, 2005, the United States District Court for the District of Montana issued a decision on the use of fire retardants on National Forest lands. Prior to this decision, the federal agencies had considered misapplications of fire retardants emergencies and initiated emergency consultation when misapplications occurred. The court determined that the use of fire retardant predictably occurred annually and therefore the USFS was required to initiate formal consultation with NMFS and USFWS.

On October 9, 2007, NMFS issued an Opinion to the USFS, concluding the USFS was unable to insure its actions would not jeopardize or adversely modify critical habitat of 27 listed species and their 24 critical habitats.

On February 11, 2008, Oregon Coast coho salmon were listed as threatened under the ESA and NMFS began reinitiating consultation to include this species in the Opinion.

On April 2, 2008, the USFS Employees for Environmental Ethics filed suit against the USFS, NMFS, and USFWS alleging violations of both the National Environmental Policy Act (NEPA) and the ESA.

On April 14, 2008, the USFS requested clarification on several typographical errors in the October 9, 2007, Opinion, and NMFS agreed to amend the original Opinion and make the appropriate corrections prior to completing new Opinion required by reinitiation of consultation.

On June 5, 2008, NMFS issued an amended Opinion, identifying 28 listed species that were likely to be jeopardized and 22 critical habitats that were likely to be adversely modified.

On July 25, 2008, NMFS issued an Opinion to complete the reinitiation of consultation for the Oregon Coast coho salmon.

On July 27, 2010, the United States District Court for the District of Montana again ruled against USFS, USFWS, and NMFS, requiring a new NEPA process and completed Opinions to be finalized by December 31, 2011.

BIOLOGICAL OPINION

Description of the Proposed Action

The USFS has requested programmatic consultation on its long-term fire retardant specifications as well as its continued aerial application of approved long-term fire retardants on USFS lands. The USFS approves long-term fire retardants for use under its fire management program after the fire retardant products and their ingredients have been evaluated by the Wildland Fire Chemical Systems (WFCS) provided they meet USFS requirements. Once approved, the WFCS maintains the long-term fire retardant Qualified Products List (QPL), which is one of three QPLs. Several fire fighting products are approved for use and listed on the QPL. This Opinion analyzes the chemical constituents identified in by the published specifications for fire retardants as well as the effects of the currently approved aerially applied long-term fire retardants. Other fire fighting chemicals, such as foams, and activities authorized, funded, or carried out in response to wildland fires were not proposed as part of the federal action and are not analyzed herein. Since 2007, the USFS's published specifications have transitioned from long-term fire retardants with ammonia sulfate salt bases to long-term fire retardants with inorganic phosphate salt bases, which reduce the level of ammonia from 3.1 percent to 2.2 percent.

This proposed action is similar to the proposed action identified in 2007, however the USFS has implemented the Reasonable and Prudent Alternatives identified by NMFS in the 2008 Opinion. That Opinion had one RPA with five different sub-sections that needed to be completed. The first, identify toxicity of two already authorized long-term fire retardants has been completed and the toxicity is discussed in the effects analysis below. The second portion, conduct research on acute and sub-lethal toxicity of fire retardants, was completed identifying smolts as the most acutely susceptible life stage, reduced growth rates of juveniles, and increased mortality upon entering sea water of juveniles who survived the acute fire retardant dose. The third portion, guidance for conducting site assessments, has been completed and when retardants are suspected of entering water, an assessment is made and a report filed with an estimate of the amount of intrusion and likely effects. The fourth portion, policy and guidance for follow up consultations, was tied to the incidental take statement in that Opinion, which was struck down by the court. And the fifth portion, monitoring and biennial reporting, has been completed and the results of those reports have been used by both agencies during this consultation.

The decision where and when to use a particular fire retardant is left to the discretion of the Incident Commander, Forest Supervisors, District Rangers and other USFS field personnel (FSM 5100), and is informed by policy and guidance set by the Washington Office as well as the Regional Office (see the subsequent section in this Opinion on the *Legal and Policy Framework for Fire Retardant Use by the USFS).* The decision to approve particular retardants as a Qualified Product, however, is made at the Washington Office of the USFS. As a result of monitoring and research that began in 1980, the *Guidelines for Aerial Delivery of Retardant or Foam near Waterways* (2000 Guidelines) were established as interim guidelines in April 2000. These guidelines have been further adjusted based on monitoring data from 2008–2010 to minimize the amount of fire retardant entering visible bodies of water.

Decision Making and Use of Retardants

Depending on the topography, fuels amounts, fire behavior, flame lengths, and weather conditions, aerially applied fire retardants may be used in conjunction with ground support resources. Aviation use must be prioritized based on management objectives and the probability of success (2010 Interagency Guide Chapter 16). Interagency guidance (2009, Interagency Aerial Supervision Guide) recommends direct or indirect attacks in front of or parallel to fires, respectively, depending on the fire's characteristics and speed. Indirect attack pre-treats fuels which are far removed from the main fire. Examples include safety zones, ridgelines, roads, or areas of light/sparse fuels. Flame lengths from 4 to 8 feet require increasingly higher coverage levels. Retardant, unless applied in heavy coverage levels and greater widths, is not generally effective when flame lengths are greater than 8 feet. Long term retardant is most effective when applied to available fuels outside of the fire perimeter using parallel or indirect attack strategies.

Firefighters integrate fuel models and fuel descriptions to determine the appropriate retardant coverage level. Fuel models are classified into four fuel complex groups that include grasses, brush, timber litter, and slash (Anderson 1982). The fire behavior relates to the fuel loading expressed in tons/acre and the fuel bed death which relates to the fuels distribution among the fuel size classes. Anderson (1982) identified fuel load and depth as significant fuel properties for determining a fires ignition, rate of spread, and its intensity. Scott and Bergan (2005) further refined fuel models by including non-burnable fuel types (urban, ice, water, rock), and sub-grouping the fuel complexes by adding moisture climatic condition classes along with the fuel loading and distributions.

In the event that fire suppression decisions are deemed necessary, a Wildland Fire Decision Support System (WFDSS) is prepared. The WFDSS is a decision support process that provides an analytical method for evaluating alternative suppression strategies that are defined by different goals and objectives, suppression costs, and impacts on the land management base. A WFDSS alternative describes a suppression strategy consistent with the "delegation of authority," (a set of instructions) communicated from a land unit administrator to an incoming incident commander. The "delegation" identifies what is important to protect, and may also establish cost targets. The Forest Service 5100 Manual requires that the Agency Administrator ensures that a WFDSS is prepared when the conditions exist and that all decisions are documented.

When the USFS determines that a WFDSS is necessary, the Agency Administrator or designated staff prepare a preliminary WFDSS document. This document is reviewed and refined as necessary throughout the fire and includes concerns and constraints, such as the presence and locations of threatened or endangered species, designated critical habitat, or other important resources. It may also specify particular fire suppression tactics that can or cannot be used. A Resource Advisor (RA) is assigned to the fire and assists in the development of the WFDSS document. The RA also works with the Incident Commander (IC) and the Incident Management Team daily to provide information on all important resources that may be affected by the fire.

In order to inform firefighting efforts, the National Forests and Grasslands are mapping avoidance areas for ESA listed species. These avoidance areas are broken into two categories: critical avoidance areas and key avoidance areas. Critical avoidance areas are locations with ESA listed species or critical habitat. Key avoidance areas are determined by USFS sensitive species where aerial application of fire retardant is not likely to affect listed species or species that currently may be trending toward listing under the Endangered Species Act; including proposed and candidate species. When defining these areas, the USFS worked with NMFS and USFWS to identify listed species and designated critical habitat, population information in occupied sites, occupied locations of USFS sensitive species, with an annual plan to update the maps of these areas annually in cooperation with NMFS and USFWS.

Guidelines for Aerial Delivery of Retardant or Foam near Waterways[3]

The interim 2000 Guidelines were useful and likely limited misapplications of fire retardant and harmful impacts to aquatic species; however, there were numerous exceptions to the guidelines and no guidance for terrestrial areas with listed species. Through adaptive management and interagency review, a new set of guidelines has been developed for the 2012 fire season and beyond.

The 2012 modified guidelines have been reduced to reflect the newly devised avoidance areas and to limit the number of exceptions available to ICs. The 2012 modified guidelines are:

> Pilots and ICs are required to avoid aerial application of retardant on mapped avoidance areas for threatened, endangered, or certain sensitive species or within 300 feet of waterways. These guidelines do not require the helicopter or air tanker pilots-in-command to fly in such a manner as to endanger their aircraft, other aircraft or structures or compromise ground personnel safety or the public. The only exception to these guidelines is when human life or safety is threatened and the use of retardant can be reasonably expected to alleviate the threat.

Whenever practical, the USFS will use water in areas occupied by or designated critical habitat for threatened, endangered and sensitive species. However, prior to aerial application of fire retardant, the pilot will make a “dry run” over the intended application area to identify avoidance areas if mapped in the vicinity of the wildland fire. When approaching mapped avoidance areas

[3] The 2000 guidelines apply to the aerial application of foams and retardants. The USFS uses, foams, retardants, and gels while fighting fires; however, this consultation is specific to the aerial application of long-term fire retardants.

for Threatened or Endangered Species species or waterways that are visible to the pilot, the pilot will terminate the application of retardant approximately 300 feet before reaching the mapped avoidance area or waterway. When flying over a mapped avoidance area or waterway, pilots will wait one second after crossing the far border of a mapped avoidance area or bank of a waterway before applying retardant. Pilots will make adjustments for airspeed and ambient conditions such as wind to avoid the application of retardant within the 300-foot buffer zone around the mapped avoidance area.

Retardants and Methods Proposed for Aerial Delivery of Retardants on USFS Lands

The USFS is proposing to authorize the production of long-term fire retardants in accordance with Forest Service Specification 5100-304c as well as the continued use of long-term fire retardants currently on the QPL. In accordance with Section 3.5.1 of the specifications, all long-term fire retardants considered for use under the fire retardant program must be composed of ammonium polyphosphate, monoammonium phosphate, or diammonium phosphate. Additionally, Section 3.4.2 requires all approved fire retardants to have an LC50 (the point at which there is 50 percent survival) above 100 milligrams per Liter total ammonia. In addition to these active ingredients, the compounds are combined with gum thickeners, such as guar gum, and suspending agents, such as clay, dyes, and corrosion inhibitors (Johnson and Sanders 1977, Pattle Delamore Partners 1996). The QPL is available on the USFS webpage. Each chemical is listed at a specific mix ratio and for use through qualified applications. Additional information on these chemicals can be found at http://www.fs.fed.us/rm/fire/wfcs/index.htm. Although retardant is approximately 85 percent water, the ammonia compounds constitute about 60 to 90 percent of the remainder of the product. The ammonia salt causes the solution to adhere to vegetation and other surfaces; this stickiness makes the solution effective in retarding the advance of fire (Johansen and Dieterich 1971). Corrosion inhibitors are needed to minimize the deterioration of retardant tank structures and aircraft, which contributes to flight safety (Raybould et al. 1995); however, the USFS stopped using the corrosion inhibiters with sodium ferrocyanide to reduce harmful effects on the environment.

The USFS uses three primary kinds of firefighting aircraft to dispense the eight long-term fire retardants: multi-engine air tankers, single engine air tankers, and helicopters. The air tankers are classified in to four types based on size. The multi-engine air tankers comprise tanks capable of carrying more than 3,000 gallons, between 1,800 and 2,999 gallons, and between 800 and 1,799 gallons, which are types I, II, and III, respectively. The USFS only has 18 multi-engine air tankers at their disposal for fighting fires (USFS EIS). Type IV is the single engine air tanker that holds less than 800 gallons. Type IV craft are predominately modified agricultural aircraft that can operate from remote airstrips and open fields or closed roads, reloading at portable retardant bases. There are two types of helicopters, those capable of carrying large loads of up to 2,000 gallons or smaller loads of fewer than 1,000 gallons. The speed, range, and retardant delivery capacity of the large (Type I and II) air tankers make them very effective in both initial attack and support to large fires. These air tankers typically make retardant drops from a height of 150 to 200 feet above vegetation and terrain. They move at airspeeds of 125 to 150 knots. Large fixed-wing air tankers have complex, computer controlled retardant dispersal systems capable of both precise incremental drops and long-trailing drops one-fourth of a mile or more in length. Retardant flow rates are controlled to vary the retardant coverage level. Retardant is dispersed as needed after consideration of a fire's intensity/behavior and the vegetative fuel type(s) involved.