NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7 CONFERENCE AND BIOLOGICAL OPINION AND MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT RESPONSE

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ACRONYM LIST

Abbreviation	Definition
AI	Active Ingredient
AChE	Acetylcholinesterase
ACOE	United States Army Corps of Engineers
AGRRA	Atlantic and Gulf Rapid Reef Assessment
AIMS	Avian Information Monitoring System
AIWW	Atlantic Intracoastal Waterway
ALDFG	Abandoned, Lost, or otherwise Discarded Fishing Gear
AMOC	Atlantic Meridional Overturning Circulation
AMOVA	Analysis of Molecular Variance
APA	Administrative Procedure Act
APE	Alkylphenol polyethoxylates
APPS	NOAA Fisheries Authorizations and Permits for Protected Species
ASMFC	Atlantic States Marine Fisheries Commission
ATON	Aid(s) to Navigation
BA	Biological Assessment
BE	Biological Evaluation
BHC	Benzene hexachloride
BHS	Boron hydride sulfide
BLM	Bureau of Land Management
BMP	Best Management Practice
BOD	Biological Oxygen Demand
BOEM	Bureau of Ocean Energy Management
BOR	Bureau of Reclamation
BPA	Bonneville Power Administration
BRD	Bycatch Reduction Device
BRT	Biological Review Team
BSEE	Bureau of Safety and Environmental Enforcement
BSEP	Brunswick Steam Electric Plant
CADPR	California Department of Pesticide Regulation
CAFO	Concentrated Animal Feeding Operation
CC	California Coastal (Chinook Salmon)
CCC	Central California Coast (coho salmon)
CCE	California Current Ecosystem
CCV	California Central Valley (steelhead)
CDF	Confined Disposal Facility
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
CDL	Cropland Data Layer
CFC	Chlorofluorocarbon

CFGC	California Fish and Game Commission
CFR	Code of Federal Regulations
ChE	Cholinesterase
CI	Confidence Interval
CIDMP	Comprehensive Irrigation District Management Plans
CITES	Convention on International Trade in Endangered Species
CNMI	Commonwealth of the Northern Mariana Islands
COD	Chemical Oxygen Demand
COTS	Crown of Thorn Starfish
CP&L	Carolina Power and Light
CPUE	Catch per Unit Effort
CR	Columbia River (chum)
CRD	Crop Reporting District
CRR	Cohort replacement rates
cSEL	Cumulative Sound Exposure Level
CSWP	California State Water Project
CURES	Coalition for Urban/Rural Environmental Stewardship
CV	Central Valley
CVP	Central Valley Project
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
D	Dust
DAM	Destruction or Adverse Modification
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DEIS	Draft Environmental Impact Statement
DEQ	Department of Environmental Quality
DNA	Deoxyribonucleic Acid
DO	Dissolved Oxygen
DOD	Department of Defense
DOE	Department of Energy
DOI	Department of the Interior
DPS	Distinct Population Segment
DTRU	Dry Tortugas Recovery Unit of loggerhead sea turtle
DWH	Deepwater Horizon
EC	Emulsifiable Concentrate
EC50	Effective Concentration (0% of the test organisms show effects)
EEC	Estimated Environmental Concentration
EEZ	Exclusive Economic Zone
EFED	Environmental Fate and Effects Division, of EPA
EFH	Essential Fish Habitat
EGTTR	Eglin Gulf Test and Training Range

EIIS	Ecological Incident Information System
EIS	Environmental Impact Statement
EOG	Electro-olfactogram
EPA	U.S. Environmental Protection Agency
EPR	Eggs per Recruit
EQ	Effective Quiet
ERMA	Environmental Response Management Application
ESA	Endangered Species Act
ESU	Ecologically Significant Unit
EUP	Experimental Use Permit
FAA	Federal Aviation Administration
FCRPS	Federal Columbia River Power System
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FFDCA	United States Federal Food, Drug, and Cosmetic Act
FGB	Flower Gardens Bank
FHWA	Federal Highway Administration
FlC	Flowable Concentrate
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FL	Fork Length
FMP	Fishery Management Plan
FP	Fibropapillomatosis
FP&L	Florida Power and Light Company
FR	Federal Register
FST	F-statistic
FWC	Florida Fish and Wildlife Conservation Commission
FWRI	Fish and Wildlife Research Institute
FWS	Fish and Wildlife Service
G	Granular
GADNR	Georgia Department of Natural Resources
GCRU	Greater Caribbean Recovery Unit of loggerhead sea turtle
GHG	Greenhouse Gas
GIS	Geographic Information System
GIWW	Gulf Intracoastal Waterway
GOM	Gulf of Mexico
GPS	Global Positioning System
GRBO	Gulf of Mexico Regional Biological Opinion
GSI	Gonad Somatic Index
GTR	General Technical Report
HAB	Harmful Algal Bloom
HGMP	Hatchery Genetic Management Plan
HMS	Highly Migratory Species

HUC	Hydrologic Unit Code
IC50	Inhibitory Concentration by 50%
ICTRT	Interior Columbia Technical Recovery Team
ICWW	Intracoastal Waterway
ID	Identification
IDEQ	Idaho Department of Environmental Quality
IDS	Incident Data System
IDWR	Idaho Department of Water Resources
IHN	Infectious Hematopoietic Necrosis
ILWP	Irrigated Lands Waiver Program
INRMP	Integrated Natural Resources Management Plan
IPCC	Intergovernmental Panel on Climate Change
IRED	Interim Registration Eligibility Decision
ISAB	Independent Scientific Advisory Board
ISDA	Idaho State Department of Agriculture
ISED	International Sawfish Encounter Database
ITS	Incidental Take Statement
IUCN	International Union for Conservation of Nature
JAXBO	Jacksonville District's Programmatic Biological Opinion
KG	Kilogram
LAA	A "Likely to Adversely Affect" determination
LC50	Lethal Concentration (50% of the test organisms are killed)
LCR	Lower Columbia River
LLC	Limited Liability Company
LOAEC	Lowest Observable Adverse Effect Concentration
LOAEL	Lowest Observed Adverse Effect Level
LOC	Level of Concern (see also RQ)
LOEC	Lowest Observed Effect Concentration
LOEL	Lowest Observed Effect Level
LSNFH	Livingston Stone National Fish Hatchery
LWD	Large Woody Debris
MATC	Maximum Acceptable Toxicant Concentration
MCFA	Minor Crop Farmer Alliance
MCR	Middle Columbia River
MHW	Marine Heat Wave
MHWL	Mean High Water Line
MLLW	Mean Lower Low Water
MLW	Mean Low Water
MMHSRP	Marine Mammal Health and Stranding Response Program
MMPA	Marine Mammal Protection Act
MPG	Major Population Group
MRI	Minimum Reapplication Interval
MRID	Master Record Identifier

MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSMA	Monosodium methanearsonate
mtDNA	Mitochondrial DNA
NAD83	North American Datum of 1983
NAS	National Academy of Sciences
NASS	National Agricultural Statistics Services
NAST	National Assessment Synthesis Team
NAWQA	National Water-Quality Assessment
NC	Northern California (steelhead)
NCAP	Northwest Coalition for Alternatives to Pesticides
NCCA	National Coastal Condition Assessment
NCDEQ	North Carolina Department of Environmental Quality
NCDMF	North Carolina Division of Marine Fisheries
NCWRC	North Carolina Wildlife Resources Commission
nDNA	Nuclear DNA
NE	A “No Effect” determination
NEAMAP	Northeast Area Monitoring and Assessment Program
NED	National Economic Development
NEPA	National Environmental Policy Act
NF	North Fork
NGMRU	Northern Gulf of Mexico Recovery Unit of loggerhead sea turtle
NGVD	National Geodetic Vertical Datum
NLAA	A “Not Likely to Adversely Affect” determination
NLCD	National Land Cover Database
NMFS	National Marine Fisheries Service
NOAA	National Ocean and Atmospheric Administration
NOAEC	No Observed Adverse Effect Concentration
NOAEL	No Observed Adverse Effect Level
NOEC	No Observed Effect Concentration
NP	Nonylphenol
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRAS	Natural Resources Assessment Section
NRC	National Research Council of the National Academy of Sciences
NRCS	National Resource Conservation Service
NRDA	Natural Resource Damage Assessment
NRU	Northern Recovery Unit of loggerhead sea turtle
NS	Not Specified
NWFSC	Northwest Fisheries Science Center
OC	Oregon Coast (coho)
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OCT	October

ODFW	Oregon Department of Fish and Wildlife
ODMDS	Ocean Dredged Material Disposal Site
OP	Organophosphate
OPA90	Oil Pollution Act of 1990
OPP	Office of Pesticide Programs
OSRP	Oil Spill Response Plan
PAH	Polycyclic aromatic hydrocarbons
PBDE	Polybrominated Diphenyl Ethers
PBF	Physical and Biological Feature(s)
PC	Pesticide Chemical (pesticide code number used by EPA)
PCB	Polychlorinated Biphenyl(s)
PCDD	Polychlorinated dibenzo-p-dioxin(s)
PCDF	Polychlorinated dibenzofuran(s)
PCE	Primary Constituent Element
PCP	Pentachlorophenal
PCT	Percent Crop Treated
PDC	Project Design Criterion(ia)
PDF	Portable Digital Format
PDO	Pacific Decadal Oscillation
PFAM	Pesticides in Flooded Applications Model (EPA exposure model)
PFC	Perfluorinated Compound
PFRU	Peninsular Florida Recovery Unit of loggerhead sea turtle
PID	Proposed Interim Decision
PIT	Passive Integrated Transponder
PMP	Pesticide Management Plan
POP	Persistent Organic Pollutant
PRD	NMFS Southeast Regional Office Protected Resources Division
PRM	Post-release Mortality
PRZM	Pesticide Root Zone Model
PS	Puget Sound (steelhead)
PSAT	Puget Sound Action Team
PSO	Protected Species Observer
PSP	(Oregon) Pesticide Stewardship Partnership
PTS	Permanent Threshold Shift
PULA	Pesticide Use LimitationArea
PUR	Pesticide Use Reporting
PVA	Population Viability Analysis
PWC	Pesticide Water Calculator
RBDD	Red Bluff Diversion Dam
RCP	Representative Concentration Pathway(s)
RED	Reregistration Eligibility Decision
RKM	River Kilometer
RMS	Root Mean Square

ROV	Remotely Operated Vehicle
RPA	Reasonable and Prudent Alternative(s)
RPM	Reasonable and Prudent Measure(s)
RQ	Risk Quotient (see also LOC)
RRT	Regional Response Team
SC	Southern California (steelhead)
SCCC	South-Central California Coast
SCDNR	South Carolina Department of Natural Resources
SCL	Straight Carapace Length
SCTLD	Stony Coral Tissue Loss Disease
SEL	Sound Exposure Level
SHRU	Salmon Habitat Recovery Units
SL	Standard Length
SLCF	Short-lived Climate Forcer(s)
SLN	Special Local Needs FIFRA 24(c) registration
SNP	Single Nucleotide Polymorphism
SONCC	Southern Oregon/Northern California Coasts
SRB	Snake River Basin
SRKW	Southern Resident Killer Whale
SRT	Status Review Team
SSB	Spawning Stock Biomass
SSB/R	Spawning Stock Biomass per Recruit
SSD	Species Sensitivity Distribution
SSP	Shared Socio-economic Pathway(s)
SSRIT	Smalltooth Sawfish Recovery Implementation Team
SSWS	Sea Star Wasting Syndrome
STX	Saxitoxin
SURF	Surface Water Database
SUUM	Summary Use and Usage Matrix (EPA Pesticide Usage Summary)
SWFSC	Southwest Fisheries Science Center
T&C	Term(s) and Condition(s)
TCDD	Tetrachlorodibenzo-p-dioxin
TED	Turtle Excluder Device
TEP	Typical End-use Product
TGAI	Technical Grade Active Ingredient
TKI	Tessenderlo Kerley Incorporated
TL	Total Length
TMDL	Total Maximum Daily Load
TNAP	Temporary Noise Attenuation Pile
TNC	The Nature Conservancy
TRT	Technical Recovery Team
TTS	Temporary Threshold Shift
TWA	Time Weighted Average

U.S.	United States of America
UCR	Upper Columbia River
UDL	Use Data Layer
URL	Uniform Resource Locator
US	United States
USA	United States of America
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
USN	U.S. Navy
USVI	U.S. Virgin Islands
UWR	Upper Willamette River
VOC	Volatile Organic Compound
VSP	Viable Salmonid Population
VVWM	Variable Volume Water Model
WDFW	Washington Department of Fish and Wildlife
WP	Wettable Powder
WQPMT	Water Quality Pesticide Management Team
WRDA	Water Resources Development Act
WSDA	Washington State Department of Agriculture
WSP	Water Soluble Powder
YOY	Young-of-the-year

UNITS OF MEASUREMENTS

Unit	Definition	Unit	Definition
A	acre	lin ft	linear foot/feet
°C	degrees Celsius	m	meter(s)
°F	degrees Fahrenheit	mcy	million cubic yards
cm	centimeter(s)	mgd	million gallons/day
dB	decibel	mi	mile(s)
ft	foot/feet	mi2	square mile(s)
g	gram(s)	nm2	
ha	hectare	mm	millimeter(s)
in	Inch(es)	mph	miles per hour
kg	kilogram(s)	nmi	nautical mile(s)
km	kilometer(s)	yd	yard(s)
kt	knot(s)	yd3	cubic yard(s)
lb	pound(s)		

EXECUTIVE SUMMARY

The proposed action assessed in this programmatic conference and biological opinion is BLM's vegetation treatment program in 17 western states including Alaska. Vegetation treatment activities within this program include the use of herbicide active ingredients (AIs), mechanical treatments, fire treatments, manual treatments, as well as biological control treatments.

This programmatic conference and biological opinion sets forth specific project design criteria which are based on proximity to ESA-listed species and habitats. These design criteria are organized into three tiers:

- Tier 1: Locations within NMFS's PULA. Within these areas only manual treatments are permitted.
- Tier 2: Locations within NMFS's species ranges, but outside the PULA. In these areas BLM will continue to follow the SOPs as well as the Conservation Measures identified in previous consultations.
- Tier 3: Locations outside NMFS's species ranges. BLM will continue to follow the SOPs identified in previous consultations.

The SOPs contain numerous measures and guidance documents that are applicable to herbicide treatment projects. The SOPs address the vegetation treatment process at several phases, allowing opportunity to evaluate risks and introduce protective measures at each step. The following describes the SOPs and is condensed from the 2015 BA and Appendix A:

Project Planning, Development and Revegetation

- Prevention measures are considered here to lessen risk of introducing or spreading invasive plants.

Herbicide Treatment Planning

- This stage evaluates the need for chemical treatments, and the potential impact on the environment.
- Operational plans are developed. A plan could include additional herbicide buffers near water bodies, project specifications, personnel responsibilities, emergency procedures, safety measures, and spill response.

Site Revegetation Procedures

- These are procedures applied depending on site for the benefit and promotion of the native plant community after herbicides eliminate invasive plants.

Procedures for Herbicide Application

- This step establishes the use of general and specific measures intended to protect threatened and endangered species and designated critical habitat.

It is NMFS's conference and biological opinion that BLM is able to insure that their vegetation management program is not likely to jeopardize the continued existence of listed or proposed species under NMFS's jurisdiction. Similarly, it is NMFS's biological and conference opinion that BLM is able to insure this proposed action will not likely destroy or adversely modify the designated critical habitat of those species.

BLM identified affected and potentially affected EFH designated by two fishery management councils and implemented by NMFS' West Coast and Alaska Regional Offices, which includes their salmon, groundfish, coastal pelagic species, crab, and scallop fishery management plans. This programmatic consultation includes the MSA EFH response and associated EFH conservation recommendations for the BLM to address. Those EFH conservation recommendations are intended to help the action agency avoid, minimize, mitigate, or otherwise offset adverse effects on managed species and their designated EFH.

The approach described in this conference and biological opinion will expedite BLM's consultations, and at the same time provide necessary, and targeted, protections to ESA-listed species and habitats. This programmatic consultation provides take coverage to all vegetation management activities that follow the project design criteria specified in section 3.3. In cases where BLM's vegetation management cannot adhere to the project design criteria BLM should further consult with NMFS on step-down consultations, as described in section 3.4.

1 INTRODUCTION

The Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 et seq.) establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat they depend on. Section 7(a)(2) of the ESA requires Federal agencies to insure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. Federal agencies must do so in consultation with NMFS for threatened or endangered species (ESA-listed), or designated critical habitat that may be affected by the action and that are under NMFS jurisdiction (50 C.F.R. §402.14(a)). If a Federal action agency determines that an action "may affect, but is not likely to adversely affect" endangered species, threatened species, or designated critical habitat and NMFS concurs with that determination for species under NMFS jurisdiction, consultation concludes informally (50 C.F.R. §402.14(b)).

Section 7(b)(3) of the ESA requires that at the conclusion of consultation, NMFS provides an opinion stating whether the Federal agency's action is likely to jeopardize ESA-listed species or destroy or adversely modify designated critical habitat. If NMFS determines that the action is likely to jeopardize listed species or destroy or adversely modify critical habitat, NMFS provides a reasonable and prudent alternative that allows the action to proceed in compliance with section 7(a)(2) of the ESA. If an incidental take is expected, section 7(b)(4) requires NMFS to provide an incidental take statement that specifies the impact of any incidental taking and includes reasonable and prudent measures to minimize such impacts and terms and conditions to implement the reasonable and prudent measures.

This programmatic conference and biological opinion considers the effects of the BLM's program for vegetation management on BLM-administered lands in 17 western states. Those states are: Alaska, Arizona, California, Colorado, Idaho, Montana, North Dakota, South Dakota, Nevada, New Mexico, Oklahoma, Texas, Oregon, Washington, Utah, Wyoming and Nebraska. Currently, the BLM uses 21 different AIs for vegetation management. BLM's 2007 consultation with NMFS assessed the use of 18 AIs, and the 2015 consultation assessed the inclusion of three additional AIs. As part of this proposed action, the BLM proposes to add seven additional herbicide AIs to its list of approved AIs for vegetation management. This consultation also considers the impact of all 28 AIs along with the other treatment approaches and sets forth the criteria and procedures for determining if and where any additional step-down ESA consultations are required. The BLM uses an integrated vegetation management approach, per its Integrated Vegetation Management Handbook (BLM 2008), which includes vegetation treatments via manual, mechanical, biological, and chemical treatments. This conference and biological opinion addresses each of these treatment approaches and the associated stressors.

This programmatic consultation, conference and biological opinion, and incidental take statement (ITS), were completed in accordance with section 7(a)(2) of the statute (16 U.S.C. 1536 (a)(2)), associated implementing regulations (50 C.F.R. §§401-16), and agency policy and guidance was conducted by NMFS Office of Protected Resources Endangered Species Act Interagency

Cooperation Division (hereafter referred to as "we"). This conference and biological opinion (opinion) and ITS were prepared by NMFS Office of Protected Resources Endangered Species Act Interagency Cooperation Division in accordance with section 7(b) of the ESA and implementing regulations at 50 C.F.R. §402.

Updates to the regulations governing interagency consultation (50 C.F.R. Part 402) were effective on May 6, 2024 (89 Fed. Reg. 24268). We are applying the updated regulations to this consultation. The 2024 regulatory changes, like those from 2019, were intended to improve and clarify the consultation process, and, with one exception from 2024 (offsetting reasonable and prudent measures), were not intended to result in changes to the Services' existing practice in implementing section 7(a)(2) of the Act. 89 Fed. Reg. at 24268; 84 Fed. Reg. at 45015. We have considered the prior rules and affirm that the substantive analysis and conclusions articulated in this biological opinion and incidental take statement would not have been any different under the 2019 regulations or pre-2019 regulations.

This document represents the NMFS opinion on the effects of these proposed actions on ESA-listed species and designated critical habitat. A complete record of this programmatic consultation is on file electronically at NMFS Office of Protected Resources in Silver Spring, Maryland.

1.1 Background

The President and Congress have directed the USDI and BLM, through implementation of the National Fire Plan and the Healthy Forests Restoration Act of 2003, to take more aggressive actions to reduce catastrophic wildfire risk on public lands. The BLM's *A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment 10-Year Comprehensive Strategy Implementation Plan*; *Partners Against Weeds: An Action Plan for the Bureau of Land Management*; and *Pulling Together: National Strategy for Invasive Plant Management* identify broad objectives for management of vegetation on public lands, while treatment activities at the local level are guided by the goals, standards, and objectives of land use plans developed for each BLM field office.

Several laws provide for management and control of invasive vegetation. Two weed control laws, the Carlson-Foley Act of 1968 and the Plant Protection Act of 2000 (Public Law 106-224; includes management of undesirable plants on federal lands) authorize and direct the BLM to manage noxious weeds and to coordinate with other federal and state agencies to eradicate, suppress, control, prevent, or retard the spread of any noxious weeds on federal lands. The Federal Noxious Weed Act of 1974 established and funded an undesirable plant management program, implemented cooperative agreements with state agencies, and established integrated management systems to control undesirable plant species. The Noxious Weed Control Act of 2004 established a program to provide assistance through states to eligible weed management entities to control or eradicate harmful, non-native weeds on public and private lands. The Public Rangelands Improvement Act of 1978 requires the BLM to manage, maintain, and improve the condition of the public rangelands so that they become as productive as feasible. Executive Order 13112, as amended by Executive Order 13751, Safeguarding the Nation from the Impacts of Invasive Species, directs federal agencies to

prevent the introduction of invasive species and provide for their control, and to minimize the economic, ecological, and human health impacts that invasive species cause.

The BLM uses an integrated vegetation management approach, per its Integrated Vegetation Management Handbook (BLM 2008), which includes vegetation treatments via manual, mechanical, biological, and chemical treatments. Figure 1 shows the BLM administered lands in 17 western states, including Alaska. According to BLM's Biological Assessment (BA) (BLM 2023a), noxious weeds and invasive plants pose an ever-increasing threat to the integrity of our public lands and the many ecological services they provide by outcompeting native vegetation and by acting as hazardous fuels that contribute to the frequency and severity of wildfires. This problem of increasing weeds and wildfires has been exacerbated by climate change, which has resulted in higher temperatures and increased droughts (Westerling et al. 2006, Jolly et al. 2015). More wildfires facilitate the spread of invasive annuals, which results in positive feedback between wildfire and grasses (D'Antonio and Vitousek 1992). Further, potential climatic shifts may enhance the spread of invasive annuals such as cheatgrass into resistant ecosystems (Bradley et al. 2016). Protection of healthy, intact ecosystems provides the associated native plants and animals a better opportunity to persist and adapt compared with ecosystems that have already been converted to invasive annual grasses. Accordingly, BLM has determined that effective management of noxious and invasive plants is essential in maintaining ecological health on lands administered by the BLM.

This proposed action follows the BLM's formal consultations in 2007 (NMFS 2007a) and 2015 (NMFS 2015a), which similarly examined the effects of vegetation treatments on ESA-listed species on BLM-administered lands in 17 western states, including Alaska. The 2007 consultation assessed the use of 18 AIs, and the 2016 consultation assessed the inclusion of three additional AIs. Both the 2007 and 2015 consultations examined the BLM's national program under which vegetation treatments would be conducted, and did not address individual vegetation treatments that would be conducted by BLM field offices. Such site-specific treatments were to be addressed individually in subsequent section 7 consultations conducted by the NMFS Regions. Records of Decisions for two different Programmatic Environmental Impact Statements (PEISs) in 2007 (BLM 2007b) and 2016 (BLM 2016) were also signed by BLM under the National Environmental Policy Act.

This programmatic consultation differs from the previous consultations in two ways: 1) it assesses the impact of all 28 AI.s; and 2) it addresses the site-specific actions. This programmatic consultation assesses the impacts of individual site-level actions as well as the aggregate impact of all anticipated site-level actions. PDC are set forth such that BLM can insure that individual and aggregate actions are not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of critical habitat of such species. Site-level actions that do not employ all project design criteria are not covered by this programmatic consultation and may require separate ESA consultation. The specific criteria and processes for determining whether or not any particular action is covered are described in Chapter 3.

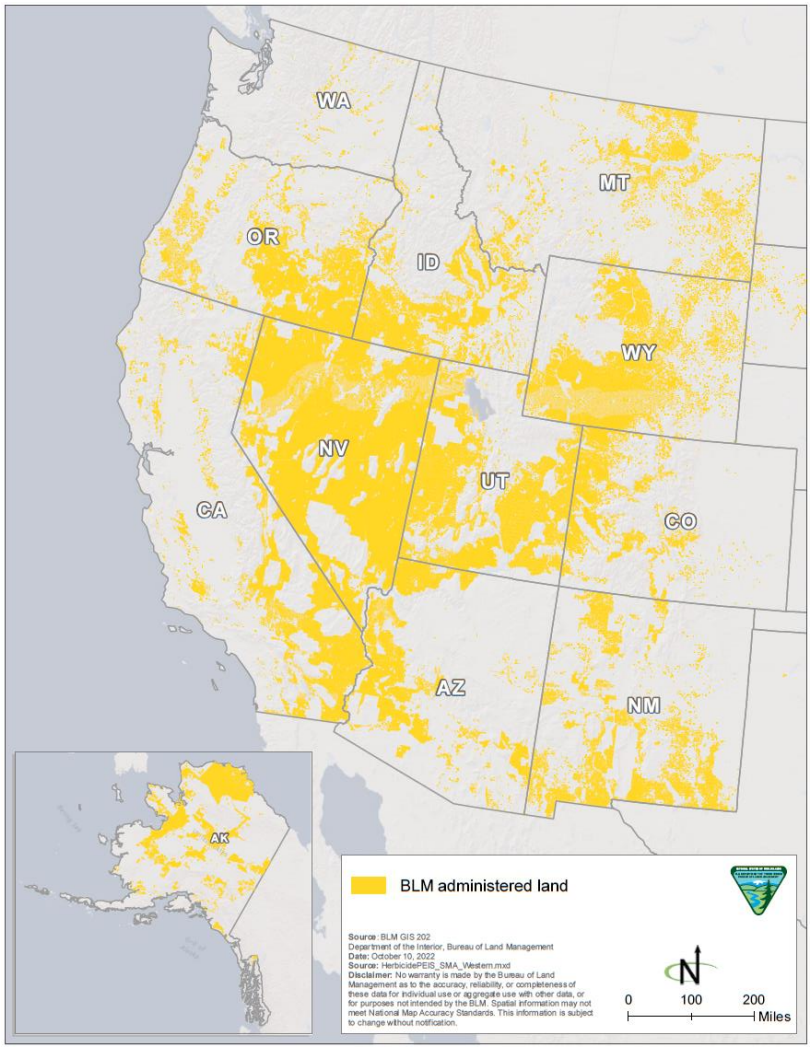


Figure 1. BLM administered land (in yellow) within the western United States. Map was taken from the BLM BA (BLM 2023a).

1.2 Consultation History

The following dates are important to the history of the current programmatic consultation:

- In August 2022, BLM contacted NMFS for technical assistance in their preparation of the BA in conjunction with the PEIS.
- In October 2023, BLM submitted a draft PEIS and draft BA to NMFS.
- On December 18, 2023, BLM transmitted to NMFS the final 2023 BA as well as a letter requesting initiation of consultation.
- In a meeting held January 26, 2024, NMFS and BLM discussed the proposed action and decided to complete a programmatic consultation to include all vegetation management actions.
- In an email exchange on March 19, 2024, NMFS and BLM decided that the geographic scope of the programmatic biological opinion would cover 17 western states, as opposed to all BLM lands as is described in the PEIS and BA.
- In a meeting held May 29, 2024, NMFS and BLM discussed the MSA-EFH assessment and conservation recommendations. NMFS conveyed the process and timelines associated with BLM's letter of response.

2 THE ASSESSMENT FRAMEWORK

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

"Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of an ESA-listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 C.F.R. §402.02).

"Destruction or adverse modification" means a direct or indirect alteration that appreciably diminishes the value of designated critical habitat as a whole for the conservation of an ESA-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 (50 C.F.R. §402.02).

An ESA section 7 assessment involves the following steps:

Description of the Proposed Action, and ***Error! Reference source not found.***: We describe the p roposed action, identify any consequences of the proposed action, and describe the action area with the spatial extent of those stressors.

Endangered Species Act Protected Resources (Section 6): We identify the ESA-listed species and designated critical habitat that are likely to co-occur with those stressors in space and time and evaluate the status of those species and habitat. In this Section, we also identify those *Species and Designated Critical Habitat Not Likely to be Adversely Affected* (Section 6.1), and those *Species and Designated Critical Habitat Likely to be Adversely Affected* (Section 6.2).

Environmental Baseline (Section 7): Environmental baseline refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. 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. The impacts to listed species or designated critical habitat from Federal agency activities or existing Federal agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

To comply with our obligation to use the best scientific and commercial data available, we collected information identified through the BA, PEIS, searches of google scholar, web of science, literature cited sections of peer reviewed articles, species listing documentation, and reports published by government and private entities. In regards the herbicide AIs, this opinion is based on our review and analysis of various information sources including ecological risk assessments (ERAs),

registration interim decisions (ID, PID) and other materials generated as part of the pesticide registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

These resources were used to identify information relevant to the potential stressors and responses of ESA-listed species and designated critical habitat under NMFS' jurisdiction that may be affected by the proposed action to draw conclusions on risks the proposed action may pose to the continued existence of these species and the value of designated critical habitat for the conservation of ESA-listed species.

Effects of the Proposed Action (Section 8): Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.02).

We identify the number, age (or life stage), and gender of ESA-listed individuals that are likely to be exposed to the stressors and the populations or subpopulations to which those individuals belong. We also consider whether the proposed action "may affect" designated critical habitat. This is our exposure analysis. We evaluate the available evidence to determine how individuals of those ESA-listed species are likely to respond given their probable exposure. We also consider how the proposed action may affect designated critical habitat. This is our response analyses. We assess the consequences of these responses of individuals that are likely to be exposed to the populations those individuals represent, and the species those populations comprise; this is our risk analysis.

Cumulative Effects: Cumulative effects are the effects to ESA-listed species and designated critical habitat of future state or private activities that are reasonably certain to occur within the action area 50 C.F.R. §402.02. Effects from future Federal actions that are unrelated to the proposed action are not considered because they require separate ESA section 7 compliance.

Integration and Synthesis: In this section, we integrate the preceding sections in the opinion to summarize the consequences to ESA-listed species and designated critical habitat under NMFS' jurisdiction. We integrate and synthesize by considering the effects of the action, cumulative effects, and the environmental baseline in full consideration of the status of the species and critical habitat likely to be adversely affected, to formulate our opinion as to whether the action would reasonably be expected to: 1) Reduce appreciably the likelihood of both the survival and recovery of the ESA-listed species in the wild by reducing its reproduction, numbers, or distribution; or 2) Appreciably diminish the value of designated critical habitat as a whole for the conservation of an ESA-listed species.

Conclusion (Section 12); With full consideration of the status of the species and the designated critical habitat, we consider the effects of the proposed action within the action area on populations or subpopulations and on essential habitat features when added to the environmental baseline and the cumulative effects to determine whether the proposed action could reasonably be expected to:

- Reduce appreciably the likelihood of survival and recovery of ESA-listed species in the wild by reducing its numbers, reproduction, or distribution, and state our conclusion as to whether the action is likely to jeopardize the continued existence of such species; or
- Appreciably diminish the value of designated critical habitat for the conservation of an ESA-listed species, and state our conclusion as to whether the action is likely to destroy or adversely modify designated critical habitat

If, in completing the last step in the analysis, we determine that the proposed action under consultation is likely to jeopardize the continued existence of ESA-listed species or destroy or adversely modify designated critical habitat, we must identify reasonable and prudent alternative(s) to the proposed action, if any, or indicate that to the best of our knowledge there are no reasonable and prudent alternatives. See 50 C.F.R. §402.14.

In addition, we include an *Incidental Take Statement* (Section 13) that specifies the amount or extent of take anticipated, reasonable and prudent measures to minimize the impact of the take, and terms and conditions to implement the reasonable and prudent measures. ESA section 7 (b)(4); 50 C.F.R. §402.14 (i). We also provide discretionary *Conservation Recommendations* (Section 14) that may be implemented by the action agency. 50 C.F.R. §402.14 (j). Finally, we identify the circumstances in which *Reinitiation of Consultation* is required (Section 15). 50 C.F.R. §402.16.

Pesticide Use Limitation Area. BLM vegetation treatment via any method (except manual) is prohibited inside the PULA. The PULA was created by NMFS in the context of the ESA section 7 consultations on FIFRA registration actions. The PULA does not represent the complete distribution of ESA-listed species, rather it represents those areas that are most important to the survival and recovery of the species. The PULA has been used in FIFRA consultations to target mitigations more meaningfully for the species. When paired with mitigation, the PULA is a powerful tool to both protect ESA-listed species while minimizing potential impacts to other neighboring land use operations. Maps of the PULA are provided in Appendix A. The PULA is also available to view in an interactive we app on EPA's Bulletin's Live Two! website https://www.epa.gov/endangered-species/bulletins-live-two-view-bulletins. If viewing on Bulletins, note that other PULAs not relevant to this consultation will also be visible.

The PULA is based on information regarding listed species distributions. Primary sources of information included Federal Register listing documents, recovery plans, status reviews, interviews with species experts, NMFS range and designated critical habitat spatial data, as well as authoritative spatial datasets from state agencies. Each of the distribution maps were reviewed by species experts within NMFS. The final set of distribution data (polylines and polygons) were then buffered out extending 300 m from the polyline or outer edge of the polygons.

We determined 300 m to be appropriate buffer distance for the following reasons. First, when considering drift, 300 m represents an upper limit to which we are able to effectively model transport and evaluate quantitative estimates (e.g., via AgDrift). Although transport beyond 300 m will occur, we anticipate the bulk of off-site transport of pesticides from drift and runoff will be

constrained within 300 m of the application zone in most scenarios. When considering run-off, the potential for transport is highly variable depending on site-specific and chemical-specific factors. Maximum overland flow distances are commonly assumed to be approximately 300 m to 370 m (1000 to 1200 ft) in engineering handbooks (VADEQ 1992, USDA 2010a, TXDOT 2019). Wu (2017) estimated flow path lengths for more than 32,000 wetlands in the prairie pothole region and 300 m was in the upper end of the distribution, with an average flow path length of 138 m and median of 83 m (Wu 2017). In most cases, 300 m represents a point at which the potential for transport via sheet or channelized flow can be considered minimal. Although off-site transport beyond 300 m following pesticide application is possible, the 300 m distance is appropriate for focusing attention on applications that pose the greatest risk.

Although the PULA was designed for pesticide applications, the parameters used to set the buffer distance (chemical and physical properties of particle movement via runoff and drift) are generally relevant to other types of land-based contaminants. For example, when considering the potential for runoff of sediments and the transport of particles via drift.

3 DESCRIPTION OF THE PROPOSED ACTION

3.1 Introduction

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies. The proposed action lends itself to consultation via a mixed programmatic conference and biological opinion. A mixed programmatic action means, for purposes of an ITS, a federal action that approves actions that will not be subject to further section 7 consultation, and also approves a framework for the development of future actions that are authorized, funded, or carried out at a later time and any take of a listed species would not occur unless and until those future actions are authorized, funded, or carried out and subject to further section 7 consultation. (50 CFR 402.02). This analysis of the BLM's vegetation treatment activities including the use of 28 herbicide AIs as part of their integrated vegetation management activities on BLM lands, a mixed programmatic action, is a programmatic consultation." (50 CFR 402.02).

Per BLM policy and manual direction, including Department of Interior Manual 517 (Integrated Pest Management), the BLM utilizes an integrated pest management approach to managing and treating vegetation. This approach is inclusive of concepts such as integrated vegetation management and more broadly, integrated vegetation management.

The BLM treats vegetation using fire, mechanical and manual methods, biological treatments, and herbicides. In an integrated vegetation management program, each management option is considered, recognizing that no one management option is a stand-alone option and that each has its own strengths and weakness. Utilizing the strengths of each allows for a more effective and environmentally sound program. When the BLM plans vegetation treatment projects, all control methods should be available for use, allowing the BLM to select the one method, or the combination of methods, that optimizes vegetation control with respect to environmental concerns, effectiveness, and cost of control.

The following factors influence treatment location and priorities:

- Statutory mandates, including the FLPMA, ESA, and Taylor Grazing Act;
- Compliance with NEPA, ESA, and other legal and regulatory statutes;
- Goals of the Strategic and Annual Performance Plans;
- Existing risks to resources;
- Likelihood of success in restoring natural biotic communities;
- Conformance with local BLM Land Use Plans and various program objectives; and
- Cost-effectiveness of actions.

National priorities have been established for various BLM vegetation management programs. These priorities were developed for use in conjunction with state and local office priorities for meeting restoration goals and address site-specific conditions and/or issues as identified in the land use plan. The following treatment priorities have been established to promote integrated efforts across BLM resource programs that manage vegetation:

- Wildland urban interface community protection treatments that are designed to reduce the risk of wildfire to the community and/or its infrastructure developed collaboratively with the community;
- Treatments to restore or maintain healthy, diverse, resilient, and productive native plant communities;
- Special status species habitat improvement projects designed to improve or protect special status fish, wildlife, and plant habitat;
- Treatments that will be planned, implemented, and/or monitored using funding from multiple sources, both internal and external;
- Landscape treatments (>1,000 acres for mechanical and >4,500 acres for prescribed fires), coordinated across field office boundaries, to improve treatment effectiveness;
- Contracted treatments that support economic opportunities for rural communities and/or high potential to use stewardship contracting authorities; and
- Treatments that have a high potential for woody biomass utilization.

Vegetation treatment methods are selected based on several parameters, which may include the following:

- Management program/objective for the site;
- Historic and current conditions;
- Opportunities to prevent future problems;
- Opportunities to conserve native and desirable vegetation;
- Effectiveness and cost of the treatment methods;
- Success of past restoration treatments or treatments conducted under similar conditions or recommendations by local experts;
- Characteristics of the target plant species, including size, distribution, density, life cycle, and life stage in which the plant is most susceptible to treatment;
- Non-target plant species that could be impacted by the treatment;
- Land use of the target area;
- Proximity to communities;
- Slope, accessibility, and soil characteristics of the treatment area;
- Weather conditions at the time of treatment, particularly wind speed and direction, precipitation prior to or likely to occur during or after application, and season;
- Proximity of the treatment area to sensitive areas, such as wetlands, streams, or habitat for plant or animal species of concern;
- Potential impacts to humans and fish and wildlife, including non-game species; and
- Need for subsequent revegetation and/or restoration.

The above parameters are considered before a treatment method is selected. For most vegetation treatment projects, pretreatment surveys are conducted before selecting one or more treatment methods. These surveys involve the consideration of all feasible treatments, including their potential

effectiveness based on previous experience, and best available science, impacts, and costs. Before vegetation treatment or ground disturbance occurs, the BLM consults specialists or databases for information on sensitive areas within the project area. The site may have to be surveyed for listed or proposed federal threatened or endangered species and for evidence of cultural or historic sites. In some cases, areas may receive one or more treatments in combination, such as prescribed burning followed by an herbicide application, and some areas may be treated using one or more treatment methods over several years.

3.2 Vegetation Treatment Activities

The vegetation treatment methods and activities for this proposed action are conducted by trained BLM staff, and in some situations, by companies that have been contracted by BLM. It is BLM's responsibility to ensure that all individuals involved in vegetation treatment activities are aware of the PDC in this programmatic consultation and have access to the complete list of SOPs, Conservation Measures, as well as maps depicting the PULA.

3.2.1 Herbicide treatments

Herbicides are chemical formulations that kill or injure plants by disrupting biochemical processes. Typically, they are applied as liquids mixed with water or oil carriers, which are sprayed onto vegetation, although some are applied in solid form, as granules placed on the soil surface which are then absorbed by plant roots. An herbicide formulation includes an AI, which is the chemical that kills the target plant, and one or more inert ingredients, which make the herbicide more effective. These inert ingredients may improve herbicide effectiveness by improving the solubility of the AI, improving its ability to stick to plants or to penetrate protective layers on plant surface, or by limiting unintended drift of the herbicide mixture when it is sprayed. In this conference and biological opinion, all herbicides that contain a particular AI are referred to by the name of that AI, since it may be found in numerous products that are sold under different names.

Several federal laws govern herbicide use in the U.S. FIFRA establishes procedures for the registration, classification, and regulation of all pesticides. Before any pesticide may be sold legally, the USEPA must register it. The USEPA may classify a pesticide for general use if it determines that the pesticide is not likely to cause unreasonable negative effects to applicators or the environment, or for restricted use if the pesticide must be applied by a certified applicator and in accordance with other restrictions. All the herbicides evaluated in this programmatic consultation are registered with the USEPA, and all applicators that apply them on public lands (i.e., certified applicators or those directly supervised by a certified applicator) must comply with the herbicide label rates, uses, and handling instructions.

The appropriate method for applying herbicides to unwanted vegetation is dependent upon a number of factors: pesticide labeling restrictions; the treatment objective (i.e., removal or reduction); the accessibility, topography, and size of the treatment area; the characteristics of the target species and the desired vegetation; the location of sensitive areas and potential environmental impacts in the immediate vicinity; the anticipated costs; equipment limitations; and the meteorological and vegetative conditions of the site (BLM 1991).

Herbicide applications are scheduled and designed to minimize potential impacts to non-target plants and animals, while remaining consistent with vegetation treatment program objectives (Team 2002). Application rates are dependent on the presence of the target species; the condition of the non-target vegetation; soil type; depth to the water table, distance to open water sources, riparian areas and/or special status species; and the requirements printed on the herbicide label.

Over very large areas, herbicides may be applied aerially by helicopter or fixed-wing aircraft. Aerial applications do not disturb the soil or protective organic layers, and are not limited by inaccessibility or rugged terrain. In general, helicopters are more maneuverable than fixed-wing aircraft, more effective in areas with irregular terrain, and more effective for treating specific target vegetation in areas with multiple vegetation types. A common problem associated with aerial application of herbicides is drift of chemicals off of the target site, which may be difficult to predict and manage.

Manual herbicide applications are suited for treatments of small areas or at sites that are inaccessible by vehicle (BLM 1991). Manual spot treatments target individual plants through herbicide injections, applications on cut surfaces, or granular application to the surrounding soil (hand crank granular spreader). Application using backpack sprayers is another means of spot treatment, in which the herbicide applicator directs a spray hose at target plants. To cover a larger number of plants, mechanical equipment is used. In this method of treatment, herbicides are applied using a spray boom or wand attached to a truck, ATV, or other type of vehicle. Truck-mounted spraying is primarily limited to roadsides and flat areas that are accessible. However, ATVs can treat vegetation in areas, such as hillsides, which are not easily accessible by road.

BLM's current vegetation treatment program makes use of 21 herbicide AIs. This programmatic consultation includes those 21 AIs as well as seven proposed AIs not previously used by BLM. The complete list of AIs is presented in Table 1, along with references and links to the most current ecological risk assessment documents.

Table 1. Herbicide AIs to be used in BLM vegetation treatment program

Herbicide AI	BLM or USFS Assessment	EPA Assessment (ERA, PID, ID, etc.)	ESA Consultation
Bromacil	BLM, 2006	ERA, 2012; PID, 2019	
Chlorsulfuron	BLM, 2005	ERA, 2015; ID, 2017	
Diflufenzopyr	BLM, 2005	ERA, 2017; PID, 2018	
Diquat	BLM, 2005	ERA, 2015; ID, 2019	
Diuron	BLM, 2005	ERA, 2020; PID, 2022	NMFS, 2011
Fluridone	BLM, 2005	ERA, 2017; ID, 2018	
Imazapic	BLM, 2005	ERA, 2014; ID, 2019	
Sulfometuron methyl	BLM, 2005	ERA, 2015; ID, 2017	
Tebuthiuron	BLM, 2005	ERA, 2014; ID, 2019	
2,4-D	USFS, 2006	ERA, 2016; ERA, 2022	NMFS, 2011
Clopyralid	BLM, 2014	ERA, 2018; ID, 2020	
Dicamba	USFS, 2004	ERA, 2022	
Glyphosate	USFS, 2011	ERA, 2015; ID, 2020	
Hexazinone	USFS, 2005	EPA, 2015; ID, 2017	
Imazapyr	USFS, 2011	ERA, 2014; ID, 2015	
Metsulfuron methyl	USFS, 2004	ERA, 2015; ID, 2017	
Picloram	USFS, 2011	ERA, 2020; ID, 2021	
Triclopyr	USFS, 2011	ERA, 2019; ID, 2020	NMFS, 2011
Aminopyralid	BLM, 2015	ERA, 2020; ID, 2021	
Fluroxypyr	BLM, 2014	ERA, 2018; ID, 2020	
Rimsulfuron	BLM, 2014	ERA, 2015; ID, 2017	
Aminocyclopyrachlor	USFS, 2012	RA, 2020	
Clethodim	USFS, 2014	ERA, 2014; ID, 2017	
Fluazifop-P-butyl	USFS, 2014	ERA, 2019; ID, 2020	
Flumioxazin	USFS, 2020	ERA, 2018; ID, 2021	
Imazamox	USFS, 2010	ID, 2019	

Indaziflam	USFS, 2020	ERA, 2020	
Oryzalin	USFS, 2015	ERA, 2017; ID, 2019	NMFS, 2012

The BLM generally uses several formulations of each AI approved for use on public lands. Herbicide formulations are a commercial mixture of both active and inactive ingredients (sometimes referred to as inert ingredients). Inactive ingredients are those ingredients that are added to the commercial product (formulation) and are not herbicidally active. This programmatic consultation takes into consideration both the active and inactive ingredients as well as the potential for added risk from any degradates, adjuvants, and tank mixtures. Degradates are physical or biological breakdown compounds of a complex compound; adjuvants are chemicals that are added to the herbicide formulation to enhance the toxicity of the AI or to make the AI easier to handle. They include surfactants, materials that improve the emulsifying, dispersing, spreading, wetting, or other surface-modifying properties of liquids; tank mixtures are the mixture of two or more compatible herbicides in a spray tank in order to apply them simultaneously.

3.2.2 Fire treatments

Fire is a treatment method that is used to reduce the buildup of hazardous fuels that can contribute to a fire's spread and intensity, control weeds, and maintain fire dependent species and ecosystems. Unlike other methods of vegetation management discussed in this section, fire can be used regardless of soil rockiness, slope steepness, or terrain irregularity, as long as adequate fuel is available to carry the fire. A prescribed fire is the intentional application of fire to wildland fuels under specified conditions of fuels, weather, and other variables. The intent is for the fire to stay within a predetermined area to achieve site-specific resource management objectives. Prescribed fire may be used to control certain species; enhance the growth, reproduction, or vigor of certain species; manage fuel loads; and maintain vegetation community types that meet multiple-use management objectives (BLM 1991).

The BLM may also utilize naturally ignited fires to accomplish resource objectives. Wildland fires may be utilized for resource benefit to maintain ecosystems that are functioning within their normal fire regime in areas where there is no threat to life and property. These fires must meet specific environmental prescriptions and be thoroughly evaluated for potential risk before being managed to benefit the resource. They are utilized only in pre-planned areas and when there are adequate fire management personnel and equipment available to achieve defined resource objectives.

The BLM conducts prescribed fire treatments in accordance with its Prescribed Fire Management Policy, which requires the preparation of a prescribed burning plan prior to every burn. Within these plans, a number of site-specific factors are evaluated, including project objectives, fuels present (quantity, type, distribution, moisture content), topography (ruggedness, elevation, slope), weather (temperature, wind, humidity), time of year, smoke dispersal, and predicted fire behavior (flame length, rate of spread). In all cases, fuel models are used to set standards for an area to be treated, and the burning treatment is delayed until the natural conditions of the site approach this standard

(BLM 1991). Under the proposed action, prescribed fire treatments would continue to be conducted in accordance with this policy.

Site Preparation

Prescribed fire projects typically consist of numerous activities, with the actual application of fire being only a small part of the total project (Team 2002). Preparation of a site for fire includes a number of activities with the potential to affect ESA-listed species and their habitats. The type of site preparation required depends on the local conditions and the individual project to be carried out. A number of possible activities are described here.

Road construction and maintenance may be required to provide access to some treatment sites. The extent of work related to this activity is dictated by the condition of the site and its roads. Some prescribed fire projects are located at remote locations and may require the creation of a temporary camp for personnel and their equipment. Depending on the size of the project, camps may be large and require daily shuttles of supplies and resources.

Prior to burning, a fireline is constructed to remove living and dead vegetation (i.e., fuel), or to create a break in its continuity, in order to help stop fire spread. The width of a fireline is determined by fuel type on the site and the anticipated flame length of the fire. The most common type of fireline is constructed using hand tools, by removing all plant material and downed dead material and exposing mineral soil. The equipment used is similar to the types of equipment used during manual control treatment methods. This type of fireline is often used in conjunction with other activities, such as black lining and wet lining (described below), and brush beating.

A machine-built fireline is created using mechanized equipment, such as bulldozers, tractors with plows, road graders, or four-wheelers. This type of fireline is utilized when a fuel break must be wide and/or lengthy, or when smaller fires have the potential to grow rapidly. In order to create a machine-built fireline, the site must have less than a 15% slope and be relatively free of surface rocks.

A wet line is created using water, with or without surfactants, which is sprayed on vegetation to increase moisture content or limit fire spread. Wet lines are most commonly used in short vegetation or fuel (e.g., grass, pine needles) and where flame lengths are short, and have the lowest impact of any human-constructed fireline. Because wet lines require large amounts of water, a reliable water source must be in the area to support these operations. Water can be drawn from ponds and streams using portable pumps, or pumps mounted to water tanks on fire engines or water tenders. In some cases, buckets suspended beneath helicopters may be used to strengthen a fireline or to quickly treat a hot spot. These buckets generally carry from 100 to 250 gallons of water, which is obtained from water sources nearby via bucket dipping or snorkeling. A helibase or helispot must also be located close to the project, and refueling of the helicopter is typically done on-site.

Natural breaks in vegetation and fuel, such as rocky ridges or scab flats, riparian areas, wetlands, or pre-existing human-made breaks such as roads, can also be utilized to help contain prescribed fire. The vegetation in riparian areas and wetlands is too wet to support combustion and is very effective

at limiting fire spread. However, these habitats can only be utilized while they are wet, and are not effective during the dry season.

An explosive built fireline is created using explosives, though this activity is used only under special circumstances and is uncommon. A long-linear explosive device is laid across the ground, and quickly removes burnable fuel and exposes mineral soil to stop the spread of a fire.

A black line is a pre-burned area that is used as a fireline, often in conjunction with other types of firelines. Vegetation is ignited on the inside of another type of fireline to create a wide fireline with minimal disturbance to the site.

Methods of Ignition

The BLM may start prescribed fires using a number of different techniques. Hand-held ignition sources include pressurized kerosene drip torches, propane torches, diesel flame-throwers, flares, and ignition grenades. Prescribed burns on large, accessible areas may be started with truck- or tractor-mounted flame-throwers. Additionally, helicopters may be used to aerially release an ignition fuel onto the area to be treated.

Hand ignition entails fire personnel walking through the burn area igniting the area in a set pattern. Hand ignition gives fire managers the highest level of control over the pattern of a prescribed burn (Team 2002). Mechanized ignition entails driving along a road or through the burn area, igniting vegetation. Like hand ignition, mechanized ignition allows an ignition pattern to be followed, with the added benefit of covering large areas over a short time period. Aerial ignition allows large, inaccessible areas to be treated with minimal impacts outside of the fire on the ground. Aerial ignition using large drip torches (helitorches) can ignite a large area in a relatively short amount of time, without ground impacts. The fuel used in helitorches is a gel mixture called alumagel. The chemicals used in this mixture must be transported and mixed in a level area close to the helispot, under regulations designated by the Department of Transportation and the Federal Aviation Administration (FAA).

Another aerial application device is referred to as a “ping-pong” ball dispenser, which releases ping-pong ball sized spheres filled with potassium permanganate onto the area to be treated. Just before the balls are dropped from the helicopter, they are injected with ethylene glycol, causing a chemical reaction that generates heat, which in turn causes the balls to ignite after they hit the ground. This technique is commonly used on lighter fuels, primarily for forest underburns, although its use is becoming more prevalent in shrub-steppe habitats.

Post-fire Activities

Once objectives have been achieved and ignition is no longer taking place, the so-called “mop-up” phase occurs, in which fire managers extinguish hot spots on the burn site. Hot spots are accumulations of dead material that continue to burn after the majority of the fire has gone out, such as stumps or downed logs. In most cases, the burning material is exposed and cooled with water and/or soil. Firefighters also use a combination of hand tools, fire engines, and hose lays to make

sure the fire is contained within the unit before it is abandoned. Fire engines are used on flat terrain to bring water to the hot spots, and hose is placed along the ground in areas where vehicles cannot travel. Hoses are supplied with water from portable pumps, fire engines, or water tenders. Hand tools (e.g., shovels, backpack pumps, the Pulaski) are used to cool hotspots in areas that are inaccessible to vehicles and laying hose.

3.2.3 Mechanical treatments

Mechanical treatments are generally used to remove thick stands of vegetation, often to prepare the site for replanting a desired species. This method involves the use of tractors or other types of vehicles with attached implements (e.g., plows, harrows, rangeland drills, and mowers). These vehicles tend to remove all vegetation in the path of travel, and often uproot vegetation and disturb the soil. The type of mechanical method used on a particular site is based on characteristics of the undesired species present, seedbed preparation and revegetation needs, topography and terrain, soil characteristics, climatic conditions, and a comparison of the improvement costs to the expected productivity of the site (BLM 1991). Mechanical treatment activities commonly occur in old agricultural areas, industrial sites, and roadsides(Team 2002). The BLM uses chaining, tilling and drilling seed, mowing, roller chopping and cutting, blading, grubbing, and feller-bunching.

Chaining entails pulling heavy (40 to 90 pounds per link) chains behind two crawler-type tractors in a “U” or “J” shaped pattern. Typically, the chain is 250 to 300 ft long, can weigh as much as 32,000 pounds, with a swath varying from 75 to 120 ft in width. Chaining works well for crushing brittle brush and uprooting woody plants. This practice can be done on irregular, moderately rocky terrain, on slopes of up to 20%.

Tilling involves the use of angled disks (disk tilling) or pointed, metal-toothed implements (chisel plowing) to uproot, chop, and mulch vegetation. This technique is commonly used on sites where complete removal of vegetation or thinning is desired, often in conjunction with seeding operations. Tilling leaves mulched vegetation near the soil surface, which encourages the growth of newly planted seeds. The equipment used for tilling is typically a brushland plow, a single axle with an arrangement of angled disks that covers a swath of about 10 ft, or an offset disk plow, which consists of multiple rows of disks set at different angles to each other. Tilling equipment is pulled by either a crawler-type tractor or a large four-wheel-drive farm tractor. Tilling works best on areas with smooth terrain, with deep, rock-free soils, and is often used for removal of sagebrush and similar shrubs. Chisel plowing can be used to break up hard soils.

Seed drilling is often used in conjunction with tilling. The drills for seeding, which consist of a series of furrow openers, seed metering devices, seed hoppers, and seed covering devices, are either towed by or mounted on a tractor. The seed drill opens a furrow in the seedbed, deposits a measured amount of seed into the furrow, and then closes the furrow to cover the seed.

Mowing tools, such as rotary mowers or straight-edged cutter bar mowers, can be used to cut herbaceous and woody vegetation above the ground surface. This technique is often implemented

along highway rights-of-way (ROW) to reduce fire hazards, improve visibility, prevent snow buildup, or improve the appearance of the area (BLM 1991). It is most effective for treating annual and biennial plants, but rarely kills weeds after a single treatment. Although mowing does not typically remove roots, it can help eliminate undesired plant species by giving desired plants a competitive advantage (Team 2002).

Roller chopping tools are heavy bladed drums that cut and crush vegetation up to five inches in diameter using a rolling action. The drums are pulled by crawler-type tractors, farm tractors, or a special type of self-propelled vehicle designed for forested areas or range improvement projects.

Blading, which also utilizes crawler-type tractors, shears small brush at ground level. The topsoil may be scraped with the brush and piled into windrows during this operation. Blading use is limited to relatively-level areas and can only be used for certain undesirable plant species.

Grubbing is done with a crawler-type tractor that has been fitted with a brush rake or root rake attachment. The rake attachment consists of a standard dozer blade adapted with a row of curved teeth projecting forward at the blade base. The base of the blade is placed below the soil surface, allowing it to uproot brush and comb roots from the soil. Typically, grubbed areas are reseeded to prevent extensive runoff and erosion (BLM 1991).

Feller-bunchers are machines that grab trees, cut them at the base, pick them up, and move them into a pile or onto the bed of a truck (Admin. 2000). They are used in forest thinning to remove potentially hazardous fuels.

Techniques for reseeding an area, commonly used in conjunction with mechanical control methods, include drill seeding and aerial application of seed. Drill seeding is commonly used on areas with moderate slopes, and entails the use of rangeland drills attached to tractors. Aerial seeding is the application of seed using fixed wing aircraft or helicopters.

3.2.4 Manual treatments

Manual treatment methods involve the use of hand-operated power tools and hand tools to cut, clear, or prune herbaceous and woody species. Plants may be cut at or above ground level, their root systems may be dug out to prevent sprouting and regrowth, or mulch may be placed around desired vegetation to limit competitive growth (BLM 1991). A number of hand tools may be used during manual treatments: hand saws, axes, shovels, rakes, machetes, grubbing hoes, mattocks (a combination of axe and grubbing hoe), brush hooks, and hand clippers. Power tools, such as chainsaws and power brush saws, may also be used, particularly on thick-stemmed plants.

Manual treatments are most suitable for areas in which the weed infestation is limited and soil types allow for complete removal of the plant material (Rees 1996). Pulling also works well for annual and biennial plants, shallowly-rooted plant species that do not resprout from residual roots, and plants growing in sandy or gravelly soils (NRAP 2000). Pulling is not recommended for use in dense infestations where native vegetation is not available to replace the pulled plants. Manual

treatment methods can be used in many areas, usually with minimal environmental impacts. Manual techniques can be highly selective, and can be used in sensitive areas, where other treatment methods would not be appropriate, and in areas that are inaccessible to ground vehicles (BLM 1991).

3.2.5 Biological control treatments

Biological control methods involve the use of living organisms to selectively suppress, inhibit, or control herbaceous and woody vegetation (Team 2002). Biological control is often selected as an alternative to other treatment methods that have a greater environmental effect. The most common biological control agents are domestic animals, and parasitic insects that are host-specific to target weeds, although mites, nematodes, and pathogens are also used occasionally. Biological control treatments do not eradicate the target species, but do cause some mortality or weaken undesirable plants, thereby decreasing their vigor or competitive abilities in an ecosystem.

Domestic Animals

Domestic animals, such as sheep and goats, control the top-growth of certain noxious weeds, thereby weakening them. After a brief adjustment period, domestic animals can consume up to 50% of their daily diet of the weed. Sheep consume a variety of forbs, as well as grasses and shrubs, and goats can eat large quantities of woody vegetation (BLM 1991). Goats and sheep can be effective control agents for leafy spurge and some types of shrubs (NRAP 2000).

A number of considerations must be made before using domestic animals to control undesirable vegetation: the size of the infestation, the plant species present, the timing of consumption, the availability of a water source for stock; and whether stock can be managed to ensure beneficial effects (Team 2002). Cultural control treatments must be properly timed to be effective, utilizing the right combination of animals and stocking rates, and taking place during the appropriate season. Properly timed grazing of high intensity and short duration can prevent seed set of undesirable species or reduce their top-growth substantially. Domestic animal control methods are not suitable for use in erosion hazard areas, sites with compactable soils, riparian areas, or steep, erodible slopes. In addition, stock presence can encourage the spread of noxious weeds into non-infested areas; domestic animals should not be used as a treatment where such effects are likely. Because weed seeds may still be viable after passing through the digestive tract of an animal, domestic animals should not be moved to weed-free areas until all seeds have passed through their systems (Tu 2001).

Other Biological Control Agents

Insects, mites, nematodes, and pathogens can reduce non-native plant populations by feeding on the plant, by destroying vital plant tissues and function, or by planting eggs in seedheads to reduce reproductive potential. These control agents are commonly used on sites where the population of target plants is large enough to support a viable population of the control agent, and when adequate

numbers of the agents can be obtained. In many cases, three to five biological control agents are required to control a single plant species. In addition, it often takes several years for the biocontrol agents to establish themselves and have a visible impact on the plant population.

Insects, pathogens, and other biological control agents used by the BLM under the proposed action will have been tested to ensure that they are host specific, and they will feed only on the target plant, and not on crops, native flora, or sensitive plant species. The Plant Pest Quarantine Branch of the USDA Animal and Plant Health Inspection Service (APHIS), which issues permits and releases insects into the United States, regulates the use of these control agents. Information on the APHIS program and approval process is available at: http://www.aphis.usda.gov.

The Plant Protection Act of 2000 provides APHIS with the authority to regulate "any enemy, antagonist or competitor used to control a plant pest of noxious weed." However, the release of nonindigenous weed biocontrol agents into the environment is controlled by NEPA and the ESA.

The approval process for a biocontrol agent is extensive. Researchers wanting to use a candidate biological control agent submit proposed test plant lists to the Technical Advisory Group (TAG) for Biological Control Agents of Weeds (APHIS 2002). This includes consulting the USFWS to determine if threatened, endangered, or candidate species should be considered in the test plant list. The researcher must apply for a permit to import the agent into the U.S. As part of the permit process, the researcher is required to consult with the Services. In addition, if the researcher proposes to use a pathogen for weed biological control, he must obtain approval from the USEPA, which regulates microbial pathogens as biological pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act of 1972 (FIFRA). Once a biological control organism has been approved for release, its release can only occur in those states that have been covered under NEPA and consultation with the Services.

Once a biological control agent such as an insect becomes established, it can reproduce and increase its numbers and continue to affect the target organism. These agents are also self-perpetuating, although it may take as many as 15 to 20 years for the agents to establish themselves and bring about the desired level of control. Treatments involving biological control agents are most suitable for large sites where the target plant is well established and very competitive with the desired species. It is unlikely that biological control agents will eradicate a pest plant, because as populations of the host plant decrease, populations of the agent will also decline.

The activities associated with non-domestic animal biological control include the collection and release of biological control agents, transport of agents by vehicle, inventory and monitoring of released agents to determine treatment success, and competitive seeding. Competitive seeding is a practice that can increase the success of biological control agents by establishing native/desirable plants that can compete with noxious weeds and help prevent soil erosion after control by agents (Team 2002). Competitive seeding treatments may require ground and/or aerial application of seeds and fertilizers.

3.3 Project Design Criteria

Non-discretionary PDCs outline aspects of the proposed action that are required for all projects implemented under the program to avoid or minimize adverse effects on listed species and designated critical habitat. The PDCs for this programmatic consultation are organized into three tiers based on geographic location:

PDC Tier 1: Within Pesticide Use Limitation Area

> BLM vegetation treatment via any method (except manual) is prohibited. Spatial data (e.g. shapefiles) representing the PULA will be provided to the BLM upon request.

PDC Tier 2: Within NMFS species ranges but outside the PULA

> The BLM will follow SOPs identified in the 2007, 2016, and 2023 PEIS (BLM 2007a, 2015b, 2023b). These procedures are provided in Appendix B and are summarized in Table 2 below.
>
> The BLM will follow the Conservation Measures identified in the 2007 BA: *Vegetation Treatments on Bureau of Land Management Lands in 17 Western States*. Accessible at https://eplanning.blm.gov/public_projects/nepa/70300/94255/113753/Final_Biological_Assessment__(June_2007).pdf.

PDC Tier 3: Outside NMFS species ranges

> The BLM will follow SOPs identified in the 2007, 2016, and 2023 PEIS.

3.3.1 SOP elements for ESA-listed species

The SOPs listed in the 2007, 2015, and 2023 PEIS's were designed to minimize risks to human health and the environment from herbicide treatment actions. Not all of the SOPs were designed specifically to minimize risk to ESA-listed species and habitats under NMFS's jurisdiction. All SOPs are provided in Appendix B. For clarity, the SOPs that are most relevant to NMFS species are provided in Table 2 below.

Table 2. Highlighted SOPs that have greater relevance to ESA-listed species under NMFS's jurisdiction.

A. General
• Conduct mixing and loading operations in an area where an accidental spill would not contaminate an aquatic body. • Apply the least amount of herbicide needed to achieve the desired result.
B. Soil
• Minimize treatments in areas where herbicide runoff is likely, such as steep slopes when heavy rainfall is expected.

- Minimize use of herbicides that have high soil mobility, particularly in areas where soil properties increase the potential for mobility.
- Do not apply granular herbicides on slopes of more than 15%, or as specified in the label, where there is the possibility of runoff carrying the granules into non-target areas.

C. Water Resources

- Select herbicide products to minimize impacts to water. This is especially important for application scenarios that involve risk from AIs in a particular herbicide, as predicted by risk assessments.
- Plan to treat between weather fronts (calms) and at appropriate time of day to avoid high winds that increase water movements, and to avoid potential stormwater runoff and water turbidity.
- Apply measures to prevent sedimentation into surface water from treatment areas.

D. Wetland and Riparian Areas

- Use a selective herbicide and a wick or backpack sprayer.
- Use appropriate herbicide-free buffer zones for herbicides not labeled for aquatic use based on risk assessment guidance, with minimum widths of 100 ft for aerial, 25 ft for vehicle, and 10 ft for hand spray applications.

E. Fish and other Aquatic Organisms

- Use appropriate buffer zones based on label and risk assessment guidance.
- Minimize treatments near fish-bearing water bodies during periods when fish are in life stages most sensitive to the herbicide(s) used, and use spot rather than broadcast or aerial treatments.
- For treatment of aquatic vegetation, 1) treat only that portion of the aquatic system necessary to achieve acceptable vegetation management; 2) use the appropriate application method to minimize the potential for injury to desirable vegetation and aquatic organisms; and 3) follow water use restrictions presented on the herbicide label.

F. Wildlife

- Use herbicides of low toxicity to wildlife, where feasible.
- Use spot applications or low-boom broadcast operations where possible to limit the probability of contaminating non-target food and water sources, especially non-target vegetation over areas larger than the treatment area.
- Use timing restrictions (e.g., do not treat during critical wildlife breeding or staging periods) to minimize impacts to wildlife.

G. Threatened, Endangered, and Sensitive Species

- Use a selective herbicide and a wick or backpack sprayer to minimize risks to special status plants.
- Avoid treating vegetation during time-sensitive periods (e.g., nesting and migration, sensitive life stages) for special status species in area to be treated.

3.3.2 Conservation measures

As described in the 2007 ROD, in addition to the SOPs, the BLM will implement additional measures to mitigate potential adverse environmental effects as a result of vegetation treatment activities using herbicides. One of the measures listed under the "Fish and Other Aquatic Organisms" subsection was to implement all conservation measures for aquatic animals presented in the 2007 BA *Vegetation Treatments on Bureau of Land Management Lands in 17 Western States Programmatic Biological Assessment.*

The 2015 ROD directs the BLM to follow protective measures identified in the 2015 BA *Vegetation Treatments Using Aminopyralid, Fluroxypyr, and Rimsulfuron on Bureau of Land Management Lands in 17 Western States Biological Assessment.* The SOP and Conservation Measure section of the 2015 BA includes the following measure under the "Threatened, Endangered, and Sensitive Species subsection: "Implement all conservation measures for special status plant and animal species presented in the 2007 BA."

Following the two previous BAs, these same conservation measures are carried forward into this programmatic conference and biological opinion as part of the PDC for actions within ESA-listed species watersheds i.e. ranges (excluding the PULA). The conservation measures from the 2007 BA are listed in Table 3 below.

Table 3. Conservation measures from the BLM 2007 BA most relevant to this programmatic consultation

A. Conservation Measures for Site Access and Fueling/Equipment Maintenance
For treatments occurring in watersheds with threatened and endangered species or designated critical habitat: • Where feasible, access work site only on existing roads, and limit all travel on roads when damage to the road surface will result or is occurring. • Where threatened and endangered aquatic species occur, consider ground-disturbing activities on a case by case basis, and implement SOPs to ensure minimal erosion or impact to the aquatic habitat. • Within riparian areas, do not use vehicle equipment off of established roads. • Outside of riparian areas, allow driving off of established roads only on slopes of 20% or less. • Except in emergencies, land helicopters outside of riparian areas. • Within 150 ft of wetlands or riparian areas, do not fuel/refuel equipment, store fuel, or perform equipment maintenance (locate all fueling and fuel storage areas, as well as service landings outside of protected riparian areas).

- Prior to helicopter fueling operations prepare a transportation, storage, and emergency spill plan and obtain the appropriate approvals; for other heavy equipment fueling operations use a slip-tank not greater than 250 gallons; Prepare spill containment and cleanup provisions for maintenance operations.
- Do not conduct biomass removal (harvest) activities that will alter the timing, magnitude, duration, and spatial distribution of peak, high, and low flows outside the range of natural variability.

B. Conservation Measures Related to Revegetation Treatments

- Avoid hydro-mulching within buffer zones established at the local level. This precaution will limit adding sediments and nutrients and increasing water turbidity.

C. Conservation Measures Related to Herbicide Treatments

Note: According to the 2007 BA, the complexity of this action (herbicide treatments) within riparian areas requires local consultation, which will be based on herbicide risk assessments. The 2007 BA provided a list of possible conservation measures as well as a table providing buffer distances to minimize risks to Threatened, Endangered, and Proposed Fish and Aquatic Invertebrates (BLM 2007; Table 5-5). A buffer distance of 0 ft is provided for many of the herbicides. However, this buffer distance recommendation is superseded by the SOP minimum buffer requirement:

> *"Use appropriate herbicide-free buffer zones for herbicides not labeled for aquatic use based on risk assessment guidance, with minimum widths of 100 ft for aerial, 25 ft for vehicle, and 10 ft for hand spray applications."*

These minimum requirements are applicable to all wetland and riparian areas outside of the PULA. As is described above, herbicide application within the PULA is prohibited.

D. Conservation Measures Related to Prescribed Fire

Within riparian areas, in watersheds with threatened and endangered species or their habitats:

- Conduct prescribed burning only when long-term maintenance of the riparian area is the primary objective, and where low intensity fires can be maintained.
- Do not construct black lines, except by non-mechanized methods.
- Utilize/create only the following firelines: natural barriers; hand-built lines parallel to the stream channel and outside of buffer zones established at the local level; or hand built lines perpendicular to the stream channel with water bars and the same distance requirement.
- Do not ignite fires using aerial methods.
- In forested riparian areas, keep fires to low severity levels to ensure that excessive vegetation removal does not occur.
- Do not camp, unless allowed by local consultation.
- Have a fisheries biologist determine whether pumping activity can occur in streams with threatened and endangered species.

- During water drafting/pumping, maintain a continuous surface flow of the stream that does not alter original wetted stream width.
- Do not alter dams or channels in order to pump in streams occupied by threatened and endangered species.
- Do not allow helicopter dipping from waters occupied by threatened and endangered species, except in lakes outside of the spawning period.
- Consult with a local fisheries biologist prior to helicopter dipping in order to avoid entrainment and harassment of threatened and endangered species.

E. Conservation Measures Related to Mechanical Treatments

Note: these measures apply only to treatments occurring in watersheds that support threatened and endangered species or in unoccupied habitat critical to species recovery

Outside riparian areas in watersheds with threatened and endangered species or designated critical habitat:

- Conduct soil-disturbing treatments only on slopes of 20% or less, where feasible.
- Do not conduct log hauling activities on native surface roads prone to erosion, where feasible.

Within riparian areas in these watersheds, more protective measures will be required to avoid negatively affecting threatened and endangered species or their habitat:

- Do not use vehicles or heavy equipment, except when crossing at established crossings.
- Do not remove large woody debris or snags during mechanical treatment activities.
- Do not conduct ground disturbing activities (e.g., disking, drilling, chaining, and plowing).
- Ensure that all mowing follows guidance to avoid negative effects to streambanks and riparian vegetation and major effects to streamside shade.
- Do not use equipment in perennial channels or in intermittent channels with water, except at crossings that already exist.
- Leave suitable quantities (to be determined at the local level) of excess vegetation and slash on site.
- Do not apply fertilizers or seed mixtures that contain chemicals by aerial methods.
- Do not apply fertilizer within 25 ft of streams and supersaturated soils; apply fertilizer following labeling instructions.
- Do not apply fertilizer in desert habitats.
- Do not completely remove trees and shrubs.

F. Conservation Measures Related to Biological Control Treatments using Livestock

For treatments occurring in watersheds that support threatened and endangered species or in critical habitat:

- Where terrain permits, locate stock handling facilities, camp facilities, and improvements at least 300 ft from lakes, streams, and springs.
- Educate stock handlers about at-risk fish species and how to minimize negative effects to the species and their associated habitat.

- Employ appropriate dispersion techniques to range management, including judicial placement of salt blocks, troughs, and fencing, to prevent damage to riparian areas but increase weed control.
- Equip each watering trough with a float valve.

Within riparian areas of these watersheds, more protective measures are required.

- Do not conduct weed treatments involving domestic animals, except where it is determined that these treatments will not damage the riparian system, or will provide long-term benefits to riparian and adjacent aquatic habitats.
- Do not locate troughs, storage tanks, or guzzlers near streams with threatened and endangered species, unless their placement will enhance weed-control effectiveness without damaging the riparian system.

3.4 Consistency Review

Project-specific ESA consultation with NMFS is required when proposed projects are unable to meet all PDC requirements described above. Departures from the PDC can generally be handled in one of three ways:

1. Minor departure; for example, modifications to language regarding SOPs or conservation measures, process steps or requirements regarding monitoring, reporting, program review, etc. In these situations, BLM should submit an email to NMFS (nmfs.hq.esa.consultations@noaa.gov) with subject line "2024 BLM Vegetation Treatment Programmatic Consultation". Within the email BLM should describe the proposed modification in detail. NMFS and BLM will then confer informally to determine what is needed. These types of edits can be resolved without consultation. Records (e.g. letters, emails) of these types of changes should be retained.
2. Moderate departure; for example, BLM wishes to include additional vegetation treatment methods (additional herbicide AIs, additional mechanical methods, use of methods described as being restricted within riparian areas, etc.). In these situations, BLM should submit an email to NMFS (nmfs.hq.esa.consultations@noaa.gov) with subject line "2024 BLM Vegetation Treatment Programmatic Consultation". Within the email BLM should describe the proposed modification in detail. In these situations BLM and NMFS will determine whether it is necessary to conduct a "step-down" consultation. This type of consultation can make use of much of the program framework but may require some additional analysis, to be discussed by BLM and NMFS.
3. Major departure; for example BLM needs to conduct non-manual vegetation treatment activities within the PULA. In these situations, BLM and NMFS will conduct a separate "stand-alone" consultation.

In cases of major departures (#3 above), a written request to initiate formal consultation shall be submitted to NMFS Office of Protected Resources (email: nmfs.hq.esa.consultations@noaa.gov)

with subject line "2024 BLM Vegetation Treatment Programmatic Consultation." NMFS recommends that the BLM submit their request for formal consultation initiation as early as possible in order to coordinate ESA and NEPA timelines. The written request shall include:

1. A description of the proposed action, including any measures intended to avoid, minimize, or offset effects of the proposed action. Consistent with the nature and scope of the proposed action, the description shall provide sufficient detail to assess the effects of the proposed action on listed species and critical habitat, including:
    a. The purpose of the proposed action;
    b. The duration and timing of the proposed action;
    c. The location of the proposed action;
    d. The specific components of the proposed action and how they will be carried out;
    e. Maps, drawings, blueprints, or similar schematics of the proposed action; and
    f. Any other available information related to the nature and scope of the proposed action relevant to its effects on listed species or designated critical habitat.
2. A map or description of all areas to be affected directly or indirectly by the Federal proposed action, and not merely the immediate area involved in the proposed action (i.e., the action area as defined at § 402.02).
3. Information obtained by or in the possession of the Federal agency and any applicant on the listed species and designated critical habitat in the action area, including available information such as the presence, abundance, density, or periodic occurrence of listed species and the condition and location of the species' habitat, including any critical habitat.
4. A description of the effects of the proposed action and an analysis of any cumulative effects.
5. A summary of any relevant information provided by the applicant, if available.
6. Any other relevant available information on the effects of the proposed action on listed species or designated critical habitat, including any relevant reports such as environmental impact statements and environmental assessments.

The BLM may supplement the initiation package by reference to the existing PEIS, BA, as well as this conference and biological opinion document. However, any such reference shall be accompanied by a written summary specifying the location of the information that satisfies the elements above in the submitted document(s).

3.5 Monitoring, Reporting, Validating Effects Predictions

Monitoring ensures that vegetation management is an adaptive process that continually builds upon past successes and learns from past ineffective treatments. The regulations of 43 Code of Federal Regulations 1610.4-9 require that land use plans establish intervals and standards for monitoring and evaluating land management actions. During preparation of implementation plans, treatment objectives, standards, and guidelines are stated in measurable terms, where feasible, so that treatment outcomes can be measured, evaluated, and used to guide future treatment actions. This approach ensures that vegetation treatment processes are effective, adaptive, and based on prior experience.

The diversity of plant communities on BLM lands calls for a diversity of monitoring approaches. Monitoring strategies may vary in time and space depending on the species. Sampling designs and techniques vary depending on the type of vegetation. Regardless of the strategy and designs used to select indicators and methods, the monitoring plan should include the principles found in the BLM's Assessment, Inventory, and Monitoring Strategy and "Adaptive monitoring for multiscale land management: Lessons learned from the Assessment, Inventory, and Monitoring (AIM) principles (Kachergis et al. 2022). Whenever possible, the core indicators and methods should be used which facilitate impact study design and analysis and allow existing monitoring points to be used as control sites.

Two types of monitoring of vegetation treatments may be pursued by the BLM. One type is implementation monitoring, which answers the question, "Did we do what we said we would do?" The second type is effectiveness monitoring, which answers the questions, "Were treatment and restoration projects effective?" and "Is there any evidence of unanticipated harm to ESA-listed species?" Implementation monitoring is usually done at the land use planning level or through annual work plan accomplishment reporting. Effectiveness monitoring is usually done at the local project implementation level.

Invasive plant implementation monitoring for non-herbicide treatments is accomplished through site revisits performed during the growing season of the target species to determine if treatments were implemented correctly and the best time for follow-up treatments.

For herbicide use, implementation monitoring is accomplished through the use of Pesticide Use Proposals (PUPs) and Pesticide Application Records. Both documents are required by the BLM in order to track pesticide use annually. The PUP requires reporting of the pesticide proposed for use and the maximum application rate. It also requires reporting of the number and timing of applications. Targeted species and non-targeted species at the treatment site are described, as well as the other site characteristics. A description of sensitive resources and mitigation measures to protect these resources is also required. Most importantly, the integrated vegetation management approach to be taken (i.e., the combination of treatments to be used) is required. The NEPA document that analyzes the effects of the treatment must also be referenced. PUPs must be signed by a certified vegetation applicator, the field office manager, state coordinator, and deputy state director before the treatment can go forward. The Pesticide Application Record, which must be completed within 24 hours after completion of the application, documents the actual rate of application and that all the above factors have been taken into account. Pesticide Application Records are used to develop annual state summaries of herbicide use for the BLM.

In addition, FIFRA labels provide information on how to report any ecological incidents that are suspected to have resulted from pesticide exposure. For guidance on reporting ecological incidents, including death, injury, or harm to plants and animals, including bees and other non-target insects, see EPA's Pesticide Incident Reporting website: https://www.epa.gov/pesticide-incidents or call the pesticide registrant phone number on the pesticide label.

The results of monitoring should be made available to interested parties. A website with links to geospatial and other data sets will ensure that inventory data, and treatment methods and results, are shared easily. The BLM has a website, http://www.blm.gov, with links to BLM programs, such as the vegetation program, and other data sources, including geospatial data. Most state offices are tied into state data clearinghouses that contain useful information gathered by federal, state, and local agencies.

3.6 Program Review

As a requirement of the programmatic action, an annual (or other frequency agreed upon by BLM and NMFS) comprehensive review meeting will be held to discuss the action agency's activities in the previous year, and to compile material for the annual report. Participants would include representatives from NMFS ESA Interagency Cooperation Division, NMFS Office of Habitat Conservation, and the BLM. NMFS will notify the regional offices as to when the annual review Meeting would be held, and invited to participate at their discretion.

Prior to the review meeting, BLM and NMFS will compile the information necessary for the creation of an annual report. The annual report is meant to be a brief summary describing the action agencies' activities carried out under the programmatic for that year. The following information should be sent between the agencies prior to the meeting:

- NMFS will query the ESA Section 7 database "ECO" (https://www.fisheries.noaa.gov/resource/tool-app/environmental-consultation-organizer-eco) for all records of BLM implementation (e.g. consistency reviews) and any step-down or stand-alone consultations. NMFS will prepare a brief summary of the consultations including: number, location, conclusions, any RPA or RPM mitigation, and ITS.
- BLM will collect records of BLM vegetation treatment projects that occurred under the ESA programmatic (e.g. BLM annual reports). BLM will prepare a brief summary of the projects including: number, location, and record of the project having considered the NMFS ESA programmatic in the planning phase.
- NMFS will query EPA's incident data system "IDS" (https://ordspub.epa.gov/ords/pesticides/f?p=359:1) for records of any ecological incidents associated with BLM vegetation treatment applications.

During the meeting, agency representatives should be prepared to exchange the information described above as well as that regarding any of the following topics, as necessary:

- New species, critical habitat (proposed, final rules);
- Changes to EFH designations;
- New or upcoming policy directives, tech memos (and revisions to any such existing documents); potential implications to the programmatic's analysis, framework, etc.
- Evaluation of the effectiveness of the programmatic's processes (e.g., step-down reviews, areas for improvement, etc.);
- Topics where more data/information is needed (e.g., future research);

- Identification of any new literature, studies, etc. that change or support previous understandings of the degree of effects to ESA species, fish, habitat, prey species; does the analysis in the programmatic still hold, does it need to be reviewed or revised?

Subsequent to the meeting BLM will be responsible for compiling any information exchanged, along with brief meeting minutes, into a single report to be submitted back to NMFS.

4 ACTION AREA

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

The BLM administers approximately 247 million acres in 29 states in the continental U.S. and Alaska. This programmatic consultation covers the vegetation treatment program within 17 western states, including Alaska.The action area also includes any areas where BLM's action may result in effects to ESA-listed species or designated critical habitat. For example herbicides applied on BLM lands may be transported outside of BLM lands via drift, runoff, or downstream transport. Below is an approximation of the action area. Note that it does not depict those areas where effects extend beyond the immediate treatment locations. Although not depicted, effects to species and habitats resulting from off-site exposure is addressed in this programmatic consultation.

5 STRESSORS OF THE PROPOSED ACTION

In this section we describe the stressors associated with the vegetation treatment activities. We begin with a discussion of the stressors common to all treatment methods, and then discuss stressors more specific to herbicide, fire, mechanical, manual, and biological control treatments.

5.1 Effects common to all treatment methods

A general reduction in the plant biomass of riparian areas, which could occur by any of the treatment methods proposed for use on public lands, can have multiple consequences for aquatic species including an increase in water temperature and sedimentation, and a decrease in water storage capacity (Quality 2000). Riparian cover provides shade to aquatic habitats, which cools water temperatures, and reduces the extent of water temperature fluctuation. In addition, riparian vegetation stabilizes the soil on banks, preventing erosion and sedimentation into streams and other aquatic habitats, and intercepts rainfall to reduce overland flow. Riparian vegetation also increases habitat quality by buffering streams from incoming sediments and other pollutants, building a sod of herbaceous plants to form undercut banks, increasing habitat complexity, and increasing terrestrial invertebrate prey for fish species (Platts 1991).

Increased sedimentation entering aquatic habitats as a result of destabilized streambanks and increased erosion can cover spawning/rearing areas, thereby reducing the survival of fish embryos and juveniles (Quality 2000). Sedimentation can also fill pool habitats, making them unusable by fish and other aquatic organisms. A number of sublethal effects to aquatic species may also occur as a result of sedimentation, including avoidance behavior, reduced feeding and growth, and physiological stress (Waters 1995). Over the long-term, increased sediment loads reduce primary production in streams (Quality 2000). Reduced instream plant growth, combined with the reductions in riparian vegetation, can limit populations of terrestrial and aquatic insects, which also serve as food sources for many threatened and endangered fish species.

Removal of large amounts of riparian vegetation can alter the nutrient dynamics of the aquatic habitat. In areas where riparian vegetation has been lost, a shift in energy inputs from riparian organic matter to primary production by algae and vascular plants have been predicted (Mitchell 1989) and observed (Spencer et al. 2003). The increased solar radiation that results from the loss of streamside (or poolside, etc.) vegetation causes temperatures, light levels, and autotrophic production (i.e., plants and algae) to increase. This change in a stream's food web could alter the composition of food and thus energy sources that are available to threatened and endangered fish and aquatic invertebrates. In addition, increased stream temperatures could affect some threatened and endangered species, and particularly salmonids, by reducing their growth efficiency, and increasing their likelihood of succumbing to disease.

By exposing more surface area of soil directly to rainfall, and increasing the overland flow of water into the aquatic habitat, removal of vegetation may result in decreased water storage capacity of the soil. Over the long-term, overland flow can erode the topsoil and cut rills and gullies or deepen existing gullies, concentrating runoff. As a result, sediment production is increased. Reduced

infiltration and increased runoff may decrease the recharge of the saturated zone and increase peak flow discharge. Thus, the amount of water retained in the watershed to sustain base flows is reduced.

Increases in streamflow can lead to alterations in channel morphology. Doubling the speed of streamflow increases its erosive power by four times and its bedload and sediment carrying power by 64 times (Quality 2000). Accelerated runoff can cause unstable stream channels to downcut or erode laterally, accelerating erosion and sediment production. Lateral erosion results in progressively wider and shallower stream channels,which can negatively affect fish populations. Pool/riffle and width/depth ratios, which are important habitat components for many threatened and endangered aquatic species, may also be altered.

The severity of the effects would vary by treatment method, location, the amount of plant material removed, and the distance from the aquatic habitat. Most of the effects would also be increased in severity if vegetation were removed prior to a period of heavy precipitation. Therefore, timing of the treatments is another important factor. The effects of vegetation removal would persist until riparian areas were revegetated.

An assumption of the BLM vegetation treatment program is that, over the long term, all treatment methods that remove non-native and competing vegetation are likely to have a beneficial effect on the habitat of aquatic species, provided that native or other desirable plant species are returned to those habitats after the treatments. Noxious weeds can have substantial negative effects on stream/riparian areas by outcompeting more desirable riparian vegetation, reducing biodiversity, altering aquatic habitats (e.g., reducing streambank protection, undercut bank cover, overhanging vegetation cover, pool depth and volume, and detrital and nutrient inputs; and increasing erosion and fine sediment deposition, stream width, and thermal relationships), and altering natural ecosystem processes (Team 2002). Vegetation treatments that target plant communities adjacent to aquatic habitats should result in conditions that would be more suitable for supporting aquatic species.

Another long-term benefit of the removal of fuels from riparian habitats is the decrease in the risk of a future high severity wildfire. Because past fire suppression has radically altered vegetation structure and fuel loads, the risks for stand-replacing fires in areas that historically experienced lower intensity and lower frequency burns are now at all-time highs on some public lands where treatments are proposed to occur. In many cases, fuels reduction is the primary intent of these treatments. In the absence of such activities, a wildfire burning through watersheds that support threatened and endangered species could potentially have much worse effects on aquatic habitats and these species than any of the treatment methods themselves.

5.2 Herbicide treatments

The BLM’s vegetation treatment program makes use of 28 herbicide AIs. Ecological risk assessments are available for each of the AIs. In this section we draw on information from the BLM or USFS risk assessments, as well as the most recent FIFRA ecological risk assessments, associated

registration decision documents, as well as any more recently available information. For each of the AIs, we first provide a summary of the herbicide AI and its uses and a discussion of the available RQs. If the RQ approach indicates a risk concern for a listed species and/or its prey (see discussion below) we continue the exposure and response analysis by looking at exposure potential via drift and runoff. Our evaluation of exposure and response is conceptually separated into two regions: impacts within the PULA, and impacts outside of the PULA. If the RQ approach does not indicate a risk concern the exposure and response analysis for that AI is concluded, to be further discussed in the risk analysis section.

Herbicide overview.

A general description of each AI will be provided including the mechanism of proposed action and the authorized uses relevant to BLM's vegetation treatment program.

Risk quotients.

The deterministic RQ method is used to provide a metric of potential risks. The RQ is a comparison of exposure estimates to toxicity endpoints (i.e., RQ = EEC/toxicity endpoint). The resulting RQs are compared to risk levels of concern (LOC). These criteria are used to indicate when the use of a pesticide, as directed on the label, has the potential to cause adverse effects to non-target organisms. For acute and chronic risks to ESA-listed aquatic animals, the LOCs are 0.05 and 1.0, respectively. For each herbicide, RQs are generated or summarized from existing risk assessments and risks are discussed. Risk quotient discussions taken directly from EPA environmental risk assessments will be identified as such.

Exposure from drift

The potential for exposure via drift was assessed for each AI using the AgDRIFT® model. AgDRIFT® (version 2.1.1), a modified version of the AGricultural DISPersal (AGDISPTM) model developed by the U.S. Forest Service, was created under a Cooperative Research and Development Agreement between the EPA, the U.S. Department of Agriculture's Forest Service, and the Spray Drift Task Force. The AgDRIFT® model has the capability to assess a variety of spray drift conditions from agricultural applications and off-site deposition of liquid formulation of pesticides. This model can be used in estimating downwind deposition of spray drift from aerial, ground boom and airblast applications. For each AI, exposure scenarios were generated to represent the potential transport into habitats both within and outside of the PULA. Habitats within the PULA are buffered by a distance of 300 m from the water's edge. Outside of the PULA, minimum buffers of 25 ft and 100 ft for ground and aerial, respectively are required. Therefore we modeled ground (e.g. tractor broadcast spray) and aerial applications from a distance of 984 ft (300 m); ground applications from 25 ft, and aerial applications from 100 ft. For each scenario we generated estimates associated with two different waterbody types.

EPA has been performing pesticide aquatic exposure assessments as a part of the ecological risk assessment process for a number of years. Ecological exposure assessments have been routinely carried out through computer modeling of a "standard" agricultural field-farm pond scenario and

through use of field monitored pesticide concentration values. Although this "standard scenario" was designed to predict pesticide concentrations in the standard farm pond, it has been shown to be a good predictor of upper level pesticide concentrations in small but ecologically important upland streams (Effland et al. 1999).

The second waterbody modeled is referred to as “bin 2.” The bin 2 parameters were developed by EPA, NMFS and FWS as part of methods development for ESA FIFRA consultations. The National Research Council Committee of the National Academy of Sciences recommended that fate and transport models be used to estimate time-varying and space-varying pesticide concentrations in generic habitats relevant to ESA-listed species (NAS 2013). Bin 2 is intended to represent habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, alcoves, etc.). Examples of ESA-listed species that utilize habitats fitting the characteristics of bin 2 include the Pacific eulachon and several salmonid species. During spawning migration, Pacific eulachon migrate upstream through shoreline habitats during low hydrograph periods at depths of 0.1-1 m. While there are different habitat preferences among the species, listed Pacific salmonids utilize lower flow habitats in some phases of their lifecycle for activities such as spawning, rearing, or migration. The bin 2 scenario used in ESA/FIFRA consultations has a flow rate component. In this assessment only the water volume parameters are utilized.

For more information on the AgDRIFT® model, visit EPA’s modeling site at: https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment

Exposure from runoff

Pesticides are commonly transported to aquatic habitats via runoff. There are many factors that influence the degree to which a pesticide can be expected to move from the site of deposition. Factors include: volume, duration, and intensity of precipitation; contour and slope of the application site, soil type, and chemical fate and transport properties. Similar to estimating drift potential, we considered the exposure potential to habitats both in and outside of the PULA.

As described above, habitats within the PULA are buffered by a distance of 300 m. For runoff/erosion, maximum overland flow distances are commonly assumed to be approximately 300 to 370 m (1000 to 1200 ft) in engineering handbooks (VADEQ 1992, USDA 2010a, TXDOT 2019). Wu (2017) estimated flow path lengths for more than 32,000 wetlands in the prairie pothole region and 300 m was in the upper end of the distribution, with an average flow path length of 138 m and median of 83 m (Wu 2017). In most cases, 300 m represents a point at which the potential for transport via sheet or channelized flow can be considered minimal. Although off-site transport beyond 300 m following pesticide application is possible, the 300 m distance is appropriate for focusing attention on applications that pose the greatest risk.

Outside of the PULA the potential for exposure via runoff increases as minimum buffer distances shrink to 25 ft and 100 ft for ground and aerial applications, respectively. To assess the potential for runoff into these habitats we first evaluate the EECs that have been generated in the ecological risk

assessments. Certain models (e.g. PWC) are able to incorporate runoff into the calculation of EECs. We are look at the fate and transport characteristics of each compound. For example, the sorption coefficient and soil metabolism half-life of the AIs. Although these two properties alone do not determine the runoff, they do provide valuable information when considering the overall potential for exposure via this pathway.

The solid-water distribution coefficient (Kd) and organic-carbon normalized solid-water distribution coefficient (KOC) are measures of the propensity of an herbicide to be dissolved in water or sorbed to soil or sediment. The ability for a pesticide to transport via runoff/erosion is considered to be reduced for chemicals with an organic carbon normalized solid-water distribution coefficient (KOC) greater than 1000 L/kg-organic-carbon or solid-water distribution coefficient (Kd) greater than or equal to 50 L/kg-soil.

Pesticides that have an aerobic soil metabolism half-life less than 10 days tend to have lower exposure and reduced offsite transport when the application does not occur within 48-hours of one inch of rain. Therefore, when all aerobic soil metabolism half-life values for the relevant residues are less than 10 days, the potential for runoff is considered to be reduced, assuming the label includes a 48-hour rain restriction.

5.2.1 2,4-dicholorophenoxyacetic (2,4-D)

2,4-D is a selective, systemic herbicide used to control broadleaf weeds. Herbicides using 2,4-D as the AI include soluble powders, soluble concentrates in both liquid and solid forms, emulsifiable concentrates, and a granular formulation designed for aquatic applications. There are several different 2,4-D salts and esters, as well as the acid form.

2,4-D is used for terrestrial vegetation control in the BLM's Rangeland, Public-Domain Forestland, Energy and Mineral Sites, Rights-of-Way, and Recreation programs. Applications are carried out through aerial and ground dispersal. Aerial applications are performed using airplanes and helicopters. Ground applications are executed on foot or on horseback with backpack sprayers, or from all-terrain vehicles, utility vehicles, or trucks equipped with spot or boom/broadcast sprayers.

Typical and maximum application rates for woody species (herein referred to as "woody") are two and four pounds (lbs.) acid equivalent (a.e.)/A, respectively. Treatment of woody species with 2,4-D represents a minor use by the BLM. Other non-woody species (i.e., herbaceous varieties; herein referred to as "annual/perennial") have typical and maximum application rates of one and two lbs. a.e./A, respectively (BLM 2014a).

2,4-D is also used for treatment of floating, emerged, and submerged aquatic vegetation. Submerged vegetation may be controlled by treating either the volume of water or the water body bottom. For control of floating and emerged aquatic vegetation or for treatment of submerged vegetation to a volume of water, 2,4-D may be applied aerially, using airplanes or helicopters, or using a boat for either spot or boom/broadcast applications. Typical and maximum application rates

of two and four lbs. a.e./A, respectively, are used for treatment of floating and emerged aquatic vegetation. Typical and maximum application rates of 5.4 and 10.8 lbs. a.e./A-ft, respectively, are used for treatment of submerged vegetation to a volume of water. The granular formulation of 2,4-D (Navigate®) is used in the treatment of submerged vegetation at the bottom of a water body. Application is conducted using a boat for either spot or boom/broadcast applications (typical and maximum application rates of 19 and 38 lbs. a.e./A, respectively) (BLM 2014a).

According to BLM's ecological risk assessment (BLM 2014a) direct applications to aquatic habitats resulted in LOC exceedances for all fish and aquatic invertebrate scenarios. In relation to offsite drift, all but one of the acute and chronic toxicity scenarios for fish and aquatic invertebrates resulted in RQs less than the relevant LOCs based on 2,4-D acid/salts forms. However, when ester forms were considered, 6.3% of the fish RQs and 83.3% of the invertebrate RQs exceeded the acute toxicity LOCs. Similarly for runoff, the acid/salt forms did not result in LOC exceedances, whereas the ester form of 2,4-D resulted in LOC exceedances for one fish and several invertebrate acute toxicity scenarios.

EPA's 2016 Preliminary Ecological Risk Assessment for Registration Review of 2,4-D (EPA 2016) arrived at similar conclusions. For freshwater and estuarine/marine fish, the direct applications to water yielded risk concerns for the ester forms of 2,4-D. In addition, acute direct risk concerns for listed freshwater fish were identified for pastures/rangelands/perennial grasslands and forestry from ester runoff; only minor risk concerns were identified from spray drift exposures. For amine/salt/acid forms of 2,4-D no direct risk concerns were identified for fish, and only one scenario (direct application at the highest application rate) resulted in LOC exceedances for aquatic invertebrates.

In 2011 NMFS consulted with USEPA on the effects of 2,4-D on listed Pacific salmonids. NMFS concluded that EPA's registration of 2,4-D will jeopardize many of the ESA listed salmonids on the West Coast. According to the biological opinion, 2,4-D is expected to reduce in-stream primary productivity as well as riparian vegetation. However, the greater concern is the potential for fish lethality resulting from direct application of 2,4-D to aquatic habitats. An RPA was prescribed in order for EPA to insure their proposed action was no longer likely to jeopardize ESA-listed salmonids. The RPA included the following elements:

- Do not apply when wind speeds are below two mph or exceed 10 mph, except when winds in excess of 10 mph will carry drift away from salmonid-bearing waters.
- Do not apply when soil is saturated, or when a precipitation event, likely to produce direct runoff to salmonid bearing waters from the treated area, is forecasted by NOAA/NWS (National Weather Service) or other similar forecasting service within 48 h following application.
- Do not apply pesticide products containing 2,4-D butoxyethyl ester directly to any surface waters accessible to listed salmonids.
- Control of invasive plants within the riparian habitat shall be by individual plant treatments for woody species, and spot treatment of less than 1/10 acre for herbaceous species.

Exposure via drift

In regards to offsite drift, only the ester (not amine, salt, or acid forms) resulted in LOC exceedances. The direct spray scenario assumes that waterbodies are accidently sprayed during applications to terrestrial environments, whereas the off-site scenario assumes a 25, 100 and 900 ft distance to the waterbody. The BLM assessment (BLM 2014a) used AgDrift to estimate aquatic concentrations in stream and pond waterbodies at distances 0, 25, 100, and 900 ft. In all scenarios, RQs for fish exceeded the LOC at distances of 25 ft and 100 ft, but never exceeded the LOC when assuming a distance of 900 ft. For aquatic invertebrates, the LOC was exceeded even when assuming a buffer distance of 900 ft.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 4. 2,4-D EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	43.7	37.1	34.3
Aerial, 30.48 m	372.0	316.1	292.3
Ground, 300 m	1.7	1.5	1.4
Ground, 30.48 m	18.9	16.1	14.8
Ground, 7.62 m	77.2	65.6	60.7

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that risk is limited to the ester and primarily a concern for habitats outside the PULA.

Exposure via runoff

Both fish and aquatic invertebrates have the potential for adverse effects when applications of 2,4-D ester are made in proximity to habitats. However, esters are significantly less soluble and rapidly disassociate into the acid form in water. Registrant-sponsored research indicates the 2,4-D esters (ethylhexyl, isopropyl, butoxyethyl) degrade rapidly (half life less than 24 hours) in soil slurries, aerobic aquatic environments, and anaerobic, acidic aquatic environments. In terrestrial field dissipation studies for 2,4-D EHE, the half-lives for 2,4-D EHE ranged from one to 14 days with median half-life of 2.9 days. 2,4-D BEE, applied as a granule formulation, degraded rapidly in the water column in aquatic field dissipation studies under alkaline conditions. However, the 2,4-D BEE residues were detected in sediment samples from Day 0 (immediately posttreatment) to 186 days posttreatment. It is unclear whether 2,4-D BEE persistence in sediment is due to the slow release of the granule formulation or to slow deesterification of sediment bound 2,4-D BEE. Available open-literature and registrant sponsored laboratory data would suggest slow granule dissolution prolonged the persistence of 2,4-D BEE. In forest dissipation studies, the 2,4-D EHE ester degraded slowly on foliage and in leaf litter (EPA 2005).

Exposure via aquatic applications

According to EPA's ecological risk assessment (EPA 2016) direct applications to water of the ester form resulted in LOC exceedances for both fish and aquatic invertebrates. Application of the amine/salt/acid form resulted in LOC exceedances for invertebrates, but not fish. Further, treating large portions of the water body may result in a large amount of decaying plant life, thereby creating an oxygen-depleted environment that would most likely result in fish kills.

In summary, the available data indicates a risk concern associated with direct applications of all forms of 2,4-D. When considering drift and runoff from terrestrial applications, the primary risk concern is with the ester form. Runoff may be associated with less risk given the fast degradation rate of the ester. These potential impacts will be further addressed in the risk analysis section.

Table 5. Potential Effects 2,4-D

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are likely but limited to invertebrates via drift of the 2,4-D ester.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are likely to both fish and invertebrates via drift and /or runoff from terrestrial applications of the 2,4-D ester. Adverse effects are likely to both fish and invertebrates from direct application to water.

5.2.2 Aminocyclopyrachlor

Aminocyclopyrachlor [6-amino-5-chloro-2-cyclopropyl-4-pyrimidinecarboxylic acid] is an herbicide belonging to the pyrimidine carboxylic acid chemical class. The pesticidal mode of action is dysregulation of gene products involved in auxin receptor activity, which interferes with normal shoot and root development to stop the growth of weeds.

Products can be applied as suspension concentrate, soluble liquid, or water dispersible granular formulations via groundboom, aerial, or handheld equipment. Application rates range from a minimum of 0.038 lb AI/A to a maximum of 0.28 lb AI/A. Aminocyclopyrachlor is currently registered for general control of broadleaf weeds and woody species on private, public, military lands and non-hayed rangelands in several different states (EPA 2020a)

Risk quotients

As of early 2024, EPA has not yet completed the human health risk assessment for aminocyclopyrachlor in registration review. The following is taken from the 2012 Aminocyclopyrachlor Human Health and Ecological Risk Assessment (USDA, 2012). No additional fish or aquatic invertebrate studies were identified in EPA's 2020 draft risk assessments, nor via an updated (March, 2024) literature search.

According to the Forest Service's 2012 risk assessment (USDA 2012) all acute and chronic RQs are below the LOCs for fish and aquatic invertebrates. The EECs used in these calculations were

generated using the Gleams-Driver model with an application rate of 1.0 lb AI/A. Applicable EECs were not presented in the more recent EPA draft risk assessment. The Canadian proposed registration decision for Aminocyclopyrachlor presented EECs generated using the PRZM/EXAMS model. The EECs for surface water were roughly one order of magnitude lower than those used in the USDA ERA (PMRA 2014).

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 6. Aminocyclopyrachlor EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	3.1	2.9	2.8
Aerial, 30.48 m	26.0	24.4	24.2
Ground, 300 m	0.1	0.1	0.1
Ground, 30.48 m	1.3	1.2	1.2
Ground, 7.62 m	5.4	5.1	5.0

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low. In summary, the available data for the RQ approach does not indicate a risk concern. Therefore, the exposure and response analysis for this AI is concluded, to be further discussed in the risk analysis section.

Table 7. Potential Effects Aminocyclopyrachlor

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are not likely.

5.2.3 Aminopyralid

Aminopyralid is a pyridine carboxylic acid that is available in a soluble liquid formulation. Its general mechanism of toxicity is to mimic the auxin plant growth hormone. Aminopyralid is used by the BLM for vegetation control for its Rangeland, Public-Domain Forestland, Energy and Mineral Sites, Rights-of-Way (ROW), and Recreation programs. Herbicide application is carried out through aerial and ground dispersal. Aerial applications are conducted using airplanes and helicopters. Ground applications are conducted on foot or on horseback with backpack sprayers or from all-terrain vehicles, utility vehicles, or trucks equipped with spot or boom/broadcast sprayers. Ground applications at energy and mineral sites, along ROW, and in recreation areas are solely carried out using all-terrain vehicles or trucks equipped with spot or boom/broadcast sprayers. The

BLM would typically apply aminopyralid at 0.078 pounds (lbs.) acid equivalent (a.e.) per acre (ac), with a maximum application rate of 0.11 lbs. a.e. /A. (BLM 2015a).

Aminopyralid is characterized as mobile to highly mobile on soil and non-persistent to moderately persistent on soil and persistent in aquatic environments. Based on these physical-chemical, fate properties and field dissipation data, it is expected to reach off-target water bodies via spray drift, runoff, and leaching, and has been detected in surface water and groundwater (EPA 2020b).

Risk quotients

According to the BLM risk assessment (BLM 2015b), when considering impacts from direct spray, all of the RQs for fish and aquatic invertebrates were below the most conservative LOC of 0.05, indicating that direct spray is not likely to pose a risk to these aquatic receptors. For off-site drift, acute toxicity RQs for fish and aquatic invertebrates were all below the most conservative LOC of 0.05. All chronic RQs were well below the LOC for chronic risk to endangered species. Finally, in regards to runoff, acute toxicity RQs for fish and aquatic invertebrates were all below the LOC for all pond and stream scenarios. In addition, all chronic RQs were well below the LOCs.

EPA's more recent ecological risk assessment (EPA 2020b), drew similar conclusions. According to that assessment, LOCs were only exceeded for risk to terrestrial plants. No potential acute or chronic risks of concern for freshwater fish and estuarine/marine fish exposed to aminopyralid have been identified. Fish acute RQs are below the acute risk LOC. Fish chronic RQs range from 0.04 to 0.17 and are also below the LOC. Similarly, no risks of concern were identified for freshwater or estuarine/marine invertebrates. Neither acute nor chronic RQs exceed the LOCs (EPA 2020b, 2021a).

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 8. Aminopyralid EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	1.2	0.7	0.2
Aerial, 30.48 m	10.2	5.6	2.0
Ground, 300 m	0.0	0.0	0.0
Ground, 30.48 m	0.5	0.3	0.1
Ground, 7.62 m	2.1	1.2	0.4

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low. In summary, the available data for the RQ approach does not indicate a risk concern. Therefore, the exposure and response analysis for this AI is concluded, to be further discussed in the risk analysis section.

Table 9. Potential Effects Aminopyralid

Location	Potential impact

PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are not likely.

5.2.4 Bromacil

Bromacil is a broad spectrum, systemic herbicide for use on annual and perennial weeds, brush, woody plants, and vines. This chemical disrupts photosynthesis by blocking electron transport and the transfer of light energy. Bromacil is available in granular, liquid, soluble liquid, and wettable powder formulations. Bromacil is used for vegetation control in the BLM's Energy & Mineral Sites, Rights-of-way (ROW), and Recreation programs. Application is carried out through ground dispersal, executed on foot or horseback with backpack sprayers, or from all terrain vehicles or trucks equipped with spot or boom/broadcast sprayers. The BLM typically applies bromacil at 4.0 pounds (lbs) AI per acre (AI/A), with a maximum application rate of 12.0 lbs AI/A (BLM 2005a).

According to BLM's ecological risk assessment (BLM 2005a), when considering impacts from direct spray, acute toxicity RQs for aquatic invertebrates in the pond were below the LOC, indicating that direct spray impacts are not likely to pose a risk to these aquatic species. However, the predicted acute toxicity RQs for fish and aquatic invertebrates in the stream were above the LOC. These results indicate the potential for risk in a stream accidentally sprayed with bromacil. For off-site drift, acute toxicity RQs for fish and aquatic invertebrates were all below the LOC. All chronic RQs were well below the LOC.

In regards to runoff, acute toxicity RQs for fish and aquatic invertebrates were below the LOC for all stream scenarios and nearly all pond scenarios. Three acute toxicity RQs for fish in the pond were 0.052, 0.056, and 0.051.

Chronic RQs for aquatic invertebrates in the pond and stream and fish in the stream were well below the LOC, indicating that these scenarios are not likely to result in long-term risk to these receptors. However, RQs for fish in the pond were above the LOC for chronic risk in several scenarios. These results indicate the potential for negative chronic impacts to fish in down gradient ponds due to surface runoff, especially at the maximum application rate (BLM 2005a).

EPA's more recent ecological risk assessment and proposed interim decision (EPA 2012, 2019a) conclude that no risks of concern were identified for any freshwater, estuarine or marine animals.

RQs exceeded the LOC for two scenarios: 1) via direct spray (fish and aquatic invertebrate); and 2) via runoff (fish only). Despite EPA's later finding of "no risks", we continue below with a discussion of drift and runoff.

Exposure via drift

RQs exceeded the LOC for both fish and aquatic invertebrates under the "direct spray" scenario. However, for "off-site" drift all acute and chronic RQs were below the LOCs. The direct spray scenario assumes that waterbodies are accidently sprayed during applications to terrestrial environments, whereas the off-site scenario assumes a 25, 100 and 900ft distance to the waterbody. The project design criteria in this programmatic require buffers of 984 ft (300 m) for PULA-associated habitats, and either 25 or 100 ft buffers for habitats outside of the PULA. The existence of these required buffers minimizes the likelihood of waterbodies from being directly sprayed with bromacil formulations.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 10. Bromacil EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	131.1	118.4	117.2
Aerial, 30.48 m	1115.9	1007.7	997.5
Ground, 300 m	5.2	4.7	4.7
Ground, 30.48 m	56.7	51.2	50.7
Ground, 7.62 m	231.7	209.2	207.1

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low.

Exposure via runoff

The RQ exceeded the LOC for fish under the runoff scenario for ponds, but not streams. The BLM ecological risk assessment made use of the GLEAMS model to predict the loading of herbicide to nearby soils, ponds, and streams from overland and surface runoff, erosion, and root-zone groundwater runoff. The GLEAMS model assumes that the soil, pond, and stream are directly adjacent to the application area. As described above, the project design criteria require buffers of 25-984 ft. However, bromacil is a persistent and mobile herbicide; the KOC value presented by EPA and BLM ranges from 2.3 to 289, and the aerobic soil metabolism half-life ranges from 132 to 275 days. In summary, the available data suggests no risks of concern for all but one route of exposure: runoff. This potential impact will be further addressed in the risk analysis section.

Table 11. Potential Effects Bromacil

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are likely to fish via runoff from terrestrial applications.

5.2.5 Clethodim

Clethodim is a selective postemergence herbicide used for the control of annual or perennial grass weeds. Formulations of clethodim are not specifically labeled for applications to forests but are used in forestry related applications including the control of grasses in tree farms, conifer nurseries, and conifer plantations as well as applications to rights-of-way, utility lines, fence lines, and several other non-crop sites.

The most common method of application for clethodim involves either directed foliar or ground broadcast foliar applications. Clethodim is also labeled for aerial applications. Clethodim is labeled for single application rates of about 0.1 to 0.25 lb AI/A. Based on current product labels, the maximum annual application rate for clethodim is 1.04 lb AI/A over a maximum of four applications.

According to BLM's ecological risk assessment (BLM 2014e), there is no basis for asserting that acute exposures of clethodim in surface water will directly impact fish. Following two applications, the highest RQ is 0.04. EPA's ecological risk assessment (EPA 2014a) similarly concluded that there was no acute risk LOC exceedances for either fish or aquatic invertebrates. Although no acute effects are anticipated, both BLM and EPA's assessments agree that there is the potential for chronic direct effects to fish for all uses of clethodim. EPA's assessment also indicates an indirect effect to aquatic invertebrates may be possible given the predicted impacts to fish and terrestrial plants.

According to EPA, the use of clethodim results in potential adverse effects to fish when exposed on a chronic basis to drift and runoff from areas treated with clethodim. Although clethodim is fairly non-persistent, it is mobile and is expected to occur in adjacent aquatic ecosystems. Also, the major toxic degradates of concern (clethodim sulfoxide and clethodim sulfone) are much more mobile and persistent than the parent. Thus, there is a possibility for exposure to the residues of concern (parent plus degradates) to non-target organisms from use of clethodim (EPA 2014a).

Because RQs exceeded the LOC for the chronic scenario, we continue below with a discussion of drift and runoff.

Exposure via drift

When calculating the chronic RQ, EPA made use of EECs generated using the PRZM model. One assumption of this model is that application is made directly adjacent to the aquatic environment. However, the project design criteria in this programmatic require buffers of 984 ft (300 m) for PULA-associated habitats, and either 25 or 100 ft buffers for habitats outside of the PULA. We used the AgDrift model to estimate peak concentrations in two receiving waterbodies: farm pond and bin 2 (see introduction for details). We used the maximum application rate of 0.25 lb AI/A, and all combinations of distance and application method.

Table 12. AgDrift estimates for clethodim (farm pond); concentrations in ppb

Application method	Distance (ft) from habitat		
	984	100	25
Air	0.16	0.71	NA
Ground - low	>0.01	0.04	0.06
Ground - high	0.01	0.06	0.10

AgDrift estimates are peak concentrations and are not appropriate from direct comparison to chronic response endpoints. However, it is notable that even peak EECs in the farm pond do not exceed EPA's 2.0 ug/L threshold for chronic risk to fish at any distance authorized.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 13. Clethodim EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	2.7	2.4	2.3
Aerial, 30.48 m	23.2	20.7	19.8
Ground, 300 m	0.1	0.1	0.1
Ground, 30.48 m	1.2	1.0	1.0
Ground, 7.62 m	4.8	4.3	4.1

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low.

Exposure via runoff

The BLM ecological risk assessment made use of the GLEAMS model to predict the loading of herbicide to aquatic habitats. EPA's ecological risk assessment made use of the PRZM model for this purpose. Both models assume the aquatic habitat is directly adjacent to the application area. As described above, the project design criteria require buffers of 25-984 ft. For clethodim, the aerobic soil metabolism of half-life ranges from 1.2 to 1.5 days. However, degradates of clethodim are considered to be moderately persistent. For the purpose of modeling, EPA assumed an aerobic soil metabolism half-life of 132 days. The mobility of clethodim also varies by degradate. For the purpose of modeling EPA chose a KOC of 44 (clethodim sulfoxide).

In summary, the available data suggests a risk of concern for chronic exposure to fish from exposures via drift and runoff. This potential impact will be further addressed in the risk analysis section.

Table 14. Potential Effects Clethodim

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.

Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are likely to fish via runoff and drift, but only when considering chronic exposures.

5.2.6 Clopyralid

Clopyralid is a selective, systemic herbicide used primarily in the control of broadleaf weeds and woody brush. It is a plant growth regulator and acts as a synthetic auxin or hormone, altering the plant's metabolism and growth characteristics and often causing a proliferation of abnormal growth that interferes with the transport of nutrients throughout the plant. Clopyralid is used for vegetation control in the BLM's Rangeland, Public-Domain Forestland, Energy and Mineral Sites, Rights-of-Way, and Recreation programs. Herbicide application is carried out through aerial and ground dispersal. Aerial applications are performed using airplanes and helicopters. Ground applications are executed on foot or on horseback with backpack sprayers or from all-terrain vehicles, utility vehicles, or trucks equipped with spot or boom/broadcast sprayers. The BLM typically applies clopyralid at 0.25 pounds (lbs) acid equivalent (a.e.) per acre (ac), with a maximum application rate of 0.5 lbs a.e. /A.

According to BLM's ecological risk assessment (BLM 2014b), when considering impacts due to direct spray, off-site drift, and runoff all of the RQs for acute and chronic fish and aquatic invertebrates were below LOCs. EPA's more recent ecological risk assessment and interim registration review decision (EPA 2018a, 2020c) similarly concluded that there are no risks of concern for freshwater or estuarine/marine fish (or the aquatic-phase amphibians for which freshwater fish serve as surrogates), freshwater or estuarine/marine invertebrates, or aquatic vascular and non-vascular plants.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 15. Clopyralid EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	5.5	5.5	5.5
Aerial, 30.48 m	46.4	46.4	46.4
Ground, 300 m	0.2	0.2	0.2
Ground, 30.48 m	2.4	2.4	2.4
Ground, 7.62 m	9.6	9.6	9.6

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low.

An updated literature search did not return any additional studies that would impact these conclusions. In summary, the available data for the RQ approach does not indicate a risk concern.

Therefore, the exposure and response analysis for this AI is concluded, to be further discussed in the risk analysis section.

Table 16. Potential Effects Clopyralid

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are not likely.

5.2.7 Dicamba

Dicamba is a systemic (i.e., absorbed through plant leaves and roots) benzoic acid used primarily to control annual, biennial, and perennial broadleaf weeds by mimicking auxins (a type of plant hormone) and causing abnormal cell growth. Dicamba is available in acid form as well as several salts which disassociate to the acid. Proposed application methods for dicamba include roadside hydraulic spraying, cut-surface treatments, and directed foliar treatments. Roadside hydraulic spraying is used primarily in rights-of-way management. Spray equipment mounted on tractors or trucks is used to apply the herbicide on either side of the roadway. Cut surface treatment methods involve creating a cut surface on the tree by either cutting the tree down or piercing the bark of a standing tree with a hatchet or an injector. The herbicide is then applied using a backpack sprayer, squirt bottle, or the injector itself. Direct applications of the herbicide to vegetation without cut surface pretreatment is conducted with an herbicide sprayer or container carried using a backpack. Aerial and broadcast foliar applications are not planned but are included in this risk assessment.

According to the USDA Forest Service ecological risk assessment (USDA 2004), RQs for aquatic animals are all under the acute and chronic LOCs. However the assessment notes that the risk characterization is limited by the available toxicity data. EPA's more recent ecological risk assessment (EPA 2022) similarly concluded that acute and chronic RQs for dicamba are < 0.01 for freshwater fish and chronic RQs are < 0.01 for estuarine/marine fish. One modeled scenario resulted in exceedance of the LOC: chronic exposure to the combination of DCSA and 6-CSA applied to Florida sugarcane. The endpoint used to calculate the RQ was a 5.5% decrease in weight. Risk to aquatic invertebrates was also described as low. Like USDA, EPA's assessment acknowledged certain data gaps. According to the assessment, acute RQs for dicamba were not calculated for estuarine-marine fish because of the non-definitive LC50 value; however, the tested estuarine-marine fish is at least six times less acutely sensitive than the most sensitive freshwater fish and the highest concentration tested with estuarine-marine fish is at least three orders of magnitude higher than EECs.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 17. Dicamba EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	21.8	20.4	20.2
Aerial, 30.48 m	186.0	173.5	171.8
Ground, 300 m	0.9	0.8	0.8
Ground, 30.48 m	9.4	8.8	8.7
Ground, 7.62 m	38.6	36.0	35.7

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low.

An updated literature review returned several recent studies on dicamba (Miller et al. 2020, Attademo et al. 2021, Felisbino et al. 2023). Attademo et al. (2021) observed 48 hour LC50 values of 859 ug/L and 221 ug/L for tadpole phase of frog species *Scinax nasicus* and *Elachistocleis bicolor*, respectively when exposed to a formulated product containing 20% dicamba. When compared to EECs generated in EPA's ecological risk assessment the *e. bicolor* data results in an exceedance of the LOC (assuming a simple 80% adjustment to the dicamba concentration). This study does not appear to have been considered in the existing ecological risk assessments.

Table 18. Potential Effects Dicamba

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects may occur when exposures occur on a chronic basis. Evidence of effects at concentrations lower than those considered in existing risk assessments appear to exist.

5.2.8 Diflufenzopyr

Diflufenzopyr, typically used together with dicamba, is a selective systematic herbicide used for the control of annual broad-leaf weeds post-emergence, the suppression or control of many perennial broad-leaf weeds, and the suppression of annual grasses. This chemical inhibits the transport of hormones (auxin) that regulate plant growth and development. Diflufenzopyr is a dry flowable that is mixed with water.

Diflufenzopyr is used by the BLM for vegetation control in their Energy and Mineral Sites, Rights-of-Way, and Recreation & Cultural Sites programs. Ground applications are executed on foot using backpack sprayers and from all terrain vehicles or trucks equipped with spot or boom/broadcast sprayers under the all three programs. The Recreation & Cultural Sites programs also use horseback

dispersion. The BLM typically applies diflufenzopyr (without dicamba) at 0.075 pounds (lbs) AI per acre (AI/A), with a maximum rate of 0.1 lbs AI/A.

According to BLM's ecological risk assessment (BLM 2005c), when considering impacts due to direct spray, off-site drift, and runoff all of the RQs for fish and aquatic invertebrates were below the LOCs. EPA's more recent ecological risk assessment and proposed interim registration review decision (EPA 2017d, 2018b) similarly found that RQs did not exceed the acute or chronic LOCs for either fish or aquatic invertebrates.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 19. Diflufenzopyr EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	1.2	1.1	1.0
Aerial, 30.48 m	9.9	9.0	8.7
Ground, 300 m	0.0	0.0	0.0
Ground, 30.48 m	0.5	0.5	0.4
Ground, 7.62 m	2.0	1.9	1.8

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low.

An updated literature search did not return any additional studies that would impact these conclusions. In summary, the available data for the RQ approach does not indicate a risk concern. Therefore, the exposure and response analysis for this AI is concluded, to be further discussed in the risk analysis section.

Table 20. Potential Effects Diflufenzopyr

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are not likely.

5.2.9 Diquat

Diquat is a nonselective contact herbicide for the control of broad-leaf aquatic weeds post-emergence. This herbicide is a cell membrane disrupter that is activated by exposure to sunlight to form oxygen compounds that damage cell membranes.

Diquat is used by the BLM for vegetation control in their Aquatics program. Application (to ponds but not streams) is carried out through both aerial and ground dispersal. Aerial dispersal is executed through the use of a plane or helicopter. Ground applications are executed on foot or horseback with backpack sprayers and from all terrain vehicles or trucks equipped with spot or boom/broadcast sprayers. The BLM typically applies diquat at a rate of 1.0 pounds (lbs) AI per acre (AI/A). The maximum application rate is 4.0 lbs AI/A.

According to the BLM ecological risk assessment (BLM 2005d) acute and chronic toxicity RQs for fish and aquatic invertebrates in the pond and stream were above the LOCs. EPA's more recent ecological risk assessment and interim registration review decision (EPA 2015c, 2019b) similarly concluded that the acute LOC is exceeded for freshwater fish following direct aquatic application of diquat. The chronic RQ for freshwater fish is very close to the chronic LOC for direct aquatic application. For the aquatic use, acute and chronic LOCs were exceeded for all types of aquatic invertebrates (freshwater, estuarine/marine, free swimming, benthic) of diquat.

Exposure via drift

The primary risk concern for diquat is aquatic applications directly to - or upstream of - listed species habitats. However, it is also possible for diquat to unintentionally drift into species habitat. For example, application targeted to a pond may drift into adjacent riverine habitats. We used the AgDrift model to estimate peak concentrations in farm pond. We used the maximum application rate of 4.0 lb AI/A/ft, and all combinations of distance (required buffers) and application method.

Table 21. AgDrift estimates for diquat (farm pond); concentrations in ppb.

Application method	Distance (ft) from habitat		
	984	100	25
Plane	2.53	11.3	NA
Ground - low	0.13	0.62	1.0
Ground - high	0.16	0.94	1.59

The toxicological thresholds chosen for aquatic animals were similar between the BLM assessment (BLM 2005d) and the more recent EPA assessment (EPA 2015c); EPA's thresholds will be referenced here as they represent more recent information. For fish, the acute and chronic thresholds are 0.75 and 0.17 mg/L, respectively. For aquatic invertebrates, the acute and chronic thresholds are 0.14 and 0.044 mg/L, respectively. An updated search of the open literature returned several more-recent studies relevant to fish and aquatic invertebrates (Reddy et al. 2018, Sesin et al. 2018, Wang et al. 2018, Jalil et al. 2019, McCuaig et al. 2020, Xiao et al. 2022). None of the findings for fish would impact the existing thresholds. For aquatic invertebrates, Reddy et al. (2018) observed decreased circulating concentrations of both testosterone and estradiol in pond snail (*Lymnaea palustris*) after chronic exposure to 0.003 mg/L diquat. Jalil et al. (2019) observed changes in the heart rate of the same test species at 0.028 mg/L. Both of these concentrations are below EPA's chronic threshold for aquatic invertebrates (0.052/0.104 NOEC/LOEC).

When comparing the AgDrift EECs to the acute thresholds for fish and aquatic invertebrates, only one scenario resulted in a RQ above 0.05; the invertebrate RQ for aerial applications at 100 ft was 0.08.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 22. Diquat EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	5.5	0.6	0.6
Aerial, 30.48 m	46.5	5.4	5.3
Ground, 300 m	0.2	0.0	0.0
Ground, 30.48 m	2.4	0.3	0.3
Ground, 7.62 m	9.7	1.1	1.1

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low.

Exposure via runoff

Due to the nature of the application method (aquatic) we do not anticipate runoff into non-targeted aquatic habitats be a significant route of exposure. Incidental deposition to terrestrial environments via spray drift may occur, which could subsequently runoff into adjacent habitats. However, diquat is considered to be immobile (KOC of 5,839) and thus has a reduced potential for runoff. When used as an aquatic herbicide, diquat dibromide is removed from the water column by adsorption to sediments, aquatic vegetation, and organic matter. Adsorbed diquat dibromide is both persistent and immobile (EPA 2015c). Due to its low BCF values, fish bioaccumulation is not likely to occur.

In summary, the available data suggests a risk of concern for acute and chronic exposure to fish and aquatic invertebrates. The primary route of exposure associated with risk is direct aquatic application.

Table 23. Potential Effects Diquat

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are likely to fish and aquatic invertebrates when aquatic applications are made outside the PULA, but still upstream of species or designated critical habitats.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are likely to fish and aquatic invertebrates when aquatic applications are made directly upstream of species or designated critical habitats.

5.2.10 Diuron

Diuron is a broad spectrum, pre- and post-emergent herbicide for use against broad-leaf weeds and annual grasses. This chemical disrupts photosynthesis by blocking electron transport and the transfer of light energy. Diuron is used by the BLM for vegetation control in their Energy & Mineral Sites, Rights-of-Way, and Recreation programs. Ground applications are executed on foot or horseback with backpack sprayers or from all-terrain vehicles or trucks equipped with spot or boom/broadcast sprayers. The application rate of diuron is typically 6.0 pounds (lbs) AI per acre (AI/A), with a maximum rate of 12.0 lbs AI/A (Rights-of-Way).

According to the BLM ecological risk assessment (BLM 2005e), when considering impacts due to direct spray, RQs exceeded the LOCs for fish and aquatic invertebrates (acute and chronic). For off-site drift RQs exceeded for several – but not all – LOCs. For example, the RQ associated with applications within 25 ft of habitat exceeded the acute LOC. Similarly, the RQs associated with pesticide runoff scenarios often exceeded the acute and chronic LOCs for both fish and aquatic invertebrates.

At the time the BLM assessment was conducted the maximum application rate was 20 lbs. AI/A. The maximum application rate was subsequently reduced to 12 lbs AI/A. EPA's more recent ecological risk assessment (EPA 2020d) has calculated RQs based on the current 12 lbs AI/A maximum. According to EPA's 2020 assessment, RQs exceed the acute and chronic LOC for both fish and aquatic invertebrates.

In 2003, EPA initiated formal consultation with NMFS on the effects of diuron and other pesticides on Pacific salmonids through the transmittal of a final Biological Evaluation. In its 2011 salmonid biological opinion (NMFS 2011b), NMFS concluded that diuron is not likely to jeopardize the continued existence of any listed salmonid but is likely to adversely modify the designated critical habitat of some listed salmonids. In the 2011 salmonid biological opinion an RPA was prescribed in order for EPA to insure their proposed action was no longer likely to jeopardize ESA-listed salmonids. The RPA included the following elements:

- Do not apply when wind speeds are below two mph or exceed 10 mph, except when winds in excess of 10 mph will carry drift away from salmonid-bearing waters.
- Do not apply when soil is saturated, or when a precipitation event, likely to produce direct runoff to salmonid bearing waters from the treated area, is forecasted by NOAA/NWS (National Weather Service) or other similar forecasting service within 48 h following application.

The biological opinion also specified several additional elements when applying within designated critical habitat. These measures are not applicable for this programmatic consultation because applications are prohibited near designated critical habitat i.e. within the PULA.

Exposure via drift

EPA modeled likely surface water concentrations of dicamba acid and its major degradate DCSA using PWC (v1.5.2) coupled with the standard pond scenario. One assumption of this model is that application is made directly adjacent to the aquatic environment. However, the project design criteria in this programmatic requires buffers of 984 ft (300 m) for PULA-associated habitats, and either 25 or 100 ft buffers for habitats outside of the PULA. We used the AgDrift model to estimate peak concentrations in the farm pond that took into consideration the buffer distances. We used the maximum application rate of 12 lb AI/A, and all combinations of distance and application method.

Table 24. AgDrift estimates for diuron (farm pond); concentrations in ppb.

Application method	Distance (ft) from habitat		
	984	100	25
Plane	7.58	33.83	NA
Ground - low	0.38	1.85	3.02
Ground - high	0.47	2.82	4.77

We calculated acute RQs with these new EECs for both fish and aquatic invertebrates. When considering buffers, none of the fish scenarios resulted in an LOC exceedance. The only RQ that exceeded 0.05 was that representing aerial applications with a 100 ft buffer and invertebrates.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 25. Diuron EECs (ppb) in small volume waterbodies

Scenario	**Instantaneous**	**1-day**	**4-day**
Aerial, 300 m	131.1	39.9	38.9
Aerial, 30.48 m	1115.9	339.4	331.3
Ground, 300 m	5.2	1.6	1.5
Ground, 30.48 m	56.7	17.2	16.8
Ground, 7.62 m	231.7	70.5	68.8

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk is limited to aquatic habitats outside of the PULA, where the buffers are reduced to 100 ft and 25 ft for aerial and ground applications, respectively.

Exposure via runoff

The BLM ecological risk assessment (BLM 2005e), used the GLEAMS model to estimate the proportion of applied dicamba lost by runoff. In soils with the highest runoff potential, up to 3.5% of the applied amount moved offsite. In EPA's ecological risk assessment (EPA 2020d), runoff was built into the PWC model, which was used to generate aquatic EECs. In both cases the models assumed application directly adjacent to the receiving waterbody. As described above, this programmatic requires buffers of 984 ft (300 m) for PULA-associated habitats, and either 25 or 100 ft buffers for habitats outside of the PULA.

Table 26. Potential Effects Diuron

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects to aquatic invertebrates are likely via drift and runoff, when applications are made within 100 ft of aquatic habitats.

5.2.11 Fluazifop-P-butyl

Fluazifop-p-butyl is a selective, post-emergent, and systemic herbicide used to control perennial and annual grass weeds with nominal effect on broad-leaved plants (dicots). The herbicide is rapidly absorbed through leaf surfaces, abiotically hydrolyzes within the plant tissue to fluazifop-acid and is transported in phloem where it accumulates in the meristems. The herbicide may be applied as a ground or aerial spray, and in irrigation systems. Fluazifop-p-butyl is rapidly (less than one day) degraded in soil to fluazifop-acid, which is much more stable in soil and water environments than the parent.

According to the USDA ecological risk assessment (USDA 2014), exposure scenarios involving fish do not appear to present a risk (except for those representing accidental spills). BLM's assessment indicates that upper bound estimates do, however, exceed the LOC for aquatic invertebrates. EPA's more recent ecological risk assessment (EPA 2019c, 2020e) was more conclusive, stating that no potential risks of concern were identified to aquatic taxa (fish, aquatic-phase amphibians, aquatic invertebrates, or aquatic vascular and non-vascular plants) from registered uses of fluazifop.

Peak EECs in the USDA assessment range from 3.42 ug/L to 16.2 ug/L; EECs are similar in EPA's assessment, ranging from 11.7 ug/L to 26.3 ug/L. The acute fish LC50s range from 250 ug/L (Nile tilapia) to 1200 ug/L (Rainbow trout). For aquatic invertebrates, the acute LC50s range from 83 ug/L (Pacific oyster) to 473,000 ug/L (*Daphnia magna*). Comparing data across the ecological risk assessments suggests a potential risk to saltwater, but not freshwater invertebrates.

Exposure via drift

USDA and EPA modeled surface water concentrations with GLEAMS and PWC, respectively. Both models assume that application is made directly adjacent to the aquatic environment. However, the project design criteria in this programmatic require buffers of 984 ft (300 m) for PULA-associated habitats, and either 25 or 100 ft buffers for habitats outside of the PULA. We used the AgDrift model to estimate peak concentrations in the farm pond that took into consideration the buffer distances. We used the maximum application rate of 0.425 lb AI/A, and all combinations of distance and application method.

Table 27. AgDrift estimates for fluazifop-P-butyl (farm pond); concentrations in ppb.

Application method	Distance (ft) from habitat

	984	100	25
Plane	0.27	1.20	NA
Ground - low	0.01	0.07	0.10
Ground - high	0.02	0.10	0.20

We calculated acute RQs with these new EECs for both fish and aquatic invertebrates. When considering buffers, none of the fish or invertebrate scenarios resulted in an LOC exceedance.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 28. Fluazifop-P-butyl EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	2.7	2.1	2.1
Aerial, 30.48 m	23.2	18.2	18.0
Ground, 300 m	0.1	0.1	0.1
Ground, 30.48 m	1.2	0.9	0.9
Ground, 7.62 m	4.8	3.8	3.7

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low.

Exposure via runoff

Fluazifop-p-butyl rapidly degrades in aerobic soil (both laboratory soil and field dissipation studies) to fluazifop-acid. Measured KF values for fluazifop-p-acid ranged from 0.27 to 13.4 L/kg and KOC values of 25.93 – 310.8 across various soils, indicating that fluazifop-p-acid is mobile to moderately mobile. As described above, this programmatic require buffers of 984 ft (300 m) for PULA-associated habitats, and either 25 or 100 ft buffers for habitats outside of the PULA. In most cases, 300 m represents a point at which the potential for transport via sheet or channelized flow can be considered minimal. Exposure via runoff resulting from applications within 100 ft is possible.

Table 29. Potential Effects fluazifop-P-butyl

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects to aquatic invertebrates may occur via runoff, when applications are made within 100 ft of aquatic habitats.

5.2.12 Flumioxazin

Flumioxazin is a light-dependent, peroxidizing N-phenylphthalimide herbicide used for pre- and post-emergence control of terrestrial and aquatic weeds. The herbicidal mechanism of flumioxazin

is inhibition of protoporphyrin oxidase (PPO), the enzyme responsible for converting protoporphyrinogen IX to protoporphyrin IX. In plants, inhibition of PPO results in accumulation of phototoxic porphyrins in plant cells and decreased heme synthesis and chlorophyll biosynthesis.

The currently registered labels allow the use of flumioxazin under the terrestrial, aquatic, forestry, and indoor use groups. The labeled single maximum application rate ranges from 0.0478 lbs. AI/A to 0.3875 lbs. AI/A and the maximum yearly application rate from 0.0478 lbs. AI/A (one application) to 0.775 lbs. AI/A (two applications). Flumioxazin is registered for control of aquatic weeds in bayous, canals, drainage ditches, lakes, marshes, ponds (including golf course ponds), and reservoirs throughout the U.S as a water dispersible granule containing 51% AI. Surface or subsurface application methods may be used for application. Applications to intertidal or estuarine areas are prohibited.

The USDA ecological risk assessment for aquatic species (USDA 2020a) indicates no risks of adverse effects are anticipated for acute exposure to fish. For chronic exposure, toxicity is likely to occur at higher exposures for all application methods (including aquatic). For invertebrates, both acute and chronic toxicity is likely following aquatic applications, but not via terrestrial applications.

EPA has also recently published an ecological risk assessment (EPA 2018c) and an interim registration review decision (EPA 2021b) on flumioxazin. For terrestrial applications, acute RQs for freshwater fish were all below the LOC. While flumioxazin was determined to be moderately toxic to freshwater fish, acute risk is expected to be low. The risk profile to fish is confined to chronic exposure from a limited number of uses (2 of the 40 scenarios modeled). Similar findings were reported for aquatic invertebrates; only chronic exposures resulted in LOC exceedances. For aquatic applications, there was chronic risk to both freshwater and estuarine and marine fish from direct applications to water. Chronic RQs for freshwater fish ranged from 86 to 126 depending on the endpoint used. No acute risk to fish was identified. Acute risk was identified for estuarine/marine invertebrates but not freshwater invertebrates. Chronic risk was identified for both freshwater and estuarine / marine invertebrates with RQS of 1.3 and 2.4 respectively.

Flumioxazin is relatively unstable to hydrolysis, especially in neutral/alkaline media (half-lives = one to <1 day at pH 7/9 compared to 4.2 days at pH 5). Flumioxazin photodegrades very rapidly in water and on soil (half-lives = one and 5.8 days, respectively). Given the rapid degradation, the extent to which chronic exposures would occur is more uncertain. At the same time, flumioxazin is known to have a photo-toxic mode of action in plants and possibly in fish. In a chronic ELS study under both standard and UV light, rainbow trout were more than ten times more sensitive to flumioxazin under UV light than under standard lighting.

Exposure via drift

USDA and EPA modeled surface water concentrations with GLEAMS and PWC, respectively. Both models assume that application is made directly adjacent to the aquatic environment. However, the project design criteria in this programmatic require buffers of 984 ft (300 m) for

PULA-associated habitats, and either 25 or 100 ft buffers for habitats outside of the PULA. We used the AgDrift model to estimate peak concentrations in the farm pond that took into consideration the buffer distances. We used the maximum application rate of 0.3875 lb AI/A, and all combinations of distance and application method.

Table 30. AgDrift estimates for flumioxazin (farm pond); concentrations in ppb, along with estimates of the associated (21-day and 60-day) concentrations.

Application method	Distance (ft) from habitat		
	984	100	25
Plane	0.24 (0.03/0.01)	1.10 (0.13/0.05)	NA
Ground - low	0.01 (<0.01)	0.06 (<0.01)	0.10 (<0.01)
Ground - high	0.02 (<0.01)	0.09 (<0.01)	0.15 (<0.01)

AgDrift estimates are peak concentrations and are not appropriate from direct comparison to chronic response endpoints. In order to consider fate properties, the 1-day, 21-day, and 60-day EECs from EPA's ecological risk assessment were compared. 1:21-day and 1-60-day ratios were calculated. These rough estimates result in RQ values that are below the chronic LOC.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 31. Flumioxazin EECs (ppb) in small volume waterbodies

Scenario	**Instantaneous**	**1-day**	**4-day**
Aerial, 300 m	4.2	1.7	0.8
Aerial, 30.48 m	35.3	14.2	6.6
Ground, 300 m	0.2	0.1	0.0
Ground, 30.48 m	1.8	0.7	0.3
Ground, 7.62 m	7.3	2.9	1.4

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low.

Exposure via runoff

Fluazifop-p-butyl rapidly degrades in aerobic soil (both laboratory soil and field dissipation studies) to fluazifop-acid. Measured KF values for fluazifop-p-acid ranged from 0.27 to 13.4 L/kg and KOC values of 25.93 – 310.8 across various soils, indicating that fluazifop-p-acid is mobile to moderately mobile. As described above, this programmatic require buffers of 984 ft (300 m) for PULA-associated habitats, and either 25 or 100 ft buffers for habitats outside of the PULA. In most cases, 300 m represents a point at which the potential for transport via sheet or channelized flow can be considered minimal. Exposure via runoff resulting from applications within 100 ft is possible.

Table 32. Potential Effects Flumioxazin

Location	**Potential impact**

PULA Associated (Aquatic buffer: 300 m)	Adverse effects are likely to fish and aquatic invertebrates when aquatic applications are made directly upstream of species or designated critical habitats.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are likely to fish and aquatic invertebrates when aquatic applications are made directly upstream of species or designated critical habitats.

5.2.13 Fluridone

Fluridone is a selective systemic herbicide that inhibits carotene production in leaves, which causes the breakdown of chlorophyll—preventing the plant from synthesizing food. This herbicide comes in two formulations: liquid and pellet. Fluridone is used by the BLM for vegetation control in their Aquatic program. Application is carried out through both aerial and ground dispersal. Aerial dispersal is executed through the use of a plane or helicopter. Ground applications are executed on foot or horseback with backpack sprayers, or from all-terrain vehicles or trucks equipped with spot or boom/broadcast sprayers. The lowest typical application of fluridone is 0.15 pounds (lbs) AI per acre (AI/A). The maximum application rate is 1.3 lbs AI/A. For the aquatic uses of fluridone, the concentrations of fluridone can be applied up to 90 ppb in ponds and 150 ppb in lakes, reservoirs, and static canals per annual growth cycle.

The BLM ecological risk assessment (BLM 2005f) found that only one exposure scenario – acute RQ for aquatic invertebrates – exceeded the LOC. BLM also stated that there were LOC exceedances associated with direct spray to streams. This exposure scenario does not represent the aquatic use; instead the direct spray scenario represents illegal or accidental spray. EPA's more recent ecological risk assessment (EPA 2017a, 2018d) arrived at similar conclusions. According to EPA, neither acute nor chronic risk LOCs are exceeded for freshwater or estuarine/marine fish for the use of fluridone in aquatic or terrestrial site evaluated. There are acute risk LOC exceedances for listed freshwater non-benthic invertebrates for the aquatic use of fluridone at the maximum rates; otherwise, no other LOCs, acute or chronic were exceeded, for any estuarine/marine non-benthic invertebrates for any fluridone use (aquatic or terrestrial).

Table 33. Potential Effects Fluridone

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are likely to aquatic invertebrates when aquatic applications are made directly upstream of species or designated critical habitats.

5.2.14 Fluroxypyr

Fluroxypyr is a selective post-emergent systemic herbicide for the control of broadleaf weeds. The fluroxypyr mode of action is to mimic the auxin plant growth hormone indoleacetic acid, causing uncontrolled growth in the targeted plant. This stress eventually leads to the death of the plant. Fluroxypyr is used by the BLM for vegetation control for its Rangeland, Public-Domain Forestland, Energy and Mineral Sites, Rights-of-Way (ROW), and Recreation programs. Herbicide application is carried out through aerial and ground dispersal. Aerial applications are conducted using airplanes and helicopters. Ground applications are conducted on foot or on horseback with backpack sprayers or from all-terrain vehicles, utility vehicles, or trucks equipped with spot or boom/broadcast sprayers. Ground applications at energy and mineral sites, along ROW, and at recreation areas are solely carried out using all-terrain vehicles or trucks equipped with spot or boom/broadcast sprayers. The BLM would typically apply fluroxypyr at 0.26 pounds (lbs.) acid equivalent (a.e.) per acre (ac), with a maximum application rate of 0.5 lbs. a.e. /A.

BLM's ecological risk assessment (BLM 2014c) demonstrated that all RQs for fish and aquatic invertebrates were below both the acute and chronic LOCs. This conclusion took into consideration direct spray, off-site drift, and runoff routes of exposure. EPA's more recent ecological risk assessment (EPA 2018e) and interim registration review decision (EPA 2020f). These assessments similarly found that none of the RQs exceeded the acute or chronic LOCs for fish or aquatic invertebrates.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 34. Fluroxypyr EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	7.9	6.9	6.9
Aerial, 30.48 m	67.0	58.9	58.7
Ground, 300 m	0.3	0.3	0.3
Ground, 30.48 m	3.4	3.0	3.0
Ground, 7.62 m	13.9	12.2	12.2

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low.

In summary, the available data for the RQ approach does not indicate a risk concern. Therefore, the exposure and response analysis for this AI is concluded, to be further discussed in the risk analysis section.

Table 35. Potential Effects Fluroxypyr

Location	Potential impact
PULA Associated	Adverse effects are not likely.

(Aquatic buffer: 300 m)	
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are not likely.

5.2.15 Glyphosate

Glyphosate is an herbicide belonging to the phosphono amino acid class of pesticides. Glyphosate formulations may be applied by directed foliar, ground broadcast foliar, or aerial. In directed foliar applications, the herbicide sprayer or container is carried by backpack and the herbicide is applied to selected target vegetation. Broadcast foliar ground applications, which may be conducted occasionally, involve the use of a boom mounted on a tractor or other heavy duty vehicle. The other method of application is an aquatic application for aquatic noxious weeds.

The USDA ecological risk assessment (USDA 2011a) reported fish LOC exceedances for acute exposures, but not chronic. Similarly for aquatic invertebrates, LOCs were exceeded only in the acute exposure scenarios. EPA's more recent ecological risk assessment (EPA 2015d, 2020g) arrived at similar conclusions. When considering effects from the AI alone, there were no LOC exceedances (acute or chronic) for fish or aquatic invertebrates. However, when considering formulations which contain Polyoxyethylene tallow amine (POEA) (not present in aquatic applications), the acute fish LOC was exceeded with aerial, but not ground) applications of 8lb per acre. For aquatic applications, neither acute nor chronic LOCs are exceeded for fish or invertebrates.

Table 36. Toxicological endpoint data reported in EPA's 2021 BE, ecological risk assessment and USDA ecological risk assessment.

Endpoint	EPA ERA	EPA BE	USDA
FW Fish Acute	43,000 ug/L 96-hr LC50 44320630 (1995)	1,000 ug/L 4-day TEP (30%) MRID 40098001	960 ug/L to 10,000 ug/L (Folmar et al. 1979) (Wan et al. 1989)
E/M Fish Acute	240,000 ug/L 96-hr LC50 44320623 (1996)	2,700 ug/L 4-day TEP (30.75%) MRID 48934205	
FW Fish Chronic	25,700 ug/L NOAEC 00108171 (1975)	704 ug/L LOAEC 90-day growth E1618033	According to USDA, because of the lack of any substantial duration-response relationship, acute values are referenced
E/M Fish Chronic	88,900 ug/L (calculated acute-to-chronic ratio)	704 ug/L LOAEC 90-day growth Same as FW fish chronic	
FW Invert Acute	53,200 ug/L 48-hr EC50 00162296 (1979)	8.7 ug/L LC50 1-day TEP (1%)	2,200 ug/L to 44,800 ug/L

		E178782	See Appendix 8; table 2 for citations
E/M Invert Acute	40,000 ug/L 48-hr EC50 44320634	765 ug/L LC50 4-day TEP MRID 48934292	
FW Invert Chronic	9,220 ug/L (calculated acute-to-chronic ratio)	576,000 ug/L MATC 55-day TGAI E161204	According to USDA, because of the lack of any substantial duration-response relationship, acute values are referenced
E/M Invert Chronic	6,110 ug/L (calculate acute-to-chronic ratio)	4,070,000 ug/L 1-day LOAEC E161498	

As with the toxicological data, a wide range of exposure values have been generated across the ecological risk assessments (Table 36). EPA's 2021 BE reported "Bin 1" (similar to farm pond) EECs ranging from 4.71 ug/L to 1,380 ug/L. In EPA (2015d), aerial and ground applications range from 49.3 ug/L to 264.4 ug/L (peak) and 23.1 ug/L to 185.2 ug/L (chronic). EPA estimated aquatic applications as resulting in peak concentrations of 103.8 ug/L to 221.5 ug/L (peak) and 98.4 ug/L to 217.5 ug/L (chronic) In USDA (2011a) EECs are reported as ranging from 0 to 83 ug/L (peak) and 0 to 4.5 ug/L (chronic). USDA estimates associated with aquatic applications ranged from 37 ug/L to 184 ug/L (peak) and 2.4 ug/L to 105 ug/L (chronic). Taken as a whole, the available data suggests that applications to both aquatic and terrestrial environments are associated with acute and chronic risk to fish, and acute risk to invertebrates.

Exposure via drift

USDA and EPA modeled surface water concentrations with GLEAMS and PWC, respectively. Both models assume that application is made directly adjacent to the aquatic environment. However, the project design criteria in this programmatic require buffers of 984 ft (300 m) for PULA-associated habitats, and either 25 or 100 ft buffers for habitats outside of the PULA. We used the AgDrift model to estimate peak concentrations in the farm pond that took into consideration the buffer distances. We used the maximum application rate of 0.38 lb/A for rangeland, 8 lb are for pastures, and all combinations of distance and application method.

Table 37. AgDrift estimates for glyphosate (farm pond) for application rates of 0.38lb/A and 8lb/A (#/#); concentrations in ppb.

Application method	Distance (ft) from habitat		
	984	100	25
Plane	0.24/5.10	1.10/22.53	NA
Ground - low	0.01/0.25	0.06/1.24	0.10/2.01
Ground - high	0.01/0.31	0.09/1.88	0.15/3.18

We calculated acute RQs with these new EECs for both fish and aquatic invertebrates. When considering buffers, the only scenarios that indicate risk are those that reference EPA's freshwater acute invertebrate threshold of 8.7 ug/L.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 38. Glyphosate EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	87.4	87.4	87.4
Aerial, 30.48 m	744.0	744.0	744.0
Ground, 300 m	3.5	3.5	3.5
Ground, 30.48 m	37.8	37.8	37.8
Ground, 7.62 m	154.5	154.5	154.5

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk is limited to aquatic habitats outside of the PULA, where the buffers are reduced to 100 ft and 25 ft for aerial and ground applications, respectively.

Exposure via runoff

Glyphosate adsorbs strongly to soils and sediments. Based on its strong adsorption to soil/sediments alone, leaching to ground water or entering surface water dissolved in runoff would be minimized. However, surface water can be contaminated by transport of suspended soil particulates, followed by desorption from the soil particulates and/or from sediments. As described above, this programmatic requires buffers of 984 ft (300 m) for PULA-associated habitats, and either 25 or 100 ft buffers for habitats outside of the PULA. In most cases, 300 m represents a point at which the potential for transport via sheet or channelized flow can be considered minimal.

Table 39. Potential Effects Glyphosate

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Potential for adverse effects to aquatic invertebrates via drift. In general, adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are likely to fish and aquatic invertebrates via runoff and drift from terrestrial applications, as well as resulting from aquatic applications.

5.2.16 Hexazinone

Hexazinone is a systemic herbicide for weed control in forestry site preparation and release areas, reforestation areas, rangeland, pastures and other non-crop areas. The herbicide belongs to the triazinone chemical family. Hexazinone products are formulated as pellets/tablets, emulsifiable concentrates, soluble concentrates/solids and a technical grade AI. Products are applied using aerial or ground equipment, by hand, or using a hand-held, boom, knapsack or power sprayer.

The USDA ecological risk assessment (USDA 2005a) concluded that there is no indication that hexazinone, when used according to the label, will cause direct toxic effects in fish. RQs do not

exceed either the acute or chronic LOCs. The risk characterization for aquatic invertebrates is virtually identical to that for fish. None of the hazard quotients for non-accidental exposures exceed a level of concern based on either peak or longer-term concentrations of hexazinone. EPA's more recent ecological risk assessment (EPA 2015e) and interim registration review decision (EPA 2017b) arrived at a similar conclusion: the potential for acute or chronic risk to freshwater fish, freshwater invertebrates and estuarine/marine invertebrates is considered low for flowable and granular uses, as acute and chronic RQ values do not exceed the risk to listed or non-listed species LOC.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 40. Hexazinone EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	43.7	43.7	43.7
Aerial, 30.48 m	372.0	372.0	372.0
Ground, 300 m	1.7	1.7	1.7
Ground, 30.48 m	18.9	18.9	18.9
Ground, 7.62 m	77.2	77.2	77.2

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low.

Table 41. Potential Effects Hexazinone

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are not likely.

5.2.17 Imazamox, Imazapic & Imazapyr

Imazamox, imazapic and imazapyr are all systemic imidazolinone herbicides. All of the imidazolinone herbicides share a common mechanism of herbicidal action which involves the inhibition of acetolactate synthase (ALS). ALS is an enzyme found in plants and required for the synthesis of essential branched chain amino acids. Animals do not synthesize these amino acids via this pathway; therefore, imidazolinone herbicides generally exhibit very little toxicity to mammals, birds, fish, or insects.

Imazamox is labeled for ground broadcast applications as well as aerial broadcast applications using either fixed wing aircraft or helicopters. Imazamox is also labeled for aquatic applications. Imazapic

is used for vegetation control in the BLM's Rangeland, Public-Domain Forest Land, Oil & Gas Site, Rights-of-Way, and Recreation & Cultural Areas programs. Application is carried out through both aerial and ground dispersal. Aerial dispersal is executed through the use of a plane or helicopter. Ground applications take place on foot or horseback with backpack sprayers or from all terrain vehicles or trucks equipped with spot or boom/broadcast sprayers. Imazapyr is currently registered for use in terrestrial (railroads and industrial right-of-ways, fencerows, wildlife habitats and forests) and aquatic (ponds, lakes, reservoirs, marshes, bayous, canals, streams, rivers, and water drainage systems) non-crop sites and for corn fields. Aqueous imazapyr formulations may be mixed with surfactants or oils for application, as well as mixed with other herbicides and fertilizers.

Imazamox

According to the USDA ecological risk assessment (USDA 2010b), a limitation to assessing the risk of imazamox is the inability to define toxicity values due to lack of data. According to the three acute toxicity studies in fish, no mortality or signs of toxicity were observed at concentrations ranging from 89.2 mg a.e./L in sheepshead minnow (Olivieri et al. 1998a) to 115 mg a.e./L in rainbow trout (Yurk and Wisk 1994b). While limited, the available toxicity data on fish suggest that imazamox concentrations in surface water are unlikely to have an adverse effect on fish or aquatic invertebrates. EPA's more recent ecological risk assessment (EPA 2014b) similarly concluded that imazamox is practically non-toxic to fish and aquatic invertebrates on the basis that none of the submitted studies have reported adverse effects.

An updated literature search returned several additional studies. Jin et al. (2018) exposed adult Delta Smelt (*Hypomesus transpacificus*) to imazamox (99% purity) for six hours. A significant reduction in brain AChE was observed at 11 ug/L. GOC RASGELE et al. (2022) exposed adult zebrafish (Danio rerio) to imazamox concentrations from 300 ug/L to 12,000 ug/L for 24, 48, 72 and 96 hours. Genotoxic effects (increase in micronuclei) were observed at 300 ug/L after 24 hours of exposure. All fish died after 24 hours at 12,000 ug/L. Stillway and Teh (2020) exposed the copepod *Eurytemora affinis* to herbicide formulations Clearcast (12.1% imazamox) for 96-hours. Authors report a NOEC/LOEC of 100,000 ug/L/140,000 ug/L and an IC50 of >220,000 ug/L. With the addition of Agri-dex the NOEC/LOEC decreased to 7,000 ug/L/40,000 ug/L with a new IC50 of 67,600 ug/L. Di Marzio et al. (2018) exposed two copepod species (*Eucyclops serrulatus* and *Diacyclops Belgicus*) individually, and then in binary mixtures of imazamox (3.7% formulation) and nitrogen fertilizer for 96-hours. For *E. serrulatus*, the imazamox LC50 was 54,970 ug/L, for D. Belgicus, the LC50 was 16,190 ug/L. Binary mixtures with ammonium indicated a potential for synergistic effects. Di Lorenzo et al. (2014) exposed copepods *Eucyclops serrualtus* and *Diacyclops Belgicus* to imazamox (3.7% formulation) for 96-hours. LC50s for the two copepods were 232,440 ug/L and 199,230 ug/L respectively. Exposure estimates in the USDA risk assessment range from 0 to 109 ug/L. Based on these data there is no reason to depart from the previous conclusion of low risk.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 42. Imazamox EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	10.9	10.9	10.9
Aerial, 30.48 m	93.0	93.0	93.0
Ground, 300 m	0.4	0.4	0.4
Ground, 30.48 m	4.7	4.7	4.7
Ground, 7.62 m	19.3	19.3	19.3

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low.

Table 43. Potential Effects Imazamox

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are not likely.

Imazapic

According to the BLM ecological risk assessment (BLM 2005g) there were no chronic or acute LOC exceedances for fish exposed to imazapic. Acute risk was not predicted for aquatic invertebrates, but chronic risk was predicted under a single direct spray scenario at the maximum application rate. EPA's more recent ecological risk assessment (EPA 2014c) states that technical grade imazapic is classified as practically non-toxic to freshwater and saltwater fish and aquatic invertebrates on an acute exposure basis. No effects were seen in chronic aquatic studies conducted with freshwater fish and invertebrates. Chronic exposure effect data for saltwater fish and invertebrates are not available.

An updated literature search returned several additional studies. Golombieski et al. (2016) exposed juvenile silver catfish (*Rhamdia quelen*) to combinations of imazapyr and imazapic for 24 and 96 hours. Numerous biochemical responses (e.g. red blood cell count, cortisol, plasma bactericidal activity) were observed at 4.88 ug/L formulated product. Rubira et al. (2023) exposed juvenile tilapia to imazapic for 24 and 96 hours and observed impacts to cellular lipid membrane structure and function at 9 ug/L imazapic. Moraes et al. (2011) exposed *Cyprinus carpio* to imazapic for 7, 30, and 90-days. The authors observed changes in AChE activity (increases and decreases) at 3.14 ug/L. It is uncertain whether these effects would translate to fitness-level effects at these concentrations.

Study results for both coldwater and warmwater fish species failed to demonstrate adverse effects to imazapic concentrations of 100 mg/L. In acute toxicity tests, the 96-hour LC50 values for rainbow trout (*Oncorhynchus mykiss*), bluegill sunfish (*Lepomis macrochirus*), and channel catfish (*Ictalurus punctatus*) were greater than 100 mg/L (USEPA 2003; MRID 42711434 and 42711435; Yurk et al 1992 as cited in SERA 2001). Chronic exposure of fathead minnow eggs and larvae for 32 days also failed to show adverse effects at imazapic concentrations of 96 mg/L using a 97% imazapic product (USEPA 2003; MRID 44728202).

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 44. Imazapic EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	2.2	0.6	0.2
Aerial, 30.48 m	18.5	4.8	1.3
Ground, 300 m	0.1	0.0	0.0
Ground, 30.48 m	0.9	0.2	0.1
Ground, 7.62 m	3.8	1.0	0.3

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low.

Table 45. Potential Effects Imazapic

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are not likely.

Imazapyr

The USDA ecological risk assessment (USDA 2011b) took into consideration the AI imazapyr as well as a formulation (Arsenal) which was found to be more toxic to fish and aquatic invertebrates. Despite the greater toxicity, USDA found there were no acute nor chronic LOC exceedances for either fish or aquatic invertebrates. EPA's most recent review of imazapyr (EPA 2014d, 2015a) found that there were no significant changes from the Agency's previous review in 2005 (DP Barcode: D313607). The assessment indicated minimal risk of acute effects to fish and aquatic invertebrates and minimal risks to aquatic non-vascular plants at maximum application rates. In addition, there were no chronic risks to fish and invertebrates, although there was an uncertainty for estuarine/marine fish and invertebrates, since no toxicity data were available.

An updated literature search returned several studies. Yahnke et al. (2013) exposed juvenile Oregon spotted frog (*Rana pretiosa*) to a tank mix containing imazapyr product Polaris AQ (28.7% AI), and surfactant Agri-dex. Frogs were exposed to Imazapyr concentrations of 4.8 mg/L and 9.7 mg/L for 96 hours. No effects were observed at either exposure concentration. Golombieski et al. (2016) exposed juvenile silver catfish (*Rhamdia quelen*) to combinations of imazapyr and imazapic for 24 and 96 hours. Numerous biochemical responses (e.g. red blood cell count, cortisol, plasma bactericidal activity) were observed at 4.88 ug/L formulated product. It is uncertain whether these effects would translate to fitness-level effects at these concentrations. Cruz et al. (2015) exposed several fish species to imazapyr. The authors reported the following 96 hour LC50s: 3.9 mg/L for red tetra fish (*Hyphessobrycon eques*); 5.3 mg/L for guaru (*Phallocerus caudimaculatus*; 8.1 mg/L for pacu (*Piaractus mesopotamicus*); 4.3 mg/L for Zebrafish (*Brachydanio rerio*); and 5.8 mg/L for snail (*Pomacea canaliculata*). Several of these endpoints are lower than those reported in the USDA and EPA ecological risk assessments. However, comparisons of these data to the EECs reported in the EPA and USDA ecological risk assessments result in RQ values all below the LOC.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 46. Imazapyr EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	16.4	16.4	16.4
Aerial, 30.48 m	139.5	139.5	139.5
Ground, 300 m	0.7	0.7	0.7
Ground, 30.48 m	7.1	7.1	7.1
Ground, 7.62 m	29.0	29.0	29.0

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low.

Table 47. Potential Effects Imazapyr

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are not likely.

5.2.18 Indaziflam

Indaziflam is a selective herbicide providing pre-emergence and post-emergence (when indaziflam is formulated with 2,4-D or dicamba) control of annual grasses and broadleaf weeds. Indaziflam

controls weeds by inhibiting cellulose biosynthesis (CB Inhibitor). Indaziflam is registered for uses associated with the management of vegetation in areas such as roadsides, utility corridors, hardscapes, and conifer and hardwood production areas, as well as for the release or restoration of desirable vegetation in wildlife management areas, recreational areas, fire rehabilitation areas, natural areas, prairies, non-crop areas, grasslands, and fire breaks. Indaziflam may be applied through a variety of application methods ranging from broadcast equipment (aerial and ground) to hand held equipment.

According to the USDA ecological risk assessment (USDA 2020b), none of the RQs for non-accidental acute or chronic exposures exceed the LOCs for either fish or aquatic invertebrates. However, EPA's ecological risk assessment (EPA 2020h) reported acute LOC exceedances for freshwater fish. There were no LOC exceedances for estuarine/marine fish or aquatic invertebrates.

An updated literature search returned one relevant study. Tissot et al. (2022) exposed adult soft-shell clam (Mya arenaria) to 5 ug/L indaziflam for 90 days. The authors observed a significant increase in mortality (36% average total mortality) and reduced feeding rates. This chronic invertebrate endpoint appears to be lower than those reported in USDA and EPA ecological risk assessments.

Exposure via drift

USDA and EPA modeled surface water concentrations with GLEAMS and PWC, respectively. Both models assume that application is made directly adjacent to the aquatic environment. However, the project design criteria in this programmatic require buffers of 984 ft (300 m) for PULA-associated habitats, and either 25 or 100 ft buffers for habitats outside of the PULA. We used the AgDrift model to estimate peak concentrations in the farm pond that took into consideration the buffer distances. The maximum single application rates range from 0.0082 to 0.0911 pound AI per acre (lb AI/A/application) and maximum annual application rates range from 0.065 to 0.0911 lb AI/A/year. We used the maximum application rate of 0.091 lb AI/A, and all combinations of distance and application method.

Table 48. AgDrift estimates for indaziflam (farm pond); concentrations in ppb.

Application method	Distance (ft) from habitat		
	984	100	25
Plane	0.06	0.26	NA
Ground - low	<0.01	0.01	0.02
Ground - high	<0.01	0.02	0.04

We calculated acute RQs with these new EECs for both fish and aquatic invertebrates. When considering buffers, none of the fish or invertebrate scenarios resulted in an LOC exceedance.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 49. Indaziflam EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	1.0	1.0	1.0
Aerial, 30.48 m	8.5	8.5	8.5
Ground, 300 m	0.0	0.0	0.0
Ground, 30.48 m	0.4	0.4	0.4
Ground, 7.62 m	1.8	1.8	1.8

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low. The highest instantaneous EECs are at concentrations below the estimated one present mortality rate for fish.

Exposure via runoff

Indaziflam is a mobile to slightly mobile chemical (mean organic-carbon normalized soil-water distribution coefficient, Koc=734 L/kg-oc) that is slightly persistent to persistent in the environment in aerobic conditions (half-lives ranging from 36 to 624 days), and persistent in anaerobic conditions (no evidence of degradation in studies). Indaziflam residues are likely to reach surface water via spray drift, runoff and erosion, and may reach ground water via leaching through the soil. As described above, this programmatic requires buffers of 984 ft (300 m) for PULA-associated habitats, and either 25 or 100 ft buffers for habitats outside of the PULA. In most cases, 300 m represents a point at which the potential for transport via sheet or channelized flow can be considered minimal. Exposure via runoff resulting from applications within 100 ft is possible.

Table 50. Potential Effects Indaziflam

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects to fish (via acute exposure) and invertebrates (via chronic exposure) are possible. However, EECs suggest the associated percent mortality is less than one percent.

5.2.19 Oryzalin

Oryzalin is a dinitroaniline, pre-emergent herbicide registered for the control of annual grasses and certain broadleaf weeds. Oryzalin is a root inhibitor; its herbicidal action is through inhibition of microtubule polymerization/function of cell division process thereby inhibiting seed germination and cellular respiration of susceptible plants. The herbicide is not considered systemic in plants (EPA 2017e).

The USDA risk assessment (USDA 2015) concluded that there were no LOC exceedances (chronic or acute) for fish or aquatic invertebrates. EPA's more recent ecological risk assessment (EPA

2017e) and interim registration review decision (EPA 2019d) arrived at similar conclusions. When considering freshwater and estuarine/marine fish and invertebrates, the only RQs that exceeded the 0.05 LOC were for the acute estuarine/marine invertebrates. However the RQ were below the non-listed LOC of 0.5.

In 2012, NMFS completed a biological opinion which assessed EPA's registration of oryzalin. NMFS found that EPA's registration was likely to jeopardize and the continued existence of 10 of 28 salmonids assessed, as well as destroy or adversely modify ten of 26 designated critical habitats assessed. NMFS issued both RPA and RPM. Of the measures, two are applicable to this programmatic consultation:

- Pesticide products containing oryzalin shall be watered-in or soil incorporated when applied to the ground within 300 ft of salmon-bearing waters. Application of these products in anticipation of rainfall meets the watering-in requirement.
- Either a ten foot vegetated filter strip which cannot be treated with these AIs or a 20 foot no-treatment zone shall be maintained between salmon-bearing waters and use sites where oryzalin is applied.

For the purpose of this programmatic consultation, "salmon-bearing" waters can be assumed to be those within the PULA. As applications within the PULA are prohibited (outside the scope of this programmatic), both of these measures will be achieved.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 51. Oryzalin EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	65.5	2.1	0.5
Aerial, 30.48 m	558.0	17.9	4.5
Ground, 300 m	2.6	0.1	0.0
Ground, 30.48 m	28.3	0.9	0.2
Ground, 7.62 m	115.8	3.7	0.9

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low. The only toxicological exceedances are for invertebrate prey and the instantaneous EEC for aerial applications with a 100 foot buffer. However, the one-day EEC is below the estimated one percent mortality rate for this same threshold.

Table 52. Potential Effects Oryzalin

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.

Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects to aquatic invertebrates may occur after exposure via drift and runoff. Chemical fate characteristics will limit the duration of this exposure.

5.2.20 Picloram

Picloram is a pyridine carboxylic acid herbicide with selective toxicity to woody plants and broadleaf weeds. Its mode of action is as a synthetic auxin, which mimics natural plant hormones. Products containing picloram are currently registered for use to control weeds on conservation reserve program land (CRP), forests, rights-of-ways, pasture and rangeland, and other non-crop areas.

The USDA ecological risk assessment (USDA 2011c) determined that all RQs for fish and aquatic invertebrates were below both the acute and chronic LOCs. However, the assessment did not consider the maximum application rate when making these calculations. EPA's more recent ecological risk assessment (EPA 2020i) and interim registration review decision (EPA 2021c) calculated RQs that are more appropriate in this context. According to those assessments, picloram is moderately toxic to freshwater fish and slightly toxic to estuarine/marine fish on an acute exposure basis. Freshwater and estuarine/marine vertebrate acute and chronic RQs range from <0.01 to 0.01 and from 0.01 to 0.07, respectively. Aquatic freshwater and estuarine/marine invertebrate acute and chronic RQs are all <0.01 to 0.02. Therefore, RQ values are below the acute and chronic risk LOCs. However, EPA has received reports of incidents involving picloram use and fish kills. Therefore, although RQs did not exceed LOCs for freshwater or estuarine/marine vertebrates for acute or chronic exposure to picloram, the reported incidents for freshwater fish suggest that there may be concerns regarding exposure of fish to picloram and its salts.

In summary, the available data for the RQ approach does not indicate a risk concern for picloram. However, the incident data for fish does indicate that impacts have occurred. This potential risk will be further discussed in the risk analysis section.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 53. Picloram EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	11.3	10.2	9.5
Aerial, 30.48 m	95.8	86.5	81.2
Ground, 300 m	0.4	0.4	0.4
Ground, 30.48 m	4.9	4.4	4.1
Ground, 7.62 m	19.9	18.0	16.9

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low.

Table 54. Potential Effects Picloram

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects to fish may occur, based on the existence of incident data.

5.2.21 Sulfonylurea Herbicides

The mode of action of sulfonylureas (SUs) is the inhibition of amino acid synthesis in plants through inhibition of ALS. ALS is the first common enzyme in the biosynthesis of branch-chain amino acids (valine, leucine and isoleucine). ALS inhibition in plants adversely affects plant growth and reproduction.

SUs are generally broad spectrum herbicides, although individual SUs can be quite specific in terms of toxicity. In general, SUs are of greater toxicity to plants post-emergence in younger, vigorous growth stages with herbicidal action primarily centered on metabolically-active meristem. While most SUs have an effect on newly emerged plants (seedling emergence stage), herbicidal activity at this growth stage is less than in the somewhat older, vigorously growing plants (vegetative vigor stage) (EPA 2015b).

EPA's most recent ecological risk assessment and proposed interim decision (EPA 2015b, 2017c) concluded that risk to all non-plant taxa has been determined to be well below levels of concern. The following discussion is taken from the assessment

The Office of Pesticides Programs has a long regulatory and risk assessment history with this class of herbicides and has routinely identified only potential risks to plants as being of concern in FIFRA registration decisions. Risk to non-plant taxa has been determined to be well below EPA's levels of concern. As part of this current effort, EFED reviewed the Problem Formulations and previous risk assessments for all of the SU herbicides for potential effects to aquatic and terrestrial animals and has ruled out potential risks at the registered application rates at or above levels of concern.

Toxicity data on terrestrial invertebrates was available for each of the chemicals. All but one of the studies was conducted as an acute contact study using the honeybee. The LD50s ranged from >1.9 ug/bee to >100 ug/bee. Only two of the LD50s from the studies yielded definitive values; the LD50s were equal to 12.5 ug/bee and 98.2 ug/bee; both of these values indicate that the SU herbicides are practically non-toxic to terrestrial invertebrates. Based on this data the potential risk to terrestrial invertebrates is considered to be minimal, pending further data requests for pollinators.

The endpoints of the acute toxicity data for freshwater invertebrates ranged from >10 ppm to >1000 ppm. All of the studies, with the exception of one, were conducted using the daphnids. Additionally, all of the studies, with the exception of one, resulted in non-definitive, greater than endpoints; the exception resulted in an EC50 = 720 ppm. Based on these study results, the SU herbicides are practically non-toxic to freshwater invertebrates on an acute basis. The chronic toxicity data for freshwater invertebrates ranged from NOAEC = 0.106 ppm to 114 ppm. The affected endpoints varied between dry weight, growth, decreased in number of young per female, and survival; in some chemicals no endpoints were affected. These values were compared to the 21-day estimated exposure concentrations and did not exceed the Agency chronic LOC for aquatic species.

An analysis of the acute toxicity studies for freshwater fish found all SU herbicides to be slightly toxic to practically nontoxic. The studies were conducted using the rainbow trout and bluegill sunfish. Nearly all of the endpoints were non-definitive values and ranged from >10 ppm to >1000 ppm; two of the chemicals yielded definitive endpoints at 115.2 ppm and 210 ppm. These values compared to the peak estimated exposure concentration, show the level of risk to freshwater fish to be well below the Agency's acute LOC for aquatic organisms. Available reproductive toxicity tests were conducted using the fathead minnow and the rainbow trout and NOAECs ranged from 1.5 ppm to 100 ppm. The affected endpoints varied between growth, survival and hatchling survival; some of the chemicals saw no effects. These values compared to the 60-day EEC found the risk to be below the Agency LOC of 1.0.

Toxicity data for estuarine/marine invertebrates was not available for all chemicals; the existing data was used to bridge the gap for those chemicals without available studies. The tested species for the acute toxicity studies were the Eastern oyster and mysid. Some of the LC50s exhibited non-definitive greater than values, and ranged from >38.2 ppm to >135 ppm; the definitive values ranged from 16 ppm to 107 ppm showing the SU herbicides to be slightly toxic to practically non-toxic to estuarine/marine invertebrates. These values were compared to the peak EEC concentrations and yielded values that do not exceed the Agency LOC for acute aquatic species. Estuarine/marine chronic data was available for three chemicals and ranged from 1.51 ppm to 27 ppm. When these values were compared to the 21-day EECs, the Agency LOC for chronic aquatic species was not exceeded.

Data for estuarine/marine fish were also not available for all chemicals; the studies were conducted using the sheepshead minnow. All of the acute toxicity tests resulted in an LC50 that was a non-definitive value. The LC50s ranged from >45 ppm to >980 ppm showing the SU herbicides to be slightly toxic to practically non-toxic to estuarine/marine fish. When these values are compared to the peak EECs, the resulting values are well below the Agency acute LOC for aquatic species. There was no toxicity data available to understand the chronic risk to estuarine/marine species. However, based on the chronic toxicity values from freshwater fish studies, it is not expected that the toxicity to estuarine/marine fish would be low enough to trigger risk and exceed the Agency chronic LOC of 1.0.

Updated literature review

An updated literature search returned several studies that post-date EPA's ecological risk assessments (Upadhyay et al. , Samanta et al. 2015, de Santo et al. 2019, Park et al. 2020, Yuan et al. 2021, Chowdhary et al. 2022, Ward et al. 2022, Cheron et al. 2023). Yuan et al. (2021) observed a decrease in hatching success in zebrafish (Danio rerio) after exposure to 10 ml/L exposure to Sulfometuron methyl. Embryos were exposed (daily renewal) from 5.5 hpf to 72 hpf. However the screening-level aquatic acute EEC for sulfometuron methyl was only 0.02 mg/L which results in a RQ (0.002) below the fish LOCs. None of the other endpoints measures in the studies were more sensitive than those described in EPA's assessments.

BLM's Chlorsulfuron Assessment

Chlorsulfuron, another sulfonylurea herbicide, is used for vegetation control in the BLM's Rangeland, Energy & Mineral Sites, Rights-of-Way, and Recreation programs. Rangeland application is carried out through aerial and ground dispersal. Aerial applications are performed using airplanes and helicopters. Ground applications are executed on foot or on horseback with backpack sprayers or from all-terrain vehicles or trucks equipped with spot or boom/broadcast sprayers. Ground applications at energy and mineral sites, rights-of-way, and recreation and culture areas are solely carried out using all-terrain vehicles or trucks equipped with spot or boom/broadcast sprayers. The BLM typically applies chlorsulfuron at 0.047 pounds (lbs) AI per acre (AI/A), with a maximum application rate of 0.141 lbs AI/A (maximum rate of 0.062 lbs AI/A under the Rangeland program).

According to BLM's ecological risk assessment (BLM 2005b) impacts from direct spray, off-site drift, and runoff all resulted in acute and chronic RQs for fish and aquatic invertebrates below the LOCs, indicating that impacts are not likely to pose a risk to these aquatic receptors.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 55. Chlorsulfuron EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	0.7	0.7	0.7
Aerial, 30.48 m	5.8	5.8	5.8
Ground, 300 m	0.0	0.0	0.0
Ground, 30.48 m	0.3	0.3	0.3
Ground, 7.62 m	1.2	1.2	1.2

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low.

Table 56. Potential Effects Chlorsulfuron

Location	Potential impact
PULA Associated	Adverse effects are not likely.

(Aquatic buffer: 300 m)	
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are not likely.

BLM's Metsulfuron methyl and sulfometuron methyl Assessments

Metsulfuron methyl and sulfometuron methyl are used by the BLM for vegetation control in their Public-Domain Forest Land, Energy and Mineral Sites, Rights-of-Way, and Recreation programs. Application is carried out in these programs through both aerial (helicopter) and ground dispersal. Ground applications are executed on foot or horseback with backpack sprayers or from all-terrain vehicles or trucks equipped with spot or boom/broadcast sprayers. Metsulfuron methyl has a maximum application rate 0.15 lbs. AI/A. The maximum application rate for sulfometuron methyl is 0.0281 lbs AI/A.

For metsulfuron methyl, USDA's ecological risk assessment (USDA 2005b) concluded there is very low potential to cause any adverse effects in aquatic animals. All RQs were below the LOCs for fish and aquatic invertebrates.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 57. Metsulfuron methyl EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	1.6	1.6	1.6
Aerial, 30.48 m	13.9	13.9	13.9
Ground, 300 m	0.1	0.1	0.1
Ground, 30.48 m	0.7	0.7	0.7
Ground, 7.62 m	2.9	2.9	2.9

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low.

Table 58. Potential Effects Metsulfuron methyl

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are not likely.

For sulfometuron methyl, BLM's ecological risk assessment (BLM 2005h) concluded that impacts from direct spray, off-site drift, and runoff all resulted in acute and chronic RQs for fish and aquatic

invertebrates below the LOCs, indicating that impacts are not likely to pose a risk to these aquatic receptors.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 59. Sulfometuron methyl EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	4.2	4.2	4.2
Aerial, 30.48 m	35.3	35.3	35.3
Ground, 300 m	0.2	0.2	0.2
Ground, 30.48 m	1.8	1.8	1.8
Ground, 7.62 m	7.3	7.3	7.3

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low.

Table 60. Potential Effects Sulfometuron methyl

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are not likely.

BLM's Rimsulfuron Assessment

The BLM is proposing to use rimsulfuron for vegetation control for its Rangeland, Public-Domain Forestland, Energy and Mineral Sites, Rights-of-Way (ROW), and Recreation programs. Herbicide application may be carried out through both aerial and ground dispersal. Aerial applications may be performed using airplanes and helicopters. Ground applications may be executed on foot or on horseback with backpack sprayers or from all-terrain vehicles, utility vehicles, or trucks equipped with spot or boom/broadcast sprayers. On rangeland and public-domain forestland, the BLM typically applies rimsulfuron at 0.0469 lbs/AI/A, with a maximum application rate of 0.0625 lbs. AI/A. Rimsulfuron is applied at the maximum application rate along ROW, on recreation areas, and at energy and mineral sites.

For rimsulfuron, BLM's ecological risk assessment (BLM 2014d) concluded that impacts from direct spray, off-site drift, and runoff all resulted in acute and chronic RQs for fish and aquatic invertebrates below the LOCs, indicating that impacts are not likely to pose a risk to these aquatic receptors.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 61. Rimsulfuron EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	0.7	0.7	0.7
Aerial, 30.48 m	5.9	5.9	5.9
Ground, 300 m	0.0	0.0	0.0
Ground, 30.48 m	0.3	0.3	0.3
Ground, 7.62 m	1.2	1.2	1.2

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low.

Table 62. Potential Effects Rimsulfuron

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects are not likely.

5.2.22 Tebuthiuron

Tebuthiuron is a nonselective systemic herbicide for use against broad-leaf and woody weeds, grasses, and bushes. This chemical disrupts photosynthesis by blocking electron transport and the transfer of light energy. Tebuthiuron is available in pellet and wettable powder formulations. Tebuthiuron is used by the BLM in their Rangeland, Public-Domain Forest Land, Energy and Mineral Sites, Rights-of-Way, and Recreation programs. Application is carried out through both aerial and ground dispersal. Aerial dispersal (pellet formulation) is performed using planes or helicopters. Ground dispersal is via foot or horseback with backpack sprayers and all terrain vehicles or trucks equipped with spot or boom/broadcast sprayers. The BLM typically applies tebuthiuron at 0.5 pounds (lbs) AI per acre (AI/A), with a maximum application rate of 4.0 lbs AI/A (BLM 2005i).

BLM's ecological risk assessment (BLM 2005i) concluded that impacts from direct spray, off-site drift, and runoff all resulted in acute and chronic RQs for fish and aquatic invertebrates below the LOCs, except for one scenario. At the maximum application rate in the pond scenario, chronic RQs for aquatic invertebrates were elevated above the LOC. No RQs for aquatic invertebrates in the stream scenario were above their LOCs. EPA's more recent ecological risk assessment (EPA 2014e) and interim registration review decision (EPA 2019e) similarly concluded that there are no risks of concern for freshwater fish and aquatic-phase amphibians, estuarine/marine fish, freshwater invertebrates, and estuarine/marine invertebrates; all applicable RQs were below the LOCs.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 63. Tebuthiuron EECs (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	65.5	65.5	65.5
Aerial, 30.48 m	558.0	558.0	558.0
Ground, 300 m	2.6	2.6	2.6
Ground, 30.48 m	28.3	28.3	28.3
Ground, 7.62 m	115.8	115.8	115.8

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that the potential for risk via spray drift is low.

Table 64. Potential Effects Tebuthiuron

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects to aquatic invertebrates may occur if exposed on a chronic basis. In general adverse effects are not likely.

5.2.23 Triclopyr

Triclopyr is a pyridine carboxylic acid herbicide with selective toxicity to broadleaf weeds and some woody plants. It is classified as a group four herbicide according to the Weed Science Society of America and like other herbicides in this group, its mode of action is as a synthetic auxin (mimicking natural plant hormones). Products containing triclopyr are registered for use on rangeland and pasture, forests, rights of way, commercial turf including golf courses, sod farms, residential/institutional turf, and aquatic sites (lakes, ponds, rivers, marshes, and wetlands).

There are several different registered AIs within this family of herbicides. For this programmatic consultation, BLM is considering triclopyr acid and triclopyr BEE. USDA's and EPA's ecological risk assessments both evaluated these AIs separately. The acid form of triclopyr is highly water soluble, highly mobile and exhibits a low potential to bioaccumulate in aquatic food webs. The BEE form, however, is much less soluble in water, is much more toxic to aquatic animals and has a potential to bioaccumulate given its higher octanol-water partition coefficient (log Kow= 4.01). This bioaccumulation potential of BEE, however, is expected to be mitigated substantially by its short persistence in the aquatic environment. Several formulations of triclopyr TEA are labeled for aquatic applications. No formulations of triclopyr BEE are labeled for aquatic applications

The USDA ecological risk assessment (USDA 2011d) found that, for terrestrial applications of triclopyr acid formulations, no risks to fish are identified, based on expected peak concentrations or longer-term concentrations of triclopyr acid in surface water. For terrestrial applications of triclopyr BEE formulations, the RQs associated with acute exposures to fish exceed the LOC. However, Triclopyr BEE will not persist in surface water; accordingly, the RQs associated with chronic exposures do not exceed the LOC. The risk characterization for aquatic invertebrates is very similar to that for fish. No risks associated with exposures to triclopyr acid are apparent. Applications of triclopyr BEE, however, result in LOC exceedances for acute, but not chronic, exposures. For aquatic applications (emerged or submerged vegetation) there were no LOC exceedances for fish or aquatic invertebrates.

EPA's more recent ecological risk assessment (EPA 2019f, 2020j) arrived at similar conclusions. For the triclopyr acid, no acute or chronic risks are identified for aquatic animals for any of the proposed uses. However, chronic risks to freshwater fish and invertebrates are indicated with the 2,500 ppb and 5,000 ppb aquatic weed control use based on the formation of TCP. The TCP degradate is several orders of magnitude more chronically toxic compared to triclopyr acid.

On an acute exposure basis, triclopyr BEE is consistently two to three orders of magnitude more toxic to aquatic animals compared to triclopyr acid, with LC50 values ranging from 0.35 to 0.46 mg AI/L. The chronic toxicity of triclopyr BEE is also several orders of magnitude greater than triclopyr acid. However, triclopyr BEE is much less persistent than triclopyr acid due to its rapid transformation to triclopyr acid and results in lower aquatic EECs. For aquatic animals, acute risk concerns are indicated for freshwater and estuarine/marine fish with the assessed uses of triclopyr BEE when considering the parent AI but no chronic risk concerns are evident. For aquatic invertebrates, there are acute and chronic risks of concern for the range/pasture land and meadow uses which have the highest application rates of six and nine lb AI/A, respectively.

Exposure via drift

USDA and EPA modeled surface water concentrations with GLEAMS and PWC, respectively. Both models assume that application is made directly adjacent to the aquatic environment. However, the project design criteria in this programmatic require buffers of 984 ft (300 m) for PULA-associated habitats, and either 25 or 100 ft buffers for habitats outside of the PULA. We used the AgDrift model to estimate peak concentrations in the farm pond that took into consideration the buffer distances. We used the maximum application rate of nine lbAI/A, and all combinations of distance and application method.

Table 65. AgDrift estimates for Triclopyr (farm pond); concentrations in ppb.

Application method	Distance (ft) from habitat		
	984	100	25
Plane	5.68	25.37	NA
Ground - low	0.28	1.39	2.26
Ground - high	0.35	2.11	3.58

We calculated acute RQs with these new EECs for both fish and aquatic invertebrates. When considering buffers, RQs continue to exceed the acute LOCs for fish and invertebrates.

Drift into small waterbodies

Small volume EECs inform our understanding of exposures in habitats including springs, seeps, brooks, small streams, and a variety of floodplain habitats (oxbows, side channels, etc.).

Table 66. Triclopyr BEE (ppb) in small volume waterbodies

Scenario	Instantaneous	1-day	4-day
Aerial, 300 m	98.3	82.4	70.9
Aerial, 30.48 m	837.0	701.4	603.3
Ground, 300 m	3.9	3.3	2.8
Ground, 30.48 m	42.5	35.6	30.6
Ground, 7.62 m	173.8	145.6	125.2

Comparisons of these acute EECS to the toxicological data for fish and invertebrates further supports the conclusion that adverse effects to fish and invertebrates are likely for triclopyr BEE. Aerial applications within 100 ft and ground applications within 25 ft lead to exposure levels comparable to the estimated 10% mortality rate for fish and invertebrate prey. Applications outside the PULA resulted in exposure values resulting in less than one percent mortality for fish and aquatic invertebrates.

Exposure via runoff

As described above, this programmatic require buffers of 984 ft (300 m) for PULA-associated habitats, and either 25 or 100 ft buffers for habitats outside of the PULA. In most cases, 300 m represents a point at which the potential for transport via sheet or channelized flow can be considered minimal. However, triclopyr is considered mobile; exposure via runoff resulting from applications within 300 m is possible.

Table 67. Potential Effects Triclopyr Acid

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects are not likely.
Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects to fish and invertebrates are likely when aquatic applications result in chronic exposures.

Table 68. Potential Effects Triclopyr BEE

Location	Potential impact
PULA Associated (Aquatic buffer: 300 m)	Adverse effects to fish and invertebrates are possible. However, EECs equate to less than 1% mortality.

Outside the PULA (Aquatic buffer: 100 ft aerial; 25 ft ground)	Adverse effects to fish and invertebrates are likely following acute exposures via drift. Adverse effects are likely when aquatic applications are made directly upstream of species or designated critical habitats.

5.2.24 Herbicide treatment protective measures

The protective measures are described in detail in the PDC section 3.3. The PDC are organized into three tiers based on geographic location: 1) within the PULA; 2) outside the PULA but within the species range; and 3) outside of the species range. One additional source of protective measures are the existing FIFRA label restrictions. Prior to registration, EPA's registration review process takes into consideration the ecological effects of each herbicide AI used. For FIFRA registration, the assessment threshold for risk is that a pesticide "will not generally cause unreasonable adverse effects on the environment."

5.2.25 Herbicide treatment summary

Each herbicide has its own risk profile. Below is a summary of these risks, organized into two areas: 1) aquatic habitats with 300 m PULA-based buffers; and 2) aquatic habitats within the species range but outside the PULA. As described above, these areas also include buffers of 100 ft for aerial application, 25 ft for ground, and 10 ft for hand-held applications.

Table 69. Herbicide treatment summary

Stressor	Potential impact to species and habitats	
	Inside the PULA	**Outside the PULA**
2,4-D	Adverse effects are likely but limited to invertebrates via drift of the 2,4-D ester.	Adverse effects are likely to both fish and invertebrates via drift and /or runoff from terrestrial applications of the 2,4-D ester. Adverse effects are likely to both fish and invertebrates from direct application to water.
Aminocyclopyrachlor	Adverse effects are not likely.	Adverse effects are not likely.
Aminopyralid	Adverse effects are not likely.	Adverse effects are not likely.
Bromacil	Adverse effects are not likely.	Adverse effects are likely to fish via runoff from terrestrial applications.
Clethodim	Adverse effects are not likely.	Adverse effects are likely to fish via runoff and drift, but only when considering chronic exposures.
Clopyralid	Adverse effects are not likely.	Adverse effects are not likely.
Dicamba	Adverse effects are not likely.	Adverse effects may occur when exposures occur on a chronic basis.

		Evidence of effects at concentrations lower than those considered in existing risk assessments appear to exist.
Diflufenzopyr	Adverse effects are not likely.	Adverse effects are not likely.
Diquat	Adverse effects are likely to fish and aquatic invertebrates when aquatic applications are made directly upstream of species or designated critical habitats.	Adverse effects are likely to fish and aquatic invertebrates when aquatic applications are made directly upstream of species or designated critical habitats.
Diuron	Adverse effects are not likely.	Adverse effects to aquatic invertebrates are likely via drift and runoff, when applications are made within 100 ft of aquatic habitats.
fluazifop-P-butyl	Adverse effects are not likely.	Adverse effects to aquatic invertebrates may occur via runoff, when applications are made within 100 ft of aquatic habitats.
Flumioxazin	Adverse effects are likely to fish and aquatic invertebrates when aquatic applications are made directly upstream of species or designated critical habitats.	Adverse effects are likely to fish and aquatic invertebrates when aquatic applications are made directly upstream of species or designated critical habitats.
Fluridone	Adverse effects are not likely.	Adverse effects are likely to aquatic invertebrates when aquatic applications are made directly upstream of species or designated critical habitats.
Fluroxypyr	Adverse effects are not likely.	Adverse effects are not likely.
Glyphosate	Potential for adverse effects to aquatic invertebrates via drift. In general, adverse effects are not likely.	Adverse effects are likely to fish and aquatic invertebrates via runoff and drift from terrestrial applications, as well as resulting from aquatic applications.
Hexazinone	Adverse effects are not likely.	Adverse effects are not likely.
Imazamox	Adverse effects are not likely.	Adverse effects are not likely.
Imazapic	Adverse effects are not likely.	Adverse effects are not likely.
Imazapyr	Adverse effects are not likely.	Adverse effects are not likely.
Indaziflam	Adverse effects are not likely.	Adverse effects to fish (via acute exposure) and invertebrates (via chronic exposure) are possible. However, EECs suggest the associated percent mortality is less than one percent for fish.

Oryzalin	Adverse effects are not likely.	Adverse effects to aquatic invertebrates may occur after exposure via drift and runoff. Chemical fate characteristics will limit the duration of this exposure.
Picloram	Adverse effects are not likely.	Adverse effects to fish may occur, based on the existence of incident data.
Chlorsulfuron	Adverse effects are not likely.	Adverse effects are not likely.
Metsulfuron methyl	Adverse effects are not likely.	Adverse effects are not likely.
Sulfometuron methyl	Adverse effects are not likely.	Adverse effects are not likely.
Rimsulfuron	Adverse effects are not likely.	Adverse effects are not likely.
Tebuthiuron	Adverse effects are not likely.	Adverse effects to aquatic invertebrates may occur if exposed on a chronic basis. In general adverse effects are not likely.
Triclopyr (BEE)	Adverse effects to fish and invertebrates are possible. However, EECs equate to less than one percent mortality.	Adverse effects to fish and invertebrates are likely following acute exposures via drift. Adverse effects are likely when aquatic applications are made directly upstream of species or designated critical habitats.

5.3 Fire treatments

Site Preparation: road, camp construction and maintenance

This activity could affect species and habitat via the following pathways: soil compaction, spread of noxious weeds, removal and/or damage of riparian vegetation, bank instability, sedimentation, chemical contamination, waste water contamination, and disturbance. Once roads and/or camps are established, all of the motorized equipment, and drip torches, used in fire suppression activities use fuel that will have to be transported into and within the action area. All motorized equipment will also use other chemicals (e.g., lubricating oils, hydraulic fluid, antifreeze, etc.) that will be transported into and within the action area. Very small spills will likely occur periodically as hand tools, drip torches, and pumps are refueled by hand; and when heavy equipment and helicopters are refueled, due to residual fuel left in hoses and nozzles, etc.

Fireline construction and post-fire “mop up” activities

Fireline construction removes vegetation and, when heavy equipment is used, can result in soil displacement and compaction. Consequently, fire line construction can result in increased overland flow of water, increased mobilization of sediment, increased fine sediments entering aquatic habitat, reduction in stream shade, and reduction of large woody debris recruitment to streams. Use of explosives for fire line construction could potentially injure incubating eggs, rearing juveniles, prespawning adults, and spawning adults. Fireline construction near streams could also disturb rearing juveniles and prespawning and spawning adults. In cases involving the construction of a wet

line, pumping from surface water sources could affect anadromous fishes via disturbance when pumps are installed, removed, and when pump intakes are cleaned/maintained; via direct entrainment in the pump intake; and via habitat effects related to reducing streamflow. The use of helicopter bucket dipping or snorkeling can increase the risk of entrainment and disturbance. Mop up activities can result in similar disturbances to soil and water as described above, although on a smaller scale.

Ignition

The direct effects of prescribed burning on aquatic species and their habitats include the heating of water and immediate chemical changes to aquatic habitats. Depending on its size and intensity, large quantities of heated slag and ash produced during a prescribed burn could enter the water, briefly raising water temperatures to lethal limits (Fresques et al. 2002). The accompanying changes in pH and increased levels of phosphate (as a result of phosphate leached from ash) and nitrogen (as a result of nitrogen volatilized in smoke gases) can also impair water quality. Ash created by wildfires or prescribed burning has been documented to have life-threatening effects on some species of fish (Agyagos et al. 2001). Mortality of fish and aquatic invertebrates has been reported following intense fires (Minshall and Brock 1991, Gresswell 1999). In addition, if a foam line were used as a firebreak near an aquatic system, aqueous firefighting foam could potentially leach into the water. Other chemicals that could be released or leach into aquatic habitats include ignition fuels, or fuels used to power equipment (e.g., helicopters, vehicles, and mechanical equipment), which would further degrade the water quality. In forested ecosystems, certain chemical constituents may remain elevated for years (Gresswell 1999).

5.3.1 Fire treatment protective measures

The protective measures are described in detail in the PDC section 3.3. The PDC are organized into three tiers based on geographic location: 1) within the PULA; 2) outside the PULA but within the species range; and 3) outside of the species range.

1. **Within the PULA**

   Fire treatments are prohibited. The PULA is a corridor centered on the aquatic habitats most important to the survival and recovery of species, including but not limited to all designated critical habitat. The width of the corridor is 300 m (984 ft) from the edge of habitat. This no-fire-treatment buffer is anticipated to be protective against most of the stressors identified above, especially in vegetated or forested areas where runoff concerns are lower. Ash created by fire treatment activities outside the PULA has the potential to travel, via drift, into PULA-centered habitats. In addition, sediments or chemical contaminants may travel, via downstream transport, from treatment activities upstream of the PULA. However, the SOPs described below will minimize this potential. For example, the potential for ash drift is minimized by the restriction to low-intensity fires only.

2. **Outside of the PULA, but inside the species range**

Fire treatments are permitted but must follow the SOPs as well as conservation measures. The following are examples of those particularly relevant to stressors associated with fire treatments:

Site Preparation

- Where feasible, access work site only on existing roads.
- Within riparian areas, do not use vehicle equipment off of established roads.
- Within 150 ft of wetlands or riparian areas, do not fuel/refuel equipment, store fuel, or perform equipment maintenance.
- Within riparian areas, do not use vehicles or heavy equipment, except when crossing at established crossings.
- Within riparian areas, do not use equipment in perennial channels or in intermittent channels with water, except at crossings that already exist.

Fireline and Mop-up

- Do not construct black lines, except by non-mechanized methods. Utilize/create only the following firelines: natural barriers; hand-built lines parallel to the stream channel.
- During water drafting/pumping, maintain a continuous surface flow of the stream that does not alter original wetted stream width.
- Do not allow helicopter dipping from waters occupied by threatened and endangered species, except in lakes outside of the spawning period.

Ignition & Fire

- Conduct prescribed burning only when long-term maintenance of the riparian area is the primary objective, and where low intensity fires can be maintained.
- Do not ignite fires using aerial methods.

3. Completely outside of the species range

Fire treatments are permitted but must follow the SOP. Is possible that certain stressors (e.g. ash, sediment) associated with fire treatments outside the range may be transported into aquatic habitats inside the range, however the likelihood of this occurring is minimal. In these scenarios, aquatic habitats are protected by virtue of distance and lack of hydrologic connectivity. NMFS's species ranges are watershed-based, which – in this context – helps to ensure that activities outside the range do not have hydrologic connectivity to the habitats.

5.3.2 Fire treatment summary

Stressor	Potential impact to species and habitats	
	Inside the PULA	**Outside the PULA**
Site Preparation	Adverse effects are not likely.	Adverse effects may occur as a result of increased sedimentation

		and chemical contamination. However, the restriction on activities within riparian areas will minimize these effects.
Fireline and Mop-up	Adverse effects are not likely.	Adverse effects may occur as a result of entrainment while creating wet-lines. However, the reduced likelihood of species presence in aquatic habitats outside of the PULA will minimize these effects.
Ignition & Fire	Adverse effects may occur as a result of ash deposition into aquatic habitats. However, the requirement for low-intensity fires will minimize these effects.	Adverse effects may occur as a result of ash deposition into aquatic habitats. However, the requirement for low-intensity fires will minimize these effects.

5.4 Mechanical treatments

Mechanical treatments often disturb the soil during vegetation removal (e.g., chaining, tilling, and grubbing), increasing the potential for sediment transport into the stream. The closer these activities occur to the aquatic habitat, the greater their potential effect on the threatened and endangered species therein. Soil disturbance also increases the likelihood that weeds will recolonize the site (Sheley et al. 1995). Therefore, reseeding or some other form of site restoration would be crucial in order for mechanical treatment methods to benefit riparian habitats/aquatic species.

Mechanical treatments that uproot plants (e.g., chaining, tilling, grubbing, feller-bunching) decrease slope stability in riparian areas. The root strength of plants in riparian areas, particularly trees and shrubs, contributes to slope stability. Therefore, the removal of roots may lead to increased incidence of erosion and debris slides and flows (Sidle et al. 1985). Substantial impacts would be most likely if woody vegetation on slopes directly adjacent to aquatic habitats were removed. Further from the water, where the contribution of root strength to maintaining streambank integrity declines, effects would be proportionally less severe (National Fire Plan Technical Team 2002).

Because mechanical treatments can be used to remove trees and shrubs, some activities in riparian areas may remove plants and woody materials that would eventually become coarse woody debris, an important habitat element for many aquatic species. These effects to habitats would be greatest if woody vegetation within the distance of one tree height away from the channel were removed (National Fire Plan Technical Team 2002). Further from the water, the probability that a falling tree will enter the stream channel is much reduced, and the indirect effects of future coarse woody debris removal on aquatic habitats become less important.

Leaking of equipment fuel directly into the water would decrease water quality. In addition, the use of heavy equipment in riparian areas could lead to bank collapse, which would also degrade riparian habitat. If vehicles were allowed directly into aquatic habitats, additional effects would be likely.

5.4.1 Mechanical treatment protective measures

The protective measures are described in detail in the PDC section 3.3. The PDC are organized into three tiers based on geographic location: 1) within the PULA; 2) outside the PULA but within the species range; and 3) outside of the species range:

1. **Within the PULA**

   Mechanical treatment activities are prohibited. The PULA is a corridor centered on the aquatic habitats most important to the survival and recovery of species, including but not limited to all designated critical habitat. The width of the corridor is 300 m (984 ft) from the edge of habitat. This no-treatment buffer is anticipated to be protective against most of the stressors identified above, especially in vegetated or forested areas where runoff concerns are lower. Sediments or chemical contaminants may travel, via downstream transport, from treatment activities upstream of the PULA. However, the SOPs described below will minimize this potential.

2. **Outside the PULA, but inside the species range**

   Mechanical treatments are permitted but must follow the SOPs as well as conservation measures. The following are examples of those particularly relevant to stressors associated with mechanical treatments.

   Presence of machinery

   - Within riparian areas, do not use vehicles or heavy equipment, except when crossing at established crossings.
   - Within riparian areas, do not use equipment in perennial channels or in intermittent channels with water, except at crossings that already exist.

   Ground disturbing treatments (e.g. chaining, tilling, grubbing, etc.)

   - Outside riparian areas: conduct soil-disturbing treatments only on slopes of 20% or less, where feasible
   - Within riparian areas:
     - Do not conduct ground disturbing activities.
     - Do not remove large woody debris or snags during mechanical treatment activities.
     - Do not completely remove trees and shrubs.

   Surface-level treatments (e.g. mowing, seeding)

   - Within riparian areas:

- Ensure that all mowing follows guidance to avoid negative effects to streambanks and riparian vegetation and major effects to streamside shade.
- Leave suitable quantities (to be determined at the local level) of excess vegetation and slash on site.
- Do not apply fertilizers or seed mixtures that contain chemicals by aerial methods.
- Do not apply fertilizer within 25 ft of streams and supersaturated soils; apply fertilizer following labeling instructions.

3. Completely outside of the species range

Mechanical treatments are permitted but must follow the SOP. It is possible that certain stressors associated with mechanical treatments outside the range may be transported into aquatic habitats inside the range, however the likelihood of this occurring is minimal. In these scenarios, aquatic habitats are protected by virtue of distance and lack of hydrologic connectivity. NMFS's species ranges are watershed-based, which – in this context – helps to ensure that activities outside the range do not have hydrologic connectivity to the habitats.

5.4.2 Mechanical treatment summary

Stressor	Potential impact to species and habitats	
	Inside the PULA	**Outside the PULA**
Presence of machinery	Adverse effects are not likely.	Adverse effects may occur as a result of increased sedimentation and chemical contamination. However, the restriction on activities within riparian areas will minimize these effects.
Ground disturbing treatments	Adverse effects are not likely.	Adverse effects may occur as a result of increased sedimentation. However, the restriction on activities within riparian areas will minimize these effects.
Surface-level treatments	Adverse effects are not likely.	Adverse effects may occur as a result of increased sedimentation and chemical contamination. However, the restriction on activities within riparian areas will minimize these effects.

5.5 Manual treatments

Manual treatment methods are typically associated with minimal environmental impacts, and as such are often appropriate for sensitive habitats, such as riparian areas. Some soil disturbance would

occur during the removal of plants from the soil, but it would not be widespread and should not have a major effect on aquatic habitats. There would be minor risks associated with the use of power hand tools, which may be powered by oil and other fuels. Additionally, noise from the use of power tools or other manual treatment methods may disturb fish. Use of SOPs while operating this equipment would minimize the risk of chemical leaks onto sensitive plants or into their habitats. Provided manual methods are used appropriately (e.g., for small infestations and where native vegetation will replace the pulled weeds), effects of this treatment method should be beneficial.

5.5.1 Manual treatment protective measures

The protective measures are described in detail in the PDC section 3.3. The PDC are organized into three tiers based on geographic location: 1) within the PULA; 2) outside the PULA but within the species range; and 3) outside of the species range.

1. **Within the PULA**

Manual treatment activities are permitted, provided they are used for small infestations and where native vegetation will replace the pulled weeds. These treatments must also follow the SOPs as well as conservation measures. Manual treatments methods would be expected to have few effects (either direct or indirect) on fish or their habitats, unless excessive amounts of riparian vegetation were removed. However, since manual treatment methods are only economically feasible for limited weed infestations, we anticipate large-scale manual treatment to be unlikely. The PULA is a corridor centered on the aquatic habitats most important to the survival and recovery of species, including but not limited to all designated critical habitat. Within these areas, the use of manual control methods is preferred over other types of vegetation treatment.

Manual treatments within the PULA must follow the SOPs as well as conservation measures. The following are examples of those particularly relevant to stressors associated with mechanical treatments.

- Leave suitable quantities (to be determined at the local level) of excess vegetation and slash on site.
- Do not completely remove trees and shrubs.

2. **Outside the PULA, but inside the species range**

Manual treatments are permitted but must follow the SOPs as well as conservation measures. The following are examples of those particularly relevant to stressors associated with mechanical treatments.

- Leave suitable quantities (to be determined at the local level) of excess vegetation and slash on site.
- Do not completely remove trees and shrubs.

3. **Completely outside of the species range**

Manual treatments are permitted but must follow the SOP. In these scenarios, aquatic habitats are protected by virtue of distance and lack of hydrologic connectivity. NMFS's species ranges are watershed-based, which – in this context – helps to ensure that activities outside the range do not have hydrologic connectivity to the habitats.

5.5.2 Manual treatment summary

Stressor	Potential impact to species and habitats	
	Inside the PULA	Outside the PULA
Soil disturbance	Adverse effects are not likely.	Adverse effects are not likely.
Chemical contamination	Adverse effects are not likely.	Adverse effects are not likely.

5.6 Biological control treatments

Disturbance to the soil caused by the movement of domestic animals in riparian and aquatic habitats can induce increased sedimentation. Grazing can also widen stream channels, promote incised channels, lower water tables, reduce pool frequency, and alter water quality (USFWS 1999h). The extent of these effects would vary depending on the number of animals used for the treatment, and the intensity and duration of the treatment. Under more intensive weed containment scenarios, mass erosion from trampling, sliding hooves, and streambank collapse could cause soils to move directly into the stream (USDA Forest Service 2002). Undercut banks, which often provide shelter to fish species, could be damaged or collapse in grazed areas, thus decreasing the amount of available fish habitat. In addition, heavy trampling could cause soil compaction, which reduces the infiltration of overback flows and precipitation into riparian soils.

Domestic animals could also degrade the quality of riparian and aquatic areas by facilitating the spread of non-native species in these habitats. These animals carry plant propagules on their hooves and in their fur, and can also release them in their feces.

Use of other types of biological control agents (pathogens, insects, and similar organisms) in aquatic and riparian habitats would result in the loss of some vegetation, so the general effects discussed under Effects Common to All Treatment Methods could potentially occur. Unlike under other treatment methods, however, the loss of vegetation resulting from biocontrol agents would be gradual, and therefore less likely to have a noticeable effect on aquatic systems. Some soil disturbance resulting from workers releasing agents in riparian areas could occur, but would be unlikely to have substantial effects on aquatic habitats.

Biological control agents would be thoroughly tested, and permitted by USDA Animal and Plant Health Inspection Service (APHIS) prior to release. Despite these safeguards, there is always a risk that the release of an organism into a habitat in which it does not normally occur can result in unforeseen ecological repercussions. These unanticipated effects of biological control agents would be impossible to predict, and it is believed that the appropriate precautions would be taken to

prevent their occurrence. Any use of biological control agents must have undergone a separate ESA section 7 consultation with APHIS prior to its approval as an option.

5.6.1 Biological control agent treatment protective measures

The protective measures are described in detail in the PDC section 3.3. The PDC are organized into three tiers based on geographic location: 1) within the PULA; 2) outside the PULA but within the species range; and 3) outside of the species range.

1. **Within the PULA**
   Biological control treatment activities are prohibited. The PULA is a corridor centered on the aquatic habitats most important to the survival and recovery of species, including but not limited to all designated critical habitat. The width of the corridor is 300 m (984 ft) from the edge of habitat. This no-treatment buffer is anticipated to be protective against most of the stressors identified above, especially in vegetated or forested areas where runoff concerns are lower. Sediments or other contaminants may travel, via downstream transport, from treatment activities upstream of the PULA. However, the SOPs described below will minimize this potential.

2. **Outside the PULA, but inside the species range**
   Biological control treatments are permitted but must follow the SOPs as well as conservation measures. In addition, the prior to being approved for use, USDA-APHIS must have completed the ESA section 7 process for that biological control agent. Any mitigation measures identified in the APHIS/NMFS consultation must be adhered to by BLM. The following are examples of those particularly relevant to stressors associated with mechanical treatments:
   - Where terrain permits, locate stock handling facilities, camp facilities, and improvements at least 300 ft from lakes, streams, and springs.
   - Within riparian areas of these watersheds:
     - Do not conduct weed treatments involving domestic animals, except where it is determined that these treatments will not damage the riparian system, or will provide long-term benefits to riparian and adjacent aquatic habitats.
     - Do not locate troughs, storage tanks, or guzzlers near streams with threatened and endangered species, unless their placement will enhance weed-control effectiveness without damaging the riparian system.

3. **Completely outside of the species range**
   Biological control treatments are permitted but must follow the SOP. Is possible that certain stressors associated with biological control treatments outside the range may be transported into aquatic habitats inside the range, however the likelihood of this occurring is minimal. In these scenarios, aquatic habitats are protected by virtue of distance and lack of hydrologic

connectivity. NMFS's species ranges are watershed-based, which – in this context – helps to ensure that activities outside the range do not have hydrologic connectivity to the habitats.

5.6.2 Biological control agent treatment summary

Stressor	Potential impact to species and habitats	
	Inside the PULA	**Outside the PULA**
Soil, streambank disturbance	Adverse effects are not likely.	Adverse effects may occur as a result of increased sedimentation and loss of streambank habitat. However, the restriction on activities within riparian areas will minimize these effects. In addition, all designated critical habitat is with the PULA and thereby protected from this stressor.
Animal-introduced waste and invasive species	Adverse effects are not likely.	Adverse effects may occur. However, the restriction on activities within riparian areas will minimize these effects.
Unforeseen ecological consequences	Adverse effects are possible. However, ESA Section 7 consultation on the specific biological control agent treatment will have taken the likelihood of this into consideration.	Adverse effects are possible. However, ESA Section 7 consultation on the specific biological control agent treatment will have taken the likelihood of this into consideration.

6 ENDANGERED SPECIES ACT PROTECTED RESOURCES IN THE ACTION AREA

This section identifies the ESA-listed species that potentially occur within the action area affected by the BLM's vegetation treatment program. It then summarizes the biology and ecology of those species and what is known about their life histories in the action area.

6.1 Species and Designated Critical Habitat Not Likely to be Adversely Affected

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

The second criterion is the probability of a response given exposure. ESA-listed species or designated critical habitat that is exposed to a potential stressor but is likely to be unaffected by the exposure is also not likely to be adversely affected by the proposed action.

A proposed action warrants a "may affect, not likely to adversely affect" finding when its effects are completely beneficial, insignificant or when effects are discountable. Beneficial effects have an immediate positive effect without any adverse effects to the species or habitat. Beneficial effects are usually discussed when the project has a clear link to the ESA-listed species or its specific habitat needs and consultation is required because the species may be affected. Insignificant effects relate to the size or severity of the impact and include those effects that are undetectable, not measurable, or so minor that they cannot be meaningfully evaluated. Insignificant is the appropriate effect conclusion when plausible effects are going to happen, but will not rise to the level of constituting an adverse effect. That means the ESA-listed species may be affected, but the intensity of the impacts would not reach a scale where take would occur (e.g. harm, harassment). Discountable effects are those that are extremely unlikely to occur.

If the effects of a proposed action are determined to be wholly beneficial, insignificant, or discountable, we conclude that the proposed action is not likely to adversely affect ESA-listed species or designated critical habitat. This same decision model applies to individual stressors associated with the proposed action, such that some stressors may be determined to be not likely to adversely affect ESA-listed species or critical habitat because any effects associated with the stressors will not rise to the level of take under the ESA.

Cetaceans

Effects are discountable in cases where species' habitat use is such that we expect it will be extremely unlikely that effects of the proposed action will co-occur with the species or their

designated critical habitat. This is the case for listed cetaceans, and their designated critical habitats, which are found primarily in offshore or circumpolar (*i.e.,* found at high latitudes around the earth's Polar Regions) locations. In these cases, effects are discountable due to the effect of dilution (in the case of contaminants) in these large marine environments and, because these areas are expected to be far from any potential treatment sites, limiting the potential for exposure.

The following species received NLAA determinations because effects are discountable: sei whale (*Balaenoptera borealis*), blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), all listed humpback whale DPSs (*Megaptera novaeangliae*), sperm whale (*Physeter macrocephalus*), and bowhead whale (*Balaena mysticetus*). Additionally, the designated critical habitat for the Central America, Western North Pacific, and Mexico humpback whale DPSs received NLAA determinations because effects were discountable.

Effects are insignificant where exposure is possible but the species or designated critical habitat response to that exposure is undetectable, not measurable, or so minor that they cannot be meaningfully evaluated and never rises to the level of take. This is the case for listed cetaceans that are known to occur in shallow coastal habitats, or designated critical habitat located in these areas. Although exposure is possible, we do not anticipate adverse effects to species, primarily because – in the case of the herbicides - these pesticides are readily metabolized such that the risk of bioaccumulation and/or biomagnification (via dietary exposure) is low, this is especially relevant for large animals (like whales) for which the body burden required to result in an adverse response in very unlikely to be achieved. For the five cetaceans with designated or proposed critical habitat, prey availability is the only PBF that may be affected. While impacts to aquatic invertebrate prey could occur, we expect effects to this PBF to be insignificant as they would be localized to areas in proximity of use sites, limited in spatial extent and temporal persistence, and will not meaningfully reduce the overall prey availability to the species.

For Southern Resident Killer whales, we took into consideration the long-term reduction of listed salmon and steelhead and its impact on nutritional stress in the whales. Nutritional stress can lead to reduced body size and can also lower reproductive and survival rates. The highest priority salmon stocks in order of importance, are as follows: 1) Northern Puget Sound (Fall) and Southern Puget Sound (Fall), 2) Lower Columbia (Fall) and Georgia Strait (Fall), 3) Upper Columbia (Fall) and Snake River (Fall), Fraser (Spring), and Lower Columbia (Spring) (Wasser et al. 2017). As is described in the effects analysis and integration and synthesis sections, we anticipate the effects of this proposed action on salmonids – including those identified as highest priority of importance - to be minor. Therefore we do not anticipate any adverse effects to killer whales via loss of prey resulting from this proposed action.

NMFS made an LAA determination for Southern Resident Killer whale in a previous biological opinion on BLM's use of herbicides as part of their vegetation treatment program (NMFS 2015a). According to the 2015 biological opinion "we believe that minimizing the likelihood of exposure to Chinook salmon and other Pacific salmonids would reduce the likelihood that Southern Resident killer whales or their designated critical habitat could be affected by the proposed action. If

Southern Resident killer whales consume Chinook salmon that had been exposed to the three proposed AIs, Southern Resident killer whales and their critical habitat could be indirectly affected by herbicides. Thus, reducing the likelihood of exposure for Chinook salmon would in turn reduce the likelihood of exposing Southern Resident killer whales and their critical habitat to the proposed action." The present programmatic consultation has significantly reduced the likelihood of exposure for Chinook salmon by prohibiting herbicide application within 300 m of their habitats.

The following species (and associated designated or proposed critical habitats) received NLAA determinations because effects are insignificant: Beluga whale Cook Inlet DPS (*Delphinapterus leucas*), and North Pacific Right whale (*Eubalaena japonica*).

Table 70. Cetaceans with NLAA determinations

Species	Species	Critical Habitat
Sei whale *(Balaenoptera borealis)*	NLAA	--
North Pacific Right Whale *(Eubalaena japonica)*	NLAA	NLAA
Fin whale *(Balaenoptera physalus)*	NLAA	--
Bowhead whale *(Balaena mysticetus)*	NLAA	--
Blue whale *(Balaenoptera musculus)*	NLAA	--
Sperm whale *(Balaenoptera borealis)*	NLAA	--
beluga whale, Cook Inlet DPS *(Delphinapterus leucas)*	NLAA	NLAA
Humpback Whale *(Megaptera novaeangliae)*		
Western North Pacific DPS	NLAA	NLAA
Mexico DPS	NLAA	NLAA
Central America DPS	NLAA	NLAA
Killer whale, Southern resident DPS (*Orcinus orca*)	NLAA	NLAA

Pinnipeds

Effects are discountable in cases for both the bearded seal Beringia DPS and the ringed seal Arctic subspecies, and their associated designated critical habitats. These two seal species are strongly associated with ice-covered waters of the Arctic Ocean Basin and southward into adjacent seas. Bearded seals of the Beringia DPS inhabit seasonally ice-covered waters of the Bering, Chukchi, Beaufort, and East Siberian Seas. Their effective habitat is generally restricted to areas where seasonal ice occurs over relatively shallow waters. Designated critical habitat for the bearded seal Beringia DPS comprises an area of marine habitat in the Bering, Chukchi, and Beaufort Seas. Arctic ringed seals are found in the Arctic Basin and adjacent seas, including the Bering and Labrador Sea. Arctic ringed seals are highly associated with sea ice. Designated critical habitat for the Arctic subspecies of ringed seal (*Phoca hispida hispida*) comprises an area of marine habitat in the Bering, Chukchi, and Beaufort Seas. We anticipate exposure to vegetation treatment activities in those environments to be extremely unlikely. The exposure potential for marine-based prey is similarly unlikely such that we anticipate impacts to primary prey resources (a proposed PBF for both species) to be discountable as well.

The following species received NLAA determinations because effects are discountable: Pacific bearded seal, Beringia DPS (Erignathus barbatus nauticus) and Ringed seal, Arctic subspecies (Phoca (pusa) hispida).

Effects are insignificant for listed pinnipeds that utilize habitats near BLM lands with potential for vegetation treatments. Although exposure is possible, we do not anticipate adverse effects to these species, primarily because – in the case of herbicides - these pesticides are readily metabolized such that the risk of bioaccumulation and/or biomagnification (via dietary exposure) in their aquatic habitats is low. Dermal and inhalation exposure are also possible due to aerial transport of pesticide droplets and vapors to terrestrial habitats utilized by these pinnipeds. However, we do not expect these herbicides will be transported to these species habitats in concentrations sufficient to cause adverse effects from these routes of exposure. For species with designated critical habitat, prey availability is the only PBF that may be affected. While impacts to some aquatic invertebrate prey could occur, we expect effects to this PBF to be insignificant as prey impacts would be localized to areas in proximity of vegetation treatments, and limited in spatial extent and temporal persistence. Given the varied pinniped diet, these impacts will not meaningfully reduce the overall prey availability to the species.

The following species (and associated designated critical habitats) received NLAA determinations because effects are insignificant: Guadalupe fur seal (*Arctocephalus townsendi*) and Steller sea lion (*Eumetopias jubatus*).

Table 71. Pinnipeds with NLAA determinations

Species	Species	Critical Habitat
Guadalupe fur seal *(Arctocephalus townsendi)*	NLAA	--
Steller sea lion, Western DPS *(Eumetopias jubatus)*	NLAA	NLAA
Bearded Seal, Beringia DPS *(Erignathus barbatus)*	NLAA	NLAA
Ringed Seal, Arctic subspecies *(Phoca (pusa) hispida)*	NLAA	NLAA

Sea Turtles

Adverse effects from the proposed action for these listed sea turtle species (as well as their proposed or designated critical habitat) are anticipated to be discountable or insignificant, as described below.

All of the listed sea turtles use three marine habitat zones:

- Supralittoral terrestrial zone - beaches or occasionally estuarine shoreline habitats where egg laying, embryonic development, and hatching occur;
- Open ocean/convergence zones – deep water habitats (depths >200 m) utilized for ocean juvenile rearing stage and foraging habitat for adults;
- Neritic zone - coastal areas for benthic feeding and migration (0-200 m depth), the nearshore marine environment used by post-hatchlings moving from beach to convergence zones, by adults and subadults to forage, and as a migration corridor and breeding habitat for adults.

The potential for impacts to sea turtles while occupying beaches and other terrestrial habitats was not assessed by NMFS. NMFS and the USFWS have joint administrative responsibilities of the ESA as it pertains to ESA-listed sea turtles. Under a 1973 Memorandum of understanding, all consultations under section 7(a)(2) of the ESA for activities affecting sea turtles and their habitat in the terrestrial environment shall be the responsibility of USFWS. All consultations under section 7(a)(2) of the ESA for activities affecting sea turtles and their habitat in the marine environment shall be the responsibility of NMFS. USFWS is concurrently consulting with EPA on the effects of carbaryl and methomyl on sea turtles when they are in the terrestrial environment.

The impacts to sea turtles and designated critical habitats in open ocean and convergence zones are discountable. Transport modeling and consideration of habitat depth suggest that it will be extremely unlikely that herbicides or other contaminants will occur at concentrations that could affect either the species or their designated critical habitat in these deep-water habitats.

Effects are insignificant for listed sea turtles and designated critical habitats in the coastal neritic zone. Sea turtles feed in and migrate through coastal waters in relatively close proximity to potential BLM vegetation treatment sites to varying extents. Although dietary exposure is possible, we do not anticipate adverse effects to species, primarily because the herbicides are readily metabolized such that the risk of bioaccumulation and/or biomagnification is low. For species with designated critical habitat, prey availability is the only PBF that may be affected. Sea turtles diet and use of the coastal habitats varies among the ESA-listed species. In the coastal neritic zone, green turtles feed primarily on algae and grasses in benthic habitats, leatherback turtles feed primarily on soft bodied prey (jelly fish and salps), loggerhead turtles forage on bottom dwelling invertebrates (e.g., mollusks and crabs), and olive ridley turtles have an omnivorous diet that includes algae and benthic invertebrates. While it is possible that some invertebrate prey may be impacted in close proximity to vegetation treatment sites in nearshore habitats within this zone, we do not anticipate that effects will be either widespread or sustained in the marine environment considering the chemical fate characteristics of the approved herbicides and dissipation from mixing associated with tidal exchange and ocean currents. We do not anticipate any meaningful reductions in the overall prey availability to the species.

The following species received NLAA determinations because effects are insignificant: green sea turtle, East Pacific DPS (*Chelonia mydas*), leatherback sea turtle (*Dermochelys coriacea),* loggerhead sea turtle, North Pacific Ocean (*Caretta caretta*), and olive Ridley sea turtle (*Lepidochelys olivacea).* The following designated critical habitats also received NLAA determinations because effects were insignificant: hawksbill sea turtle, leatherback sea turtle, and loggerhead sea turtle (Northwest Atlantic Ocean DPS). Finally, the following proposed critical habitat also received NLAA determinations because effects were insignificant: green sea turtle, East Pacific DPS.

Table 72. Sea turtle NLAA determinations

Species	Species	Critical Habitat
Green sea turtle, East Pacific DPS (Chelonia mydas)	NLAA	May Affect (P)

Leatherback sea turtle (*Dermochelys coriacea*)	NLAA	May Affect
Loggerhead sea turtle, North Pacific DPS (Caretta caretta)	NLAA	--
Olive ridley sea turtle (*Lepidochelys olivacea*)		
Pacific Coast of Mexico breeding populations	NLAA	--
All other populations	NLAA	--

(P) Critical habitat is proposed, not designated

Marine Fish

Effects are insignificant for the scalloped hammerhead shark, Eastern Pacific DPS (*Sphyrna lewini*). Although exposure is possible, we do not anticipate adverse effects to scalloped hammerhead sharks, primarily because – in the case of herbicides - these pesticides are readily metabolized such that the risk of bioaccumulation and/or biomagnification (via dietary exposure) is low. In regard to prey availability, we expect impacts to be insignificant as affects to prey will be limited spatially, temporally, and to sensitive species (e.g., potentially some invertebrates). Additionally, given the varied diet of this species we do not expect these impacts to meaningfully reduce the overall prey availability.

Effects are discountable in cases where species' habitat use is such that we expect it will be extremely unlikely that effects of the proposed action will co-occur with the species or their designated critical habitat. This is the case for the Bocaccio and Yelloweye rockfish. BLM land within the ranges of these species is minor in extent. Given the distribution and life history of these two rockfish species relative to the BLM lands, we expect that it will be extremely unlikely that effects of the proposed action will co-occur with the species or their designated critical habitat. The following species received NLAA determinations because effects are discountable: Bocaccio, Puget Sound-Georgia Basin DPS (*Sebastes paucispinis*) and Yellow Eye Rockfish, Puget Sound-Georgia Basin DPS (*Sebastes ruberrimus*).

Table 73. Marine fish NLAA determinations

Species	Species	Critical Habitat
Scalloped Hammerhead Shark, Eastern Pacific DPS (*Sphyrna lewini*)	NLAA	--
Bocaccio, Puget Sound-Georgia Basin DPS (*Sebastes paucispinis*)	NLAA	NLAA
Yellow Eye Rockfish, Puget Sound-Georgia Basin DPS (*Sebastes ruberrimus*)	NLAA	NLAA

Anadromous Fish

Effects are discountable in cases where species' habitat use is such that we expect it will be extremely unlikely that effects of the proposed action will co-occur with the species or their designated critical habitat. This is the case for sockeye salmon, Ozette Lake DPS and chum salmon, Hood Canal summer-run DPS. NMFS made LAA determinations for these two species in a previous biological opinion on BLM's use of herbicides as part of their vegetation treatment program (NMFS 2015a). According to that biological opinion "It is possible that ESA-listed species like Pacific salmonids, eulachon, and green sturgeon of both sexes could be exposed to herbicides containing the three proposed AIs at all life stages, with the exception of those life stages which occur in the marine or estuarine environments." In the present programmatic consultation we considered updated species distribution data and found, for both species, the extent of BLM lands within their ranges is so minor in extent that exposure would be highly unlikely. Further, for both species, the BLM land that does exist is along the coast. This assessment is in agreement with NMFS (2015) in that exposure to salmonid life stages in the marine environment is extremely unlikely to occur. Given the distribution and life history of this species relative to the BLM lands, we expect that it will be extremely unlikely that effects of the proposed action will co-occur with the species or their designated critical habitat. The following species received NLAA determinations because effects are discountable: Sockeye salmon, Ozette Lake DPS (*Oncorhynchus nerka*) chum salmon, Hood Canal summer-run DPS (*Oncorhynchus keta*).

Table 74. Anadromous fish NLAA determinations

Species	Species	Critical Habitat
Sockeye salmon, Ozette Lake DPS (*Oncorhynchus nerka*)	NLAA	NLAA
Hood Canal summer-run DPS (*Oncorhynchus keta*)	NLAA	NLAA

White abalone

Effects are discountable in cases where species' habitat use is such that we expect it will be extremely unlikely that effects of the proposed action will co-occur with the species or their designated critical habitat. This is the case for white abalone due primarily to the proximity of white abalone habitat relative to BLM land. Historically, white abalone populations could be found in coastal waters between 5-60 m deep from Point Conception, California to Punta Abreojos, Baja California, Mexico (Cox 1960, Stierhoff et al. 2012). Prior to the fishery collapse, major concentrations of white abalone occurred between 25-30 m deep (Stierhoff et al. 2012). Since the fishery collapse, the depth distribution of white abalone has shifted toward deeper depths, as most living individuals are those that were too deep to be fished during the 1960s and 1970s (Lafferty et al. 2004). In surveys conducted at an offshore bank from 2002 – 2010 between depths of 30 to 60 m, white abalone were most abundant and dense at depths of 40-50 m (Stierhoff et al. 2012). There are no BLM lands within the watersheds (HUC-12) adjacent to white abalone habitats. Although it is possible that upstream activities could be transported to the coast, we expect that any exposures

and associated responses would be so minor that they could not be meaningfully evaluated and would never rise to the level of take.

Table 75. White abalone NLAA determinations

Species	Species	Critical Habitat
White abalone (*Haliotis sorenseni*)	NLAA	--

6.2 Species and Designated Critical Habitat Likely to be Adversely Affected

The purpose of this section is to characterize the status of the species that are likely to be adversely affected by the proposed action, and to describe the status, conservation role and function of their respective critical habitats.

The status is determined by the level of risk that the ESA-listed species faces, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This helps to inform the description of the species' current "reproduction, numbers, or distribution," which is part of the jeopardy determination as described in 50 C.F.R. §402.02. More detailed information on the status and trends of these ESA-listed species, and their biology and ecology can be found in the listing regulations and critical habitat designations published in the Federal Register, status reviews, recovery plans, and on this NMFS website: https://www.fisheries.noaa.gov/find-species.

Note about maps: Each section below contains a map depicting the species range and, when applicable, designated critical habitat. These maps are provided for general reference only and do not necessarily represent the spatial data that was used later in the assessment (e.g., for generating overlap percentages in the effects analysis). For more detailed information on species range and distribution, visit: https://www.fisheries.noaa.gov/species-directory/threatened-endangered.

6.2.1 Chum salmon, Columbia River ESU

Table 76. Chum salmon, Columbia River ESU; overview table

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus keta	Chum Salmon	Columbia River ESU	Threatened	2022	70 FR 37160	2013	70 FR 52630

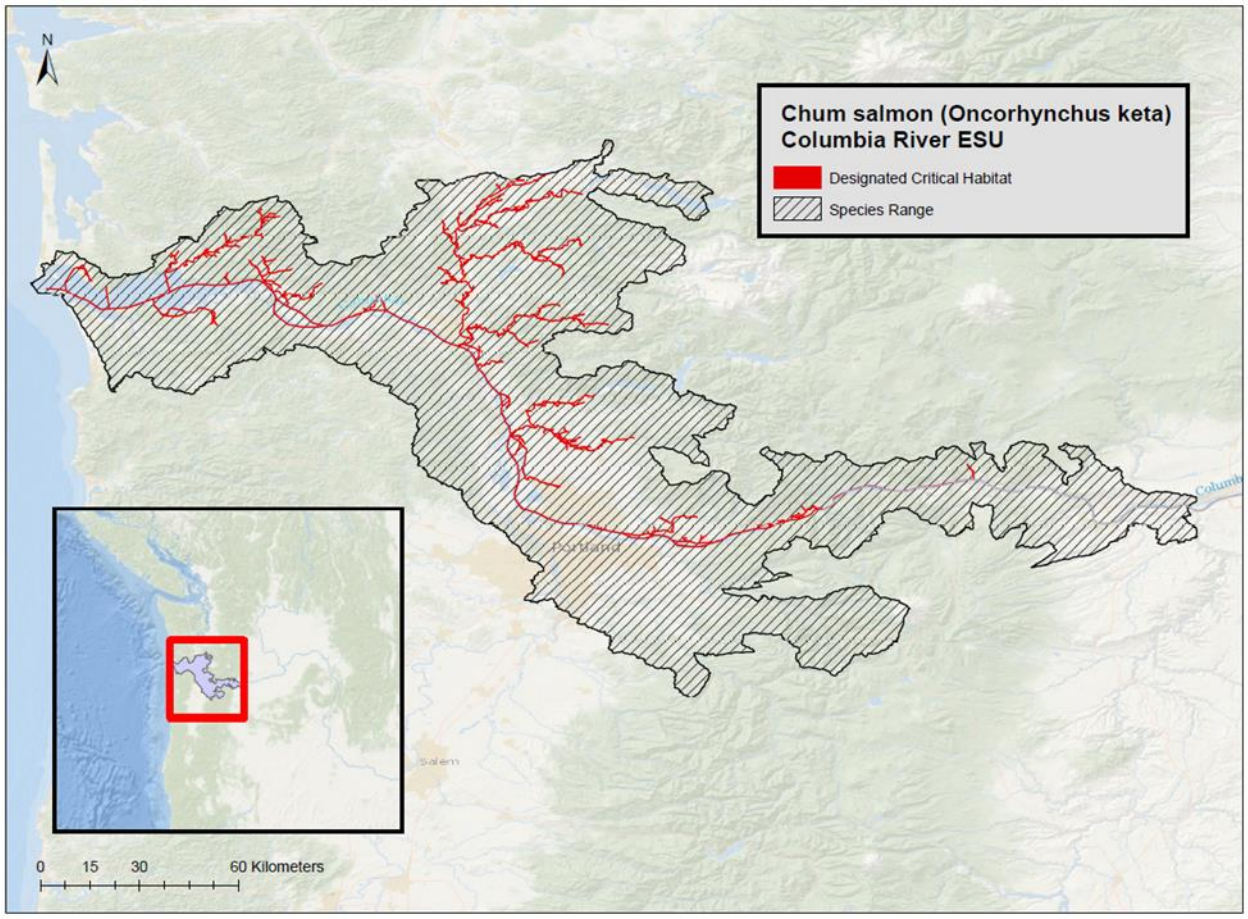


Figure 2. Chum salmon, Columbia River ESU range and designated critical habitat

Species Description. Chum salmon are an anadromous (i.e., adults migrate from marine to freshwater streams and rivers to spawn) and semelparous (i.e., they spawn once and then die) fish species. Adult chum salmon are typically between eight and 15 pounds, but they can get as large as 45 pounds and 3.6 ft long. Males have enormous canine-like fangs and a striking calico pattern body color (front two-thirds of the flank marked by a bold, jagged, reddish line and the posterior third by a jagged black line) during spawning. Females are less flamboyantly colored and lack the extreme dentition of the males. Ocean stage chum salmon are metallic greenish-blue along the back with black speckles. On March 25, 1999, NMFS listed the Hood Canal Summer-run ESU and the Columbia River ESU of chum salmon as threatened (64 FR 14508). NMFS reaffirmed the status of these two ESUs as threatened on June 28, 2005 (70 FR 37160), and in the 2022 Status Update.

Status. For the CR Chum Salmon ESU, some populations have increased in abundance since the last review (2016). However, improvements in a few populations do not warrant a change in the risk category for the ESU as a whole, especially given the uncertainty regarding climatic effects in the near future (Ford 2022; Myers, personal communication, May 11, 2022). The viability of this ESU is relatively unchanged since the last review and therefore remains at moderate to high risk of extinction. The majority of the populations within the Columbia River chum salmon ESU are at high to very high risk, with very low abundances (NWFSC 2015c). These populations are at risk of

extirpation due to demographic stochasticity and Allee effects. It is notable that during this most recent review period the three populations (Grays River, Washougal, and Lower Gorge demographically independent populations (DIPS) improved markedly in abundance. Improvements in productivity were observed in almost every year during the 2015–19 interval. This is somewhat surprising, given that the majority of chum salmon emigrate to the ocean as subyearlings after only a few weeks, and one would expect the poor ocean conditions to have a strong negative influence on the survival of juveniles (as with many of the other ESUs in this region). In contrast to the three DIPs, the remaining populations in this ESU have not exhibited any detectable improvement in status. Abundances for these populations are assumed to be at or near zero, and straying from nearby healthy populations does not seem sufficient to reestablish self-sustaining populations. It may be that the chum salmon life-history strategy of emigrating post-emergence en masse (possibly as a predator swamping mechanism) requires a critical number of spawners to be effective. The potential prospect of poor ocean conditions for the near future may put further pressure on the Columbia River chum salmon ESU (NWFSC 2015c). Freshwater habitat conditions may be negatively influencing spawning and early rearing success in some basins, and contributing to the overall low productivity of the ESU. Columbia River chum salmon were historically abundant and subject to substantial harvest until the 1950s (Johnson et al. 1997). There is no directed harvest of this ESU and the incidental harvest rate has been below 1% for the last five years (NWFSC 2015c). Land development, especially in the low gradient reaches that chum salmon prefer, will continue to be a threat to most chum salmon populations due to projected increases in the population of the greater Vancouver-Portland area and the Lower Columbia River overall (Metro 2015). The Columbia River chum salmon ESU remains at a moderate risk of extinction (NWFSC 2015c). Based on the 2022 Status Update, no reclassification for the Columbia River (CR) Chum Salmon ESU is warranted. Therefore, the CR Chum Salmon ESU remains listed as threatened.

Life History. Most chum salmon mature and return to their birth stream to spawn between three and five years of age, with 60% to 90% of the fish maturing at four years of age. Age at maturity appears to follow a latitudinal trend (i.e., greater in the northern portion of the species' range). Chum salmon typically spawn in the lower reaches of rivers, with redds usually dug in the mainstem or inside channels of rivers from just above tidal influence to 100 km from the sea. Juveniles out-migrate to seawater almost immediately after emerging from the gravel covered redds (Salo 1991). This ocean-type migratory behavior contrasts with the stream-type behavior of some other species in the genus *Oncorhynchus* (e.g., coastal cutthroat trout, steelhead, Coho salmon, and most types of Chinook and sockeye salmon), which usually migrate to sea at a larger size, after months or years of freshwater rearing. This means that survival and growth in juvenile chum salmon depend less on freshwater conditions (unlike stream-type salmonids which depend heavily on freshwater habitats) than on favorable estuarine conditions. Upon entering marine water, young of year (YOY) chum salmon are nearshore (intertidal zone and shallow subtidal) obligate feeders. For several months they are observed in just several inches of water feeding on small marine invertebrates. Another behavioral difference between chum salmon and species that rear extensively in freshwater is that chum salmon form schools, presumably to reduce predation (Pitcher 1986), especially if their movements are synchronized to confuse predators (Miller and Brannon 1982).

Chum salmon spend two to five years in feeding areas in the northeast Pacific Ocean, which is a greater proportion of their life history compared to other Pacific salmonids. Chum salmon distribute throughout the North Pacific Ocean and Bering Sea, although North American chum salmon (as

opposed to chum salmon originating in Asia), rarely occur west of 175 E longitude (Johnson et al. 1997). North American chum salmon migrate north along the coast in a narrow band that broadens in southeastern Alaska, although some data suggest that Puget Sound chum, including Hood Canal summer-run chum, may not make extended coastal migrations into northern British Columbian and Alaskan waters, but instead may travel directly offshore into the north Pacific Ocean (Johnson et al. 1997).

Table 77. Temporal distribution of Chum salmon, Columbia River ESU in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)									Present			
Spawning	Present										Present	
Incubation (eggs)	Present										Present	
Emergence (alevin to fry phases)		Present										
Rearing and migration (juveniles)		Present										

Population Dynamics

Abundance / Productivity. Chum populations in the Columbia River historically reached hundreds of thousands to a million adults each year (NMFS 2017b). In the past 50 years, the average has been a few thousand a year. The majority of populations in the Columbia River chum ESU remain at high to very high risk, with very low abundances (NWFSC 2015c). Ford (2011) concluded that 14 out of 17 of chum populations in this ESU were either extirpated or nearly extirpated. The very low persistence probabilities or possible extirpations of most chum salmon populations are due to low abundance, productivity, spatial structure, and diversity. Only one population (Grays River) is at low risk, with spawner abundances in the thousands, and demonstrating a recent positive trend. Two other populations (Washougal River and Lower Gorge) are fluctuating, but overall have an increasing numbers of spawners and appear to be relatively stable (NWFSC 2015c).

Genetic Diversity. There are currently four hatchery programs in the Lower Columbia River releasing juvenile chum salmon: Grays River Hatchery, Big Creek Hatchery, Lewis River Hatchery, and Washougal Hatchery (NMFS 2017b). Total annual production from these hatcheries has not exceeded 500,000 juvenile fish. All of the hatchery programs in this ESU use integrated stocks developed to supplement natural production. Other populations in this ESU persist at very low abundances and the genetic diversity available would be very low (NWFSC 2015c). Although, hatchery production of Columbia River chum salmon has been limited and hatchery effects on diversity are thought to have been relatively small, diversity has been greatly reduced at the ESU level because of presumed extirpations and low abundance in the remaining populations (fewer than 100 spawners per year for most populations) (LCFRB 2010a, NMFS 2013a).

Distribution. Chum salmon have the widest natural geographic and spawning distribution of the Pacific salmonids. Chum salmon have been documented to spawn from Korea and the Japanese island of Honshu, east around the rim of the North Pacific Ocean to Monterey Bay, California. Historically, chum salmon were distributed throughout the coastal regions of western Canada and the U.S. At present, major spawning populations occur as far south as Tillamook Bay on the northern Oregon coast. The Columbia River chum salmon ESU includes all natural-origin chum salmon in the Columbia River and its tributaries in Washington and Oregon. The ESU consists of

three populations: Grays River, Hardy Creek and Hamilton Creek in Washington State. Chum salmon from four artificial propagation programs also contribute to this ESU.

Designated Critical Habitat. NMFS designated critical habitat for the Columbia River chum salmon ESU in 2005 (70 FR 52630). Sixteen of the 19 subbasins reviewed in NMFS's assessment of critical habitat for the CR chum salmon ESU were rated as having a high conservation value. The remaining three subbasins were given a medium conservation value. Washington's federal lands were rated as having high conservation value to the species. PBFs considered essential for the conservation of the Columbia River ESU of Chum salmon described in Appendix B.

Limited information exists on the quality of essential habitat characteristics for CR chum salmon. However, the migration PBF has been significantly impacted by dams obstructing adult migration and access to historic spawning locations. Water quality and cover for estuary and rearing PBFs have decreased in quality to the extent that the PBFs are not likely to maintain their intended function to conserve the species.

Recovery Goals. The ESU recovery strategy for Columbia River chum salmon focuses on improving tributary and estuarine habitat conditions, reducing or mitigating hydropower impacts, and reestablishing chum salmon populations where they may have been extirpated (NMFS 2013a). The goal of the strategy is to increase the abundance, productivity, diversity, and spatial structure of chum salmon populations such that the Coast and Cascade chum salmon strata are restored to a high probability of persistence, and the persistence probability of the two Gorge populations improves. For details on Columbia River chum salmon ESU recovery goals, including complete down-listing/delisting criteria, see the NMFS 2013 recovery plan (NMFS 2013a).

Recommendations for Future Actions

- Conduct systematic review and analysis of high priority Lower Columbia River mainstem and tributary area habitat needs, identified in NMFS 2013a, and compare needs to what has been accomplished;
- Conduct monitoring to evaluate ship wake stranding frequency and locations where stranding occurs and assess factors contributing to wake stranding such as location, topography, vessel speed, et cetera, to determine best practices to reduce wake stranding mortality;
- Promote riparian plantings of native canopy tree cover species opportunistically in all watersheds;
- Coordinate with EPA in an evaluation of Washington State Water Quality Standards, reflecting Oregon and Idaho consultation outcomes;
- For populations within the below listed major population groups (MPGs), we recommend the following recovery actions over the next five years.

Coast MPGs

- Increase the number of projects that reduce sediment load in spawning habitat for Grays/Chinook River chum;
- Promote projects that reduce flashy stream conditions to improve spawning habitat for Grays/Chinook River chum;

- Implement additional habitat improvement projects in the Elochoman River and Abernathy, Mill, and Germany creeks, and their tributaries to augment spawning (chum) and rearing (coho) habitat.

Cascade MPGs

- Identify and implement spawning habitat projects to expand spatial distribution of chum into the Cascade MPG, with priority on the Lewis and Washougal rivers, (Washington Primary populations) and the Cowlitz and Kalama rivers (contributing populations);
- Work with county and city jurisdictions to protect watershed hydrology from long-term development impacts (floodplain development and groundwater withdrawals). Focus these efforts on high growth rate watersheds along the I-5 and I-205 corridors, including the East Fork Lewis River, North Fork Lewis River, Coweeman River, Kalama River, Washougal River, Salmon Creek, and Lower Cowlitz tributaries.

Gorge MPGs

- Continue to work with partners on programs protecting instream and floodplain habitats in key chum spawning areas, such as Duncan Creek and Hamilton Creek, (e.g., evaluate if large wood debris mitigates excess winter stream flows that degrade spawning for Upper Gorge chum);
- Continue to work with partners to identify suitable chum spawning habitat streams and reaches to emplace habitat creation or enhancement projects in order to expand spatial distribution into the gorge strata;
- Implement habitat projects to mitigate excess winter flow to improve spawning habitat for Lower Gorge chum and Upper Gorge chum.

6.2.2 Chinook salmon, California coastal ESU

Table 78. Chinook salmon, California coastal ESU; overview table

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus tshawytscha	Chinook salmon	California Coastal	Threatened	2016	70 FR 37160	2016	70 FR 52488

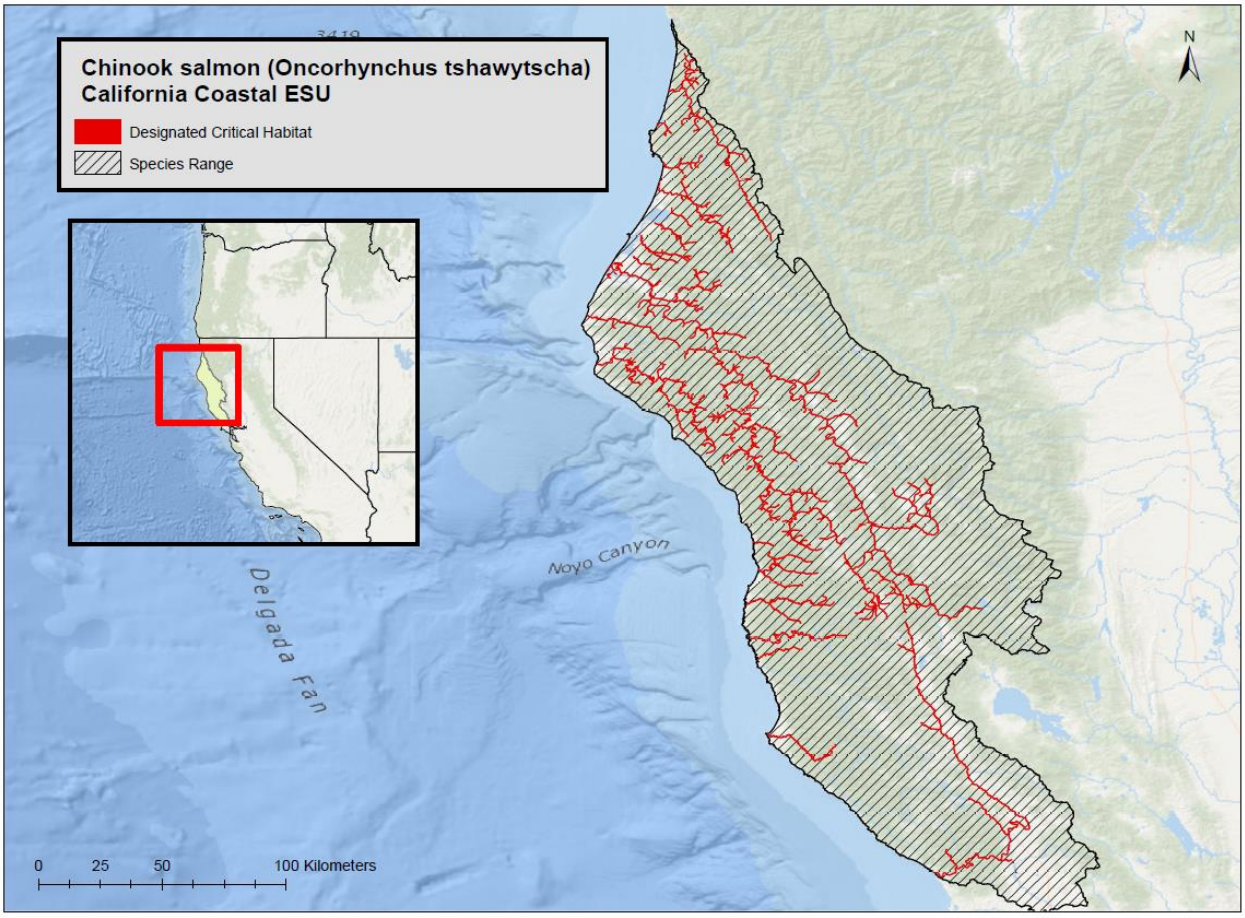


Figure 3. Chinook salmon, California coastal ESU range and designated critical habitat

Species Description. Chinook salmon, also referred to as king salmon, are the largest of the Pacific salmon. Spawning adults are olive to dark maroon in color, without conspicuous streaking or blotches on the sides. Spawning males are darker than females, and have a hooked jaw and slightly humped back. They can be distinguished from other spawning salmon by the color pattern, particularly the spotting on the back and tail, and by the dark, solid black gums of the lower jaw (Moyle 2002a). On September 16, 1999, NMFS listed the California coastal (CC) ESU of Chinook salmon as a threatened species (FR 64 50394). On June 28, 2005, NMFS confirmed the listing of CC Chinook salmon as threatened under the ESA and also added seven artificially propagated populations from the following hatcheries or programs to the listing. The CC Chinook salmon ESU

includes all naturally spawned populations of Chinook salmon from rivers and streams south of the Klamath River (Humboldt County, CA.) to the Russian River (Sonoma County, CA) (70 FR 37160).

Status. The ESU was historically comprised of 38 populations which included 32 fall-run populations and six spring-run populations across four Diversity Strata (Spence et al. 2008b). All six of the spring-run populations were classified as functionally independent, but are considered extinct (Williams et al. 2011). Good et al. (2005a) cited continued evidence of low population sizes relative to historical abundance, mixed trends in the few available time series of abundance indices available, and low abundance and extirpation of populations in the southern part of the ESU. In addition, the apparent loss of the spring-run life history type throughout the entire ESU as a significant diversity concern. The 2016 recovery plan determined that the four threats of greatest concern to the ESU are channel modification, roads and railroads, logging and wood harvesting, and both water diversion and impoundments and severe weather patterns.

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

The length of time required for embryo incubation and emergence from the gravel is dependent on water temperature. For maximum embryo survival, water temperatures reportedly must be between 41°F and 55.4°F and oxygen saturation levels must be close to maximum. Under those conditions, embryos hatch in 40 to 60 days and remain in the gravel as alevins (the life stage between hatching and egg sack absorption) for another four to six weeks before emerging as fry. Juveniles may reside in freshwater for 12 to 16 months, but some migrate to the ocean as young-of-the- year in the winter or spring months within eight months of hatching.

Juvenile Chinook salmon are nearshore obligate feeders foraging in shallow areas with protective cover, such as eelgrass in tidally influenced sandy beaches and other vegetated zones (Healey et al. 1991). Invertebrates including cladocerans, copepods, amphipods, and larvae of diptera, as well as small arachnids and ants are common prey items (Kjelson et al. 1982a, Sommer et al. 2001, MacFarlane and Norton 2002). Upon reaching the ocean, juvenile Chinook salmon feed voraciously on larval and juvenile fishes, plankton, and terrestrial insects (Healey et al. 1991, MacFarlane and Norton 2002). Chinook salmon grow rapidly in the ocean environment, with growth rates dependent on water temperatures and food availability.

Table 79. Temporal distribution of Chinook salmon, California coastal ESU in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)	Present									Present		
Spawning	Present										Present	
Incubation (eggs)	Present										Present	
Emergence (alevin to fry phases)		Present										
Rearing and migration (juveniles)		Present										

Population Dynamics

Abundance. Comparison of historical and current abundance information indicates that independent populations of Chinook salmon are depressed in many basins (Bennet 2005, Good et al. 2005b, NMFS 2008a); only the Russian River currently has a run of any significance (Bjorkstedt et al. 2005). The 2000 to 2007 median observed (at Mirabel Dam) Russian River Chinook salmon run size is 2,991 with a maximum of 6,103 (2003) and a minimum of 1,125 (2008) adults (Cook 2008, Sonoma County Water Agency (SCWA) 2008).

Productivity / Population Growth Rate. The available data, a mixture of short-term (6-year or less) population estimates or expanded redd estimates and longer-term partial population estimates and spawner/red indexes, provide no indication that any of the independent populations (likely to persist in isolation) are approaching viability targets. Overall, there is a lack of compelling evidence to suggest that the status of these populations has improved or deteriorated appreciably since the previous status review back in 2011 (Williams et al. 2011).

Genetic Diversity. At the ESU level, the loss of the spring-run life history type represents a significant loss of diversity within the ESU, as has been noted in previous status reviews (Good et al. 2005b, Williams et al. 2011). Concern remains about the extremely low numbers of Chinook salmon in most populations of the North-Central Coast and Central Coast strata, which diminishes connectivity across the ESU. However, the fact that Chinook salmon have regularly been reported in the Ten Mile, Noyo, Big, Navarro, and Garcia rivers represents a significant improvement in our understanding of the status of these populations in watersheds where they were thought to have been extirpated. These observations suggest that spatial gaps between extant populations are not as extensive as previously believed.

Distribution. The California Coastal Chinook ESU includes all naturally spawned populations of Chinook salmon from rivers and streams south of the Klamath River to the Russian River, California (64 FR 50394; September 16, 1999). Seven artificial propagation programs are considered to be part of the ESU: The Humboldt Fish Action Council (Freshwater Creek), Yager Creek, Redwood Creek, Hollow Tree, Van Arsdale Fish Station, Mattole Salmon Group, and Mad River Hatchery fall-run Chinook hatchery programs. These artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (NMFS 2005a).

Designated Critical Habitat. NMFS designated critical habitat for the California coastal Chinook salmon on September 2, 2005 (70 FR 52488). It includes multiple CALWATER hydrological units north from Redwood Creek and south to Russian River. The total area of critical habitat includes 1,500 miles of stream habitat and about 25 square miles of estuarine habitat, mostly within Humboldt Bay. PBFs considered essential for the conservation of the California coastal ESU of Chinook salmon described in Appendix B.

There are 45 occupied CALWATER Hydrologic Subarea watersheds within the freshwater and estuarine range of this ESU. Eight watersheds received a low rating, 10 received a medium rating, and 27 received a high rating of conservation value to the ESU (70 FR 52488). Two estuarine habitat areas used for rearing and migration (Humboldt Bay and the Eel River Estuary) also received a high conservation value rating. Critical habitat in this ESU consists of limited quantity and quality summer and winter rearing habitat, as well as marginal spawning habitat. Compared to historical conditions, there are fewer pools, limited cover, and reduced habitat complexity. The current condition of PBFs of the California coastal Chinook salmon critical habitat indicates that PBFs are not currently functioning or are degraded; their conditions are likely to maintain a low population abundance across the ESU.

Recovery Goals. Recovery goals, objectives and criteria for the CC Chinook salmon are fully outlined in the 2016 Recovery Plan(NMFS 2016d). Recovery plan objectives are to: 1. Reduce the present or threatened destruction, modification, or curtailment of habitat or range; 2. Ameliorate utilization for commercial, recreational, scientific, or educational purposes; 3. Abate disease and predation; 4. Establish the adequacy of existing regulatory mechanisms for protecting CC Chinook salmon now and into the future (i.e., post-delisting); 5. Address other natural or manmade factors affecting the continued existence of CC Chinook salmon; and 6. Ensure the status of CC Chinook salmon is at a low risk of extinction based on abundance, growth rate, spatial structure and diversity.

6.2.3 Chinook salmon, Central Valley spring-run ESU

Table 80. Chinook salmon, Central Valley spring-run ESU; overview table

Species	Common Name	Distinct Population Segments (DPS)	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus tshawytscha	Chinook Salmon	Central Valley Spring-run	Threatened	2016	1999 64 FR 50394 2014 79 FR 20802	2014	2005 70 FR 52630

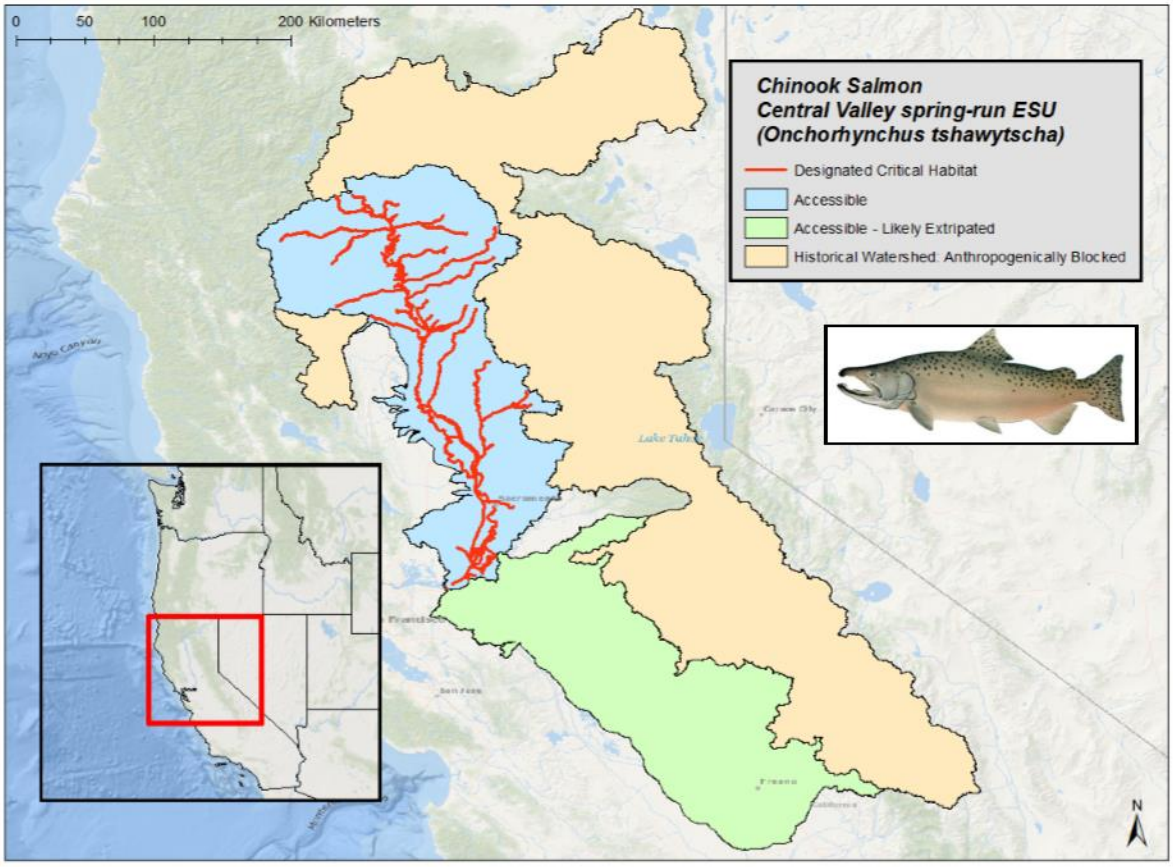


Figure 4. Chinook salmon, Central Valley spring-run ESU range and designated critical habitat

Species Description. On September 16, 1999, NMFS listed the Central Valley ESU of spring-run Chinook salmon as a threatened species (FR 64 50394). Historically, spring-run Chinook salmon occurred in the headwaters of all major river systems in the Central Valley where natural barriers to migration were absent. The only known streams that currently support self-sustaining populations

of non-hybridized spring-run Chinook salmon in the Central Valley are Mill, Deer and Butte creeks. Each of these populations is small and isolated (NMFS 2014b).

Status. Although spring-run Chinook salmon were probably the most abundant salmonid in the Central Valley, this ESU has suffered the most severe declines of any of the four Chinook salmon runs in the Sacramento River Basin (Fisher 1994). The ESU is currently limited to independent populations in Mill, Deer, and Butte creeks, persistent and presumably dependent populations in the Feather and Yuba rivers and in Big Chico, Antelope, and Battle creeks, and a few ephemeral or dependent populations in the Northwestern California region (e.g., Beegum, Clear, and Thomes creeks). The Central Valley spring-run Chinook salmon ESU is currently faced with three primary threats: (1) loss of most historic spawning habitat; (2) degradation of the remaining habitat; and (3) genetic introgression with the Feather River fish hatchery spring-run Chinook salmon strays. The potential effects of climate change are likely to adversely affect spring-run Chinook salmon and their recovery (NMFS 2014b).

Life History. Adult Central Valley spring-run Chinook salmon leave the ocean to begin their upstream migration in late January and early February, and enter the Sacramento River between March and September, primarily in May and June (Yoshiyama et al. 1998, Moyle 2002a). Spring-run Chinook salmon generally enter rivers as sexually immature fish and must hold in freshwater for up to several months before spawning. While maturing, adults hold in deep pools with cold water. Spawning normally occurs between mid- August and early October, peaking in September (Moyle 2002a).

The length of time required for embryo incubation and emergence from the gravel is dependent on water temperature. For maximum embryo survival, water temperatures reportedly must be between 41°F and 55.4°F and oxygen saturation levels must be close to maximum. Under those conditions, embryos hatch in 40 to 60 days and remain in the gravel as alevins (the life stage between hatching and egg sack absorption) for another four to six weeks before emerging as fry. Spring-run fry emerge from the gravel from November to March (Moyle 2002a). Juveniles may reside in freshwater for 12 to 16 months, but some migrate to the ocean as young-of-the- year in the winter or spring months within eight months of hatching.

Juvenile Chinook salmon are nearshore obligate feeders foraging in shallow areas with protective cover, such as eelgrass in tidally influenced sandy beaches and other vegetated zones (Healey et al. 1991). Invertebrates including cladocerans, copepods, amphipods, and larvae of diptera, as well as small arachnids and ants are common prey items (Kjelson et al. 1982a, Sommer et al. 2001, MacFarlane and Norton 2002). Upon reaching the ocean, juvenile Chinook salmon feed voraciously on larval and juvenile fishes, plankton, and terrestrial insects (Healey et al. 1991, MacFarlane and Norton 2002). Chinook salmon grow rapidly in the ocean environment, with growth rates dependent on water temperatures and food availability.

Table 81. Temporal distribution of Chinook salmon, Central Valley spring-run ESU in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)			Present									
Spawning								Present				
Incubation (eggs)								Present				
Emergence (alevin to fry phases)											Present	
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance. The Central Valley as a whole is estimated to have supported spring-run Chinook salmon runs as large as 600,000 returning spawners between the late 1880s and 1940s. The only known streams that currently support self-sustaining populations of nonhybridized spring-run Chinook salmon in the Central Valley are Mill, Deer and Butte creeks. Abundance and trend estimates for these streams as well as streams supporting dependent populations are provided in Table 82 (NMFS 2014b).

Table 82. Viability metrics for Central Valley spring-run ESU Chinook salmon populations.

Population	**N**	**Ŝ**	**10-year trend 2005-2015 (95% CI)**	**Recent Decline (%)**
Antelope Creek	8.0	2.7	-0.375 (-0.706, -0.045)	87.8
Battle Creek	1836	612	0.176 (0.033, 0.319)	9.0
Big Chico Creek	0.0	0.0	-0.358 (-0.880, 0.165)	60.7
Butte Creek	20169	6723	0.353 (-0.061, 0.768)	15.7
Clear Creek	822	274	0.010 (-0.311, 0.330)	63.3
Cottonwood Creek	4	1.3	-0.343 (-0.672, -0.013)	87.5
Deer Creek	2272	757.3	-0.089 (-0.337, 0.159)	83.8
Feather River Fish Hatchery	10808	3602.7	0.082 (-0.015, 0.179)	17.1
Mill Creek	2091.0	697.0	-0.049 (-0.183, 0.086)	58.0
Sacramento Rivera	-	-	-	-
Yuba River	6515	2170.7	0.67 (-0.138, 0.272)	9.0

N: Total population size (N) is estimated as the sum of estimated run sizes over the most recent three years for Core 1 populations (bold) and Core 2 populations.
Ŝ: The mean population size (Ŝ) is the average of the estimated run sizes for the most recent three years (2012 to 2014).
Population growth/decline rate (10 year trend) is estimated from the slope of log-transformed estimated run size.
The catastrophic metric (recent decline) is the largest year-to-year decline in total population size (N) over the most recent 10 such ratios.
[a] *Beginning in 2009, estimates of spawning escapement of Upper Sacramento River spring chinook were no longer monitored.*

Productivity / Population Growth Rate. Cohort replacement rates (CRR) are indications of whether a cohort is replacing itself in the next generation. The majority of Central Valley (CV) spring-run Chinook salmon are found to return as 3-year olds, therefore looking at returns every three years is used as an estimate of the CRR. In the past the CRR has fluctuated between just over 1.0 to just under 0.5, and in the recent years with high returns (2012 and 2013), CRR jumped to 3.84 and 8.68 respectively. CRR for 2014 was 1.85, and the CRR for 2015 with very low returns was a record low of 0.14. Low returns in 2015 were further decreased due to high temperatures and

most of the CV spring-run Chinook salmon tributaries experienced some pre-spawn mortality. Butte Creek experienced the highest prespawn mortality in 2015, resulting in a carcass survey CRR of only 0.02.

Genetic Diversity. Threats to the genetic integrity of spring-run Chinook salmon was identified as a serious concern to the species when it was listed in 1999 (Myers et al. 1998a, FR 64 50394). Three main factors compromised the genetic integrity of spring-run Chinook salmon: (1) the lack of reproductive isolation following dam construction throughout the Central Valley resulting in introgression with fall-run Chinook salmon in the wild; (2) within basin and inter-basin mixing between spring and fall broodstock for artificial propagation, resulting in introgression in hatcheries; and (3) releasing hatchery-produced juvenile Chinook salmon in the San Francisco estuary, which contributes to the straying of returning adults throughout the Central Valley (NMFS 2014b).

Distribution. The Central Valley Technical Recovery Team delineated 18 or 19 historic independent populations of CV spring-run Chinook salmon, and a number of smaller dependent populations, that are distributed among four diversity groups (southern Cascades, northern Sierra, southern Sierra, and Coast Range) (Lindley et al. 2004). Of these independent populations, only three are extant (Mill, Deer, and Butte creeks) and they represent only the northern Sierra Nevada diversity group. Of the dependent populations, CV spring-run Chinook salmon are found in Battle, Clear, Cottonwood, Antelope, Big Chico, and Yuba creeks, as well as the Sacramento and Feather rivers and a number of tributaries of the San Joaquin River including Mokelumne, Stanislaus, and Tuolumne rivers. The 2005 listing determination concluded that the Feather River Fish Hatchery spring-run Chinook salmon production should be included in the Central Valley spring-run Chinook salmon ESU (79 FR 20802, NMFS 2016a).

Designated Critical Habitat NMFS published a final rule designating critical habitat for Central Valley spring-run Chinook on September 2, 2005 (70 FR 52488). The designated critical habitat includes 1,853 km (1,158 mi) of streams and 655 km^2 (254 km^2) of estuarine habitat. PBFs considered essential for the conservation of the Central Valley spring-run ESU of Chinook salmon are described in Appendix B.

The current condition of PBFs of the CV Spring-run Chinook salmon critical habitat indicates that PBFs are not currently functioning or are degraded; their conditions are likely to maintain a low population abundance across the ESU. Spawning and rearing PBFs are degraded by high water temperature caused by the loss of access to historic spawning areas in the upper watersheds which maintained cool and clean water throughout the summer. The rearing PBF is degraded by floodplain habitat being disconnected from the mainstem of larger rivers throughout the Sacramento River watershed, thereby reducing effective foraging. The migration PBF is degraded by lack of natural cover along the migration corridors. Juvenile migration is obstructed by water diversions along Sacramento River and by two large state and federal water-export facilities in the Sacramento-San Joaquin Delta.

Recovery Goals. Recovery goals, objectives and criteria for the Central Valley spring-run Chinook are fully outlined in the 2014 Recovery Plan (NMFS 2014b). The ESU delisting criteria for the spring-run Chinook are: 1) one population in the Northwestern California Diversity Group at low

risk of extinction; 2) two populations in the Basalt and Porous Lava Diversity Group at low risk of extinction; 3) four populations in the Northern Sierra Diversity Group at low risk of extinction; 4) two populations in the Southern Sierra Diversity Group at low risk of extinction; and 5) Maintain multiple populations at moderate risk of extinction.

6.2.4 Chinook salmon, Lower Columbia River ESU

Table 83. Chinook salmon, Lower Columbia River ESU; overview table

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus tshawytscha	Chinook Salmon	Lower Columbia River ESU	Threatened	2022	70 FR 37160	2013	70 FR 52630

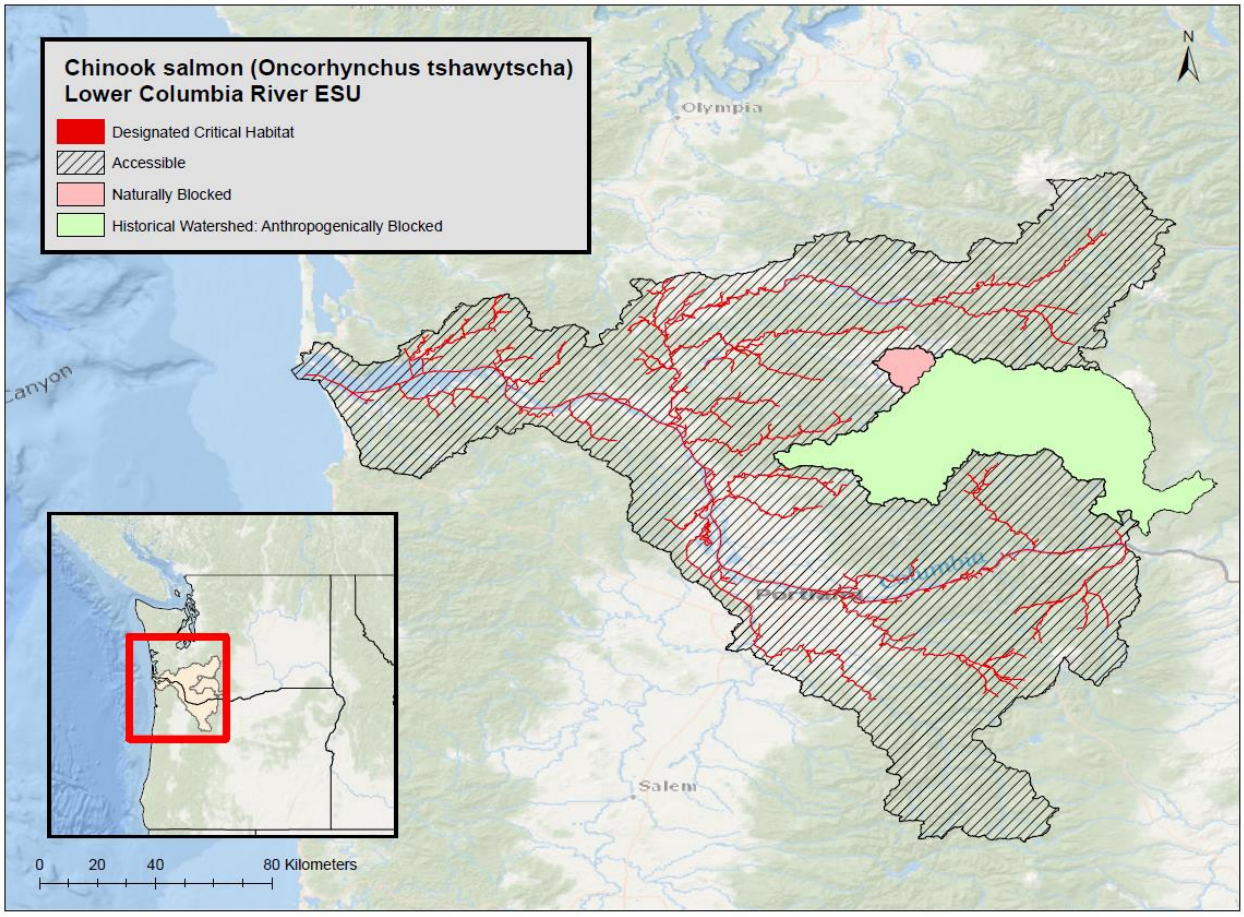


Figure 5. Chinook salmon, Lower Columbia River ESU range and designated critical habitat

Species Description. Chinook salmon, also referred to as king salmon in California, are the largest of the Pacific salmon. Spawning adults are olive to dark maroon in color, without conspicuous streaking or blotches on the sides. Spawning males are darker than females, and have a hooked jaw and slightly humped back. They can be distinguished from other spawning salmon by the color pattern, particularly the spotting on the back and tail, and by the dark, solid black gums of the lower jaw (Moyle 2002a).

On March 24, 1999, NMFS listed the Lower Columbia River ESU of Chinook salmon as a threatened species (64 FR 14308). The listing was revisited and confirmed as threatened in 2005 (70

FR 37160). The Lower Columbia River Chinook salmon ESU reaffirmed in the 2022 Status Update, includes all naturally-spawned populations of fall-run and spring-run Chinook salmon from the Columbia River and its tributaries from its mouth at the Pacific Ocean upstream to a transitional point between Oregon and Washington, east of the Hood River and the White Salmon River and any such fish originating from the Willamette River and its tributaries below Willamette Falls. Twenty artificial propagation programs are included in the ESU (70 FR 37160). The Northwest Fisheries Science Center's review (Ford 2022) found that no new information has become available that would justify a change in the delineation of the LCR Chinook salmon ESU.

Status. The 2022 update determined that no reclassification for the LCR Chinook salmon ESU is warranted. Therefore, the LCR Chinook salmon ESU remains listed as threatened. Although many of the populations in this ESU are at high risk, it is important to note the poor ocean and freshwater conditions existed during the 2015-2019 period and despite these conditions the status of a number of populations improved, some remarkably so (Grays River, Lower Cowlitz River, and Kalama River fall runs). Overall, the viability of the Lower Columbia River Chinook Salmon ESU has increased somewhat since the last 5-year review, although the ESU remains at moderate risk of extinction (Ford 2022). Populations of Lower Columbia River Chinook salmon have declined substantially from historical levels. Out of the 32 populations that make up this ESU, only the late-fall run Sandy River run is considered viable. Of the seven spring-run DIPs in this MPG, there are abundance estimates for the Upper Cowlitz/Cispus Rivers (2 DIPs combined), Kalama River, North Fork Lewis River, and Sandy River populations. Of these, only the Sandy River population appears to be sustaining natural-origin abundance at near-recovery levels. The most-recent 5-year geomean abundance for the Sandy River was 3,359, which represents an 89% increase over 2010–14. Most populations (26 out of 32) have a very low probability of persistence over the next 100 years and some are extirpated or nearly so. Five of the six strata fall significantly short of the recovery plan criteria for viability. Low abundance, poor productivity, losses of spatial structure, and reduced diversity all contribute to the very low persistence probability for most Lower Columbia River Chinook salmon populations. All of the spring-run populations except Sandy River exhibited a recent uniform decline, possibly related to climatic and oceanic conditions (Tables 28 and 29, Figure 52). Elsewhere in this MPG natural-origin abundances for spring-run Chinook salmon were very low, with negative trends. For the Upper Cowlitz/Cispus Rivers, Kalama River, and North Fork Lewis River populations, hatchery returns currently constitute the vast majority of fish returning to the river. Hatchery contribution to naturally-spawning fish remains high for a number of populations, and it is likely that many returning unmarked adults are the progeny of hatchery origin parents, especially where large hatchery programs operate. Continued land development and habitat degradation in combination with the potential effects of climate change will present a continuing strong negative influence into the foreseeable future. Based on the 2022 Status Update, no reclassification for the LCR Chinook Salmon ESU is warranted. Therefore, the LCR Chinook Salmon ESU remain listed as threatened.

Life History. Lower Columbia River Chinook salmon display three run types including early fall-runs, late fall-runs, and spring-runs. Presently, the fall-run is the predominant life history type. Spring-run Chinook salmon were numerous historically. Fall-run Chinook salmon enter fresh water typically in August through October. Early fall-run spawn within a few weeks in large river mainstems. The late fall-run enters in immature conditions, has a delayed entry to spawning grounds, and resides in the river for a longer time between river entry and spawning. Spring-run

Chinook salmon enter fresh water in March through June to spawn in upstream tributaries in August and September.

Offspring of fall-run spawning may migrate as fry to the ocean soon after yolk absorption (*i.e.*, ocean-type), at 30–45 mm in length (Healey 1991). In the Lower Columbia River system, however, the majority of fall-run Chinook salmon fry migrate either at 60-150 days post-hatching in the late summer or autumn of their first year. Offspring of fall-run spawning may also include a third group of yearling juveniles that remain in fresh water for their entire first year before emigrating. The spring-run Chinook salmon migrates to the sea as yearlings (stream-type) typically in spring. However, the natural timing of LCR spring-run Chinook salmon emigration is obscured by hatchery releases (Myers et al. 2006). Once at sea, the ocean-type LCR Chinook salmon tend to migrate along the coast, while stream-type LCR Chinook salmon appear to move far off the coast into the central North Pacific Ocean (Healey 1991, Myers et al. 2006). Adults return to tributaries in the lower Columbia River predominantly as 3- and 4-year-olds for fall-run fish and 4- and 5-year-olds for spring-run fish.

Juvenile Chinook salmon are nearshore obligate feeders foraging in shallow areas with protective cover, such as eelgrass in tidally influenced sandy beaches and other vegetated zones (Healey et al. 1991). Invertebrates including cladocerans, copepods, amphipods, and larvae of diptera, as well as small arachnids and ants are common prey items (Kjelson et al. 1982a, Sommer et al. 2001, MacFarlane and Norton 2002). Upon reaching the ocean, juvenile Chinook salmon feed voraciously on larval and juvenile fishes, plankton, and terrestrial insects (Healey et al. 1991, MacFarlane and Norton 2002). Chinook salmon grow rapidly in the ocean environment, with growth rates dependent on water temperatures and food availability.

Table 84. Temporal distribution of Chinook salmon, Lower Columbia River ESU in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)			Present									
Spawning	Present							Present				
Incubation (eggs)	Present							Present				
Emergence (alevin to fry phases	Present											
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance. Populations of Lower Columbia River Chinook salmon have declined substantially from historical levels. Many of the ESU's populations are believed to have very low abundance of natural-origin spawners (100 adult spawners or fewer), which increases genetic and demographic risks. Other populations have higher total abundance, but several of these also have high proportions of hatchery-origin spawners.

Productivity / Population Growth Rate. Trend indicators for most populations are negative. The majority of populations for which data are available have a long-term trend of <1; indicating the population is in decline (Bennet 2005, Good et al. 2005b). Only the Sandy River population appears to be sustaining natural-origin abundance at near-recovery levels. The most-recent 5-year geomean

abundance for the Sandy River was 3,359, which represents an 89% increase over 2010–14. The late-fall run of the Sandy River seems to be gone (NMFS 2022a).

Genetic Diversity. The genetic diversity of all populations (except the late fall-run Chinook salmon) has been eroded by large hatchery influences and periodically by low effective population sizes. The near loss of the spring-run life history type remains an important concern for maintaining diversity within the ESU.

Distribution. The basin wide spatial structure has remained generally intact. However, the loss of about 35% of historic habitat has affected distribution within several Columbia River subbasins. Currently, only one population appears self-sustaining (Good et al. 2005b).

Designated Critical Habitat. NMFS designated critical habitat for LCR Chinook salmon on September 2, 2005 (70 FR 52630). It includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Hood Rivers as well as specific stream reaches in a number of tributary subbasins. PBFs considered essential for the conservation of Chinook salmon, Lower Columbia River ESU are described in Appendix B.

Timber harvest, agriculture, and urbanization have degraded spawning and rearing PBFs by reducing floodplain connectivity and water quality, and by removing natural cover in several rivers. Hydropower development projects have reduced the timing and magnitude of water flows, thereby altering the water quantity needed to form and maintain physical habitat conditions and support juvenile growth and mobility. Adult and juvenile migration PBFs are affected by several dams along the migration route.

Recovery Goals. NMFS has developed the following delisting criteria for the Lower Columbia River Chinook salmon ESU (NMFS 2013a) . For a complete description of the ESU recovery goals, including complete down-listing/delisting criteria, see the 2013 recovery plan.
All strata that historically existed have a high probability of persistence or have a probability of persistence consistent with their historical condition. High probability of stratum persistence is defined as:

- At least two populations in the stratum have at least a 95% probability of persistence over a 100-year time frame (i.e., two populations with a score of 3.0 or higher based on the Technical Recovery Team's (TRT) scoring system).
- Other populations in the stratum have persistence probabilities consistent with a high probability of stratum persistence (i.e., the average of all stratum population scores is 2.25 or higher, based on the TRT's scoring system).
- Populations targeted for a high probability of persistence are distributed in a way that minimizes risk from catastrophic events, maintains migratory connections among populations, and protects within-stratum diversity.
- A probability of persistence consistent with historical condition refers to the concept that strata that historically were small or had complex population structures may not have met Criteria A through C, above, but could still be considered sufficiently viable if they provide a contribution to overall ESU viability similar to their historical contribution.

Recommendations for Future Actions. The 2022 Status Update recommended for all populations and all MPGs that comprise the LCR Chinook salmon, future recovery actions over the next five years include:

- Conduct systematic review and analysis of high priority Lower Columbia River mainstem and tributary area habitat needs, identified in NMFS 2013a, and compare needs to what has been accomplished.
- Conduct monitoring to evaluate ship wake stranding frequency and locations where stranding occurs and assess factors contributing to wake stranding such as location, topography, vessel speed, et cetera, to determine best practices to reduce wake stranding mortality.
- Promote riparian plantings of native canopy tree cover species opportunistically in all watersheds.
- Coordinate with EPA in an evaluation of Washington State Water Quality Standards, reflecting Oregon and Idaho consultation outcomes.
- Increase the number of habitat projects that target fall Chinook salmon spawning (Big Creek, Elochoman/Skamokawa, Clatskanie River, Mill/Abernathy/Germany Creek, Toutle River, and Hood River).

6.2.5 Chinook salmon, Puget Sound ESU

Table 85. Chinook salmon, Puget Sound ESU; overview table

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus tshawytscha	Chinook salmon	Puget Sound ESU	Threatened	2022	70 FR 37160	2007	70 FR 52630

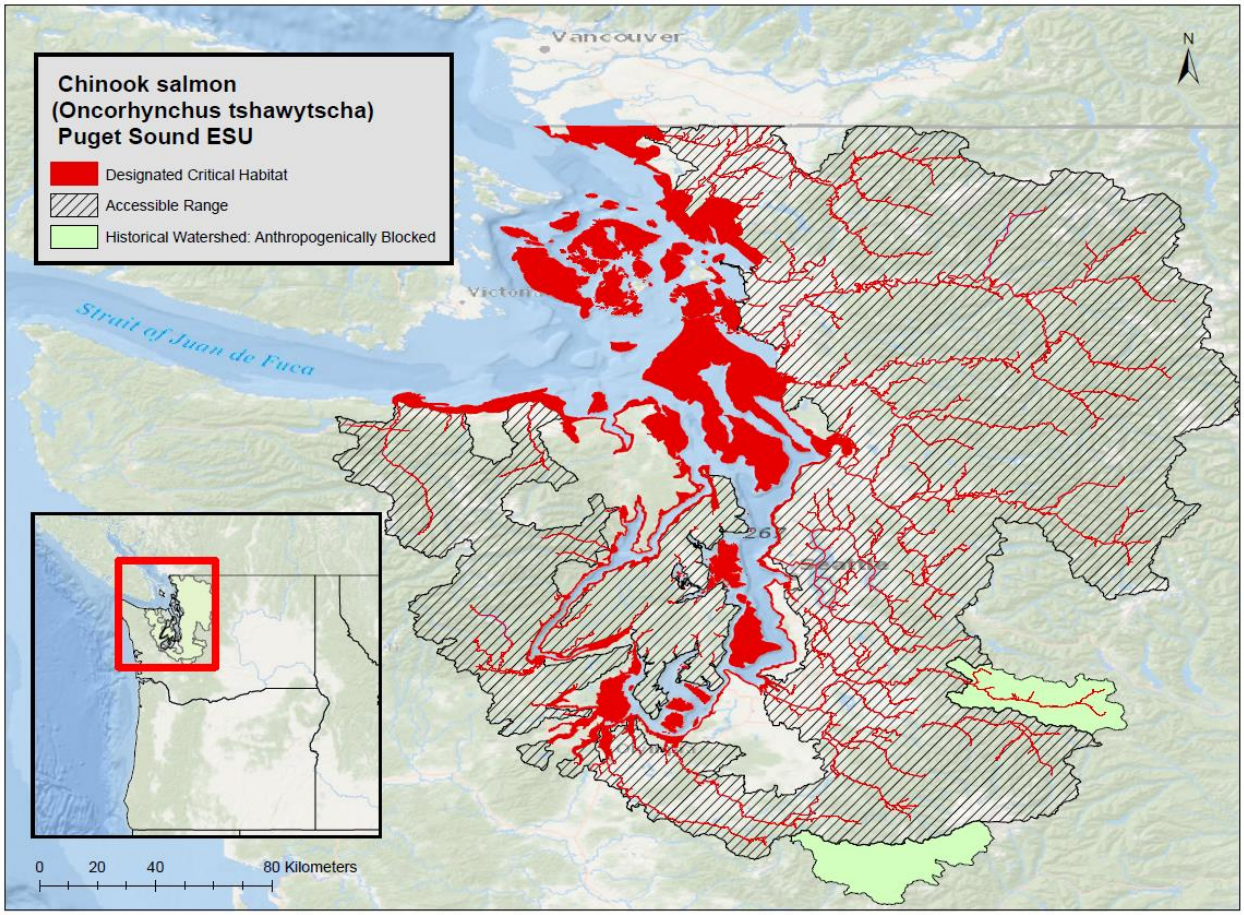


Figure 6. Chinook salmon, Puget Sound ESU range and designated critical habitat

Species Description. Chinook salmon, also referred to as king salmon in California, are the largest of the Pacific salmon. Spawning adults are olive to dark maroon in color, without conspicuous streaking or blotches on the sides. Spawning males are darker than females, and have a hooked jaw and slightly humped back. They can be distinguished from other spawning salmon by the color pattern, particularly the spotting on the back and tail, and by the dark, solid black gums of the lower jaw (Moyle 2002a). On March 24, 1999, NMFS listed the Puget Sound ESU of Chinook salmon as a threatened species (64 FR 14308). The listing was revisited and confirmed as "threatened" in 2005 (70 FR 37160). The Puget Sound ESU includes naturally spawned Chinook salmon originating from rivers flowing into Puget Sound from the Elwha River (inclusive) eastward, including rivers in

Hood Canal, South Sound, North Sound and the Strait of Georgia. Twenty-six artificial propagation programs are included as part of the ESU.

Status. All Puget Sound Chinook salmon populations are well below escapement abundance levels identified as required for recovery to low extinction risk in the recovery plan. In addition, most populations are consistently below the productivity goals identified in the recovery plan as necessary for recovery. Although trends vary for individual populations across the ESU, most populations have declined in total natural origin recruit abundance since the last status review; and natural origin recruit escapement trends since 1995 are mostly stable. A few populations have reached goals but not consistently during the past 10 years (2018 Washington State of the Salmon Report). While some have met their high productivity goals, but never their low (minimum) productivity goals, none of the Puget Sound populations of Chinook salmon could be considered exceeding their abundance recovery goals. Several of the risk factors identified in an early status review (Good et al. 2005b) are still present, including high fractions of hatchery fish in many populations and widespread loss and degradation of habitat. Although this ESU's total abundance is greatly reduced from historic levels, recent abundance levels do not indicate that the ESU is at immediate risk of extinction. This ESU remains relatively well distributed over 22 populations in five geographic areas across the Puget Sound. Although current trends are concerning, the available information indicates that this ESU remains at moderate risk of extinction.

Life History. Puget Sound Chinook salmon populations exhibit both early-returning (August) and late-returning (mid-September and October) Chinook salmon spawners (Healey 1991). Juvenile Chinook salmon within the Puget Sound generally exhibit an "ocean-type" life history. However, substantial variation occurs with regard to juvenile residence time in freshwater and estuarine environments. Hayman(Hayman et al. 1996) described three juvenile life histories for Chinook salmon with varying freshwater and estuarine residency times in the Skagit River system in northern Puget Sound. In this system, 20% to 60% of sub-yearling migrants rear for several months in freshwater habitats while the remaining fry migrate to rear in the Skagit River estuary and delta (Beamer et al. 2005). Juveniles in tributaries to Lake Washington exhibit both a stream rearing and a lake rearing strategy. Lake rearing fry are found in highest densities in nearshore shallow (<1 m) habitat adjacent to the opening of tributaries or at the mouth of tributaries where they empty into the lake (Tabor et al. 2006). Puget Sound Chinook salmon also has several estuarine rearing juvenile life history types that are highly dependent on estuarine areas for rearing (Beamer et al. 2005). In the estuaries, fry use tidal marshes and connected tidal channels including dikes and ditches developed to protect and drain agricultural land. During their first ocean year, immature Chinook salmon use nearshore areas of Puget Sound during all seasons and can be found long distances from their natal river systems (Brennan et al. 2004).

Juvenile Chinook salmon are nearshore obligate feeders foraging in shallow areas with protective cover, such as eelgrass in tidally influenced sandy beaches and other vegetated zones (Healey et al. 1991). Invertebrates including cladocerans, copepods, amphipods, and larvae of diptera, as well as small arachnids and ants are common prey items (Kjelson et al. 1981; MacFarlane and Norton 2002; Sommer et al. 2001a). Upon reaching the ocean, juvenile Chinook salmon feed voraciously on larval and juvenile fishes, plankton, and terrestrial insects (Healey et al. 1991, MacFarlane and Norton 2002). Chinook salmon grow rapidly in the ocean environment, with growth rates dependent on water temperatures and food availability.

Table 86. Temporal distribution of Chinook salmon, Puget Sound ESU in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)				Present								
Spawning							Present					
Incubation (eggs)	Present						Present					
Emergence (alevin to fry phase)	Present										Present	
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance. Estimates of the historic abundance range from 1,700 to 51,000 Puget Sound Chinook salmon spawners per population. During the period from 1996 to 2001, the geometric mean of natural spawners in populations of Puget Sound Chinook salmon ranged from 222 to just over 9,489 adult spawners. Thus, the historical estimates of spawner capacity are several orders of magnitude higher than spawner abundances currently observed throughout the ESU (Good et al. 2005b). Generally, many populations experienced increases in total abundance during the years 2000–08, and more recently in 2015–17, but general declines during 2009–14, and a downturn again in the two most-recent years, 2017–18 (Figure 90). Abundance across the Puget Sound Chinook salmon ESU has generally increased since the last status review, with only two of the 22 populations (Cascade River and North and South Fork Stillaguamish Rivers) showing a negative percentage change in the 5-year geometric mean natural-origin spawner abundances since the prior status review (Table 50). Fifteen of the remaining 20 populations with positive percentage changes since the prior status review have relatively low natural spawning abundances (<1,000 fish), so some of these increases represent small changes in total abundance. Given lack of high confidence in survey techniques, particularly with small populations, there remains substantial uncertainty in detecting trends in small populations.

Table 87. Past Puget Sound Chinook salmon population structure, abundances, and hatchery contributions (Good et al. 2005).

Independent Populations	Historical Abundance	Mean Number of Spawners	Hatchery Abundance Contributions (%)
Nooksack-North Fork	26,000	1,538	91
Nooksack-South Fork	13,000	338	40
Lower Skagit	22,000	2,527	0.2
Upper Skagit	35,000	9,489	2
Upper Cascade	1,700	274	0.3
Lower Sauk	7,800	601	0
Upper Sauk	4,200	324	0
Suiattle	830	365	0
Stillaguamish-North Fork	24,000	1,154	40
Stillaguamish-South Fork	20,000	270	Unknown
Skykomish	51,000	4,262	40

Independent Populations	Historical Abundance	Mean Number of Spawners	Hatchery Abundance Contributions (%)
Snoqualmie	33,000	2,067	16
Sammamish	Unknown	Unknown	Unknown
Cedar	Unknown	327	Unknown
Duwamish/Green			
Green	Unknown	8,884	83
White	Unknown	844	Unknown
Puyallup	33,000	1,653	Unknown
Nisqually	18,000	1,195	Unknown
Skokomish	Unknown	1,392	Unknown
Mid Hood Canal Rivers			
Dosewallips	4,700	48	Unknown
Duckabush	Unknown	43	Unknown
Hamma Hamma	Unknown	196	Unknown
Mid Hood Canal	Unknown	311	Unknown
Dungeness	8,100	222	Unknown
Elwha	Unknown	688	Unknown

Productivity / Population Growth Rate. Fifteen-year trends in log natural-origin spawner abundance were computed over two time periods (1990–2005 and 2004–19) for each Puget Sound Chinook salmon population. Trends were negative for four of the populations in the earlier period, and for 16 of the 22 populations in the later period. Thus, there is a general decline in natural-origin spawner abundance across all MPGs in the most-recent 15 years. Upper Sauk and Suiattle Rivers (Whidbey Basin MPG), Nisqually River (Central/South Sound MPG), and Mid-Hood Canal (Hood Canal MPG) are the only populations with positive trends, though Mid-Hood Canal has an extremely low population size. Further, no change in trend between the two time periods was detected in South Fork Nooksack River (Strait of Georgia MPG) or Green and Nisqually Rivers (Central/South MPG). The average trend in population growth rate across the ESU for 1990–2005 was a positive 3%. The average trends for the MPGs are: Strait of Georgia, up 3%; Whidbey Basin, up 4%; Central/South Sound, up 4%; Hood Canal, 3%; and Strait of Juan de Fuca, up 1%. However the average trend across the ESU declined between 2004 –2019 at minus 2%. The average trends for the MPGs are: Strait of Georgia, minus 2%; Whidbey Basin, minus 2%; Central/South Sound, minus 2%; Hood Canal, minus 2%; and Strait of Juan de Fuca, minus 8%. The previous status review (NWFSC 2015) concluded that there were widespread negative trends for the total ESU, despite variable escapements and trends for individual populations. The addition of the data to 2019 now shows even more substantially either flat or negative trends for the entire ESU in natural-origin Chinook salmon spawner population abundances. Across the Puget Sound Chinook salmon ESU, 10 of 22 Puget Sound populations show natural productivity below replacement in nearly all years since the mid-1980s. However, the median overall long-term trend in abundance is close to one for most populations that have a lambda exceeding one, indicating that most of these populations are barely replacing themselves. In recent years, only five populations have had productivities above

zero. These are Lower and Upper Skagit, Lower and Upper Sauk, and Suiattle Rivers in the Whidbey Basin MPG. This is consistent with, and continues the decline reported in, the 2015 status review (NWFSC 2015).

Genetic Diversity / Spatial Distribution. The Northwest Fisheries Science Center estimated the diversity index for five year time intervals over the 25 year time span of the available data. In general, a higher diversity value indicates a healthier distribution of salmon among the streams and rivers in the ESU. Current estimates of diversity show a decline over the past 25 years, indicating a decline of salmon in some areas and increases in others. Salmon returns to the Whidbey Region increased in abundance while returns to other regions declined. In aggregate, the diversity of the ESU as a whole has been declining over the last 25 years and there is a concern that some populations are no longer distinct (NMFS 2022a).

Designated Critical Habitat. Critical habitat was designated for this species on September 2, 2005 (70 FR 52630). It includes 1,683 km of stream channels, 41 square km of lakes, and 3,512 km of nearshore marine habitat. PBFs considered essential for the conservation of Chinook salmon, Puget Sound ESU are described in Appendix B.

Forestry practices have heavily impacted migration, spawning, and rearing PBFs in the upper watersheds of most river systems within critical habitat designated for the Puget Sound Chinook salmon. Degraded PBFs include reduced conditions of substrate supporting spawning, incubation and larval development caused by siltation of gravel; and degraded rearing habitat by removal of cover and reduction in channel complexity. Urbanization and agriculture in the lower alluvial valleys of mid- to southern Puget Sound and the Strait of Juan de Fuca have reduced channel function and connectivity, reduced available floodplain habitat, and affected water quality. Thus, these areas have degraded spawning, rearing, and migration PBFs. Hydroelectric development and flood control also obstruct Puget Sound Chinook salmon migration in several basins. The most functional PBFs are found in northwest Puget Sound: the Skagit River basin, parts of the Stillaguamish River basin, and the Snohomish River basin where federal land overlaps with critical habitat designated for the Puget Sound Chinook salmon. However, estuary PBFs are degraded in these areas by reduction in the water quality from contaminants, altered salinity conditions, lack of natural cover, and modification and lack of access to tidal marshes and their channels.

Recovery Goals. The ESU-wide delisting and recovery criteria (PSTRT, 2002) provide flexibility in meeting the requirements of the Endangered Species Act, and preserve options for Puget Sound Chinook in the future. The recommendations by the TRT describe the biological characteristics that would constitute a viable ESU for Puget Sound Chinook. The ESU would have a high likelihood of persistence if:

- All populations improve in status and at least some achieve a low risk status.
- At least 2-4 viable Chinook populations are present in each of the five regions.
- Each region has one or more viable populations from each major diversity group that was historically present within that region.
- Freshwater tributary habitats in Puget Sound are providing sufficient function for ESU persistence. Ecological functioning occurs even in those habitats that do not currently support any of the 22 identified Chinook populations, since they affect nearshore processes and may provide future habitat options.

- The production of Chinook salmon in Puget Sound tributaries is consistent with ESU recovery objectives, and contributes to the health of the overall ecosystem in the region.
- None of the 22 remaining Chinook populations go extinct, and the direct and indirect effects of habitat, harvest and hatchery management actions are consistent with ESU recovery.

6.2.6 Chinook salmon, Sacramento River winter-run ESU

Table 88. Chinook salmon, Sacramento winter-run ESU; overview table

Species	Common Name	Distinct Population Segments (DPS)	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus tshawytscha	Chinook Salmon	Sacramento River winter-run	Endangered	2016	1990 54 FR 32085 1994 59 FR 440	2014	1993 58 FR 33212

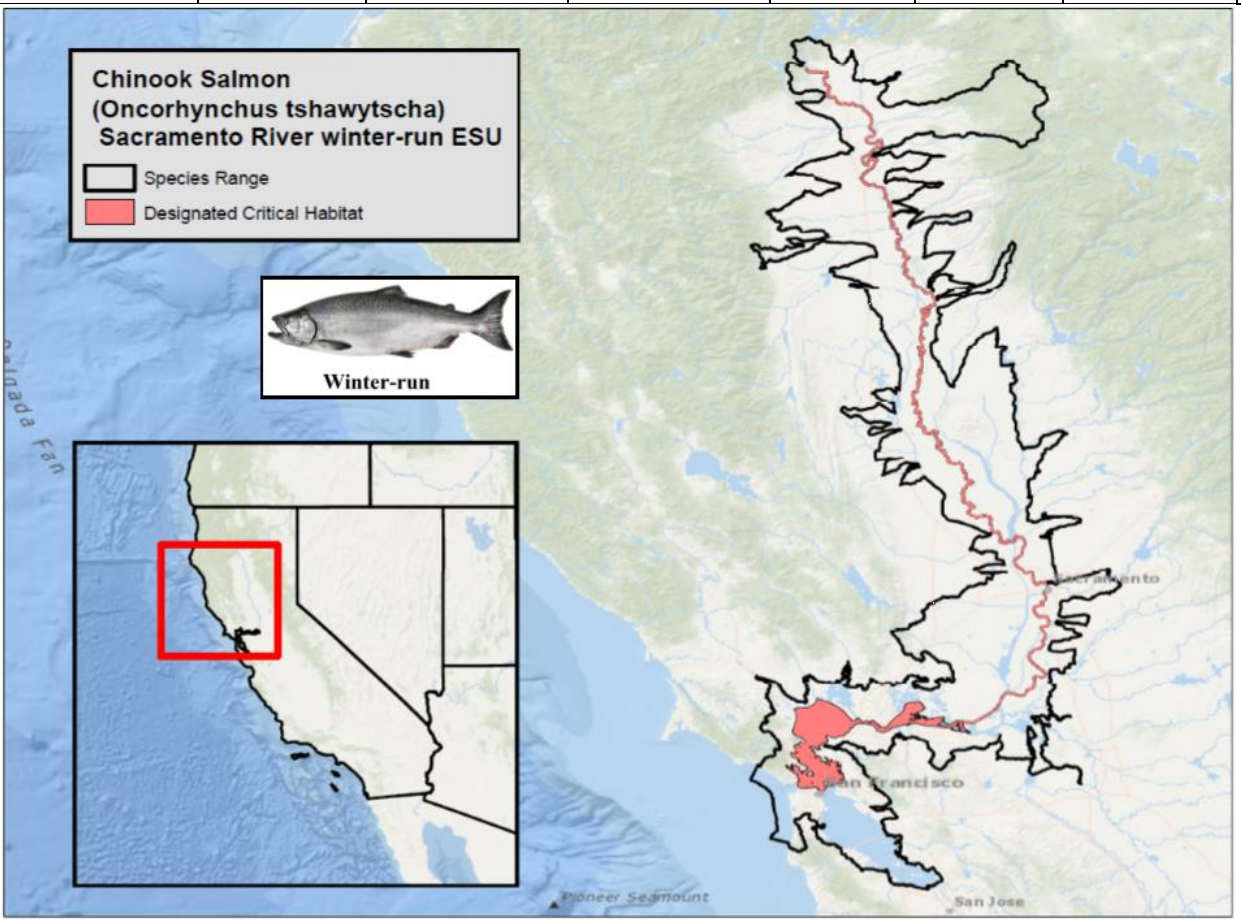


Figure 7. Chinook salmon, Sacramento winter-run ESU range and designated critical habitat

Species Description. Chinook salmon, also referred to as king salmon in California, are the largest of the Pacific salmon. Spawning adults are olive to dark maroon in color, without conspicuous streaking or blotches on the sides. Spawning males are darker than females, and have a hooked jaw and slightly humped back. They can be distinguished from other spawning salmon by the color pattern, particularly the spotting on the back and tail, and by the dark, solid black gums of the lower

jaw (Moyle 2002a). On January 4, 1994, NMFS listed the Sacramento River winter-run ESU of Chinook salmon as Endangered (59 FR 440). The Sacramento River winter-run Chinook salmon ESU includes winter-run Chinook salmon spawning naturally in the Sacramento River and its tributaries, as well as winter-run Chinook salmon that are part of the conservation hatchery program at the Livingston Stone National Fish Hatchery (LSNFH). Winter-run Chinook salmon originally spawned in the upper Sacramento River system (Little Sacramento, Pit, McCloud and Fall rivers) and in Battle Creek (Yoshiyama et al. 1998, Yoshiyama et al. 2001). Currently, winter-run Chinook salmon spawning habitat is likely limited to the reach of the Sacramento River extending from Keswick Dam downstream to the Red Bluff Diversion Dam.

Status. The Sacramento River winter-run Chinook salmon ESU is composed of just one small population that is currently under severe stress caused by one of California's worst droughts on record. Over the last 10 years of available data (2003-2013), the abundance of spawning winter-run Chinook adults ranged from a low of 738 in 2011 to a high of 17,197 in 2007, with an average of 6,298. The population subsists in large part due to agency-managed cold water releases from Shasta Reservoir during the summer and artificial propagation from Livingston Stone National Fish Hatchery's winter-run Chinook salmon conservation program. Winter-run Chinook salmon are dependent on sufficient cold water storage in Shasta Reservoir, and it has long been recognized that a prolonged drought could have devastating impacts, possibly leading to the species' extinction. The probability of extended droughts is increasing as the effects of climate change continue (NMFS 2014b). In addition to the drought, another important threat to winter-run Chinook salmon is a lack of suitable rearing habitat in the Sacramento River and Delta to allow for sufficient juvenile growth and survival (NMFS 2016g).

Life History. Winter-run Chinook salmon are unique because they spawn during summer months when air temperatures usually approach their yearly maximum. As a result, winter-run Chinook salmon require stream reaches with cold water sources that will protect embryos and juveniles from the warm ambient conditions in summer. Adult winter-run Chinook salmon immigration and holding (upstream spawning migration) through the Delta and into the lower Sacramento River occurs from December through July, with a peak during the period extending from January through April (Fish and Service 1995). Winter-run Chinook salmon are sexually immature when upstream migration begins, and they must hold for several months in suitable habitat prior to spawning. Spawning occurs between late-April and mid-August, with a peak in June and July as reported by California Department of Fish and Wildlife (CDFW) annual escapement surveys (2000-2006).

Winter-run Chinook salmon embryo incubation in the Sacramento River can extend into October (Vogel et al. 1988). Winter-run Chinook salmon fry rearing in the upper Sacramento River exhibit peak abundance during September, with fry and juvenile emigration past Red Bluff Diversion Dam (RBDD) primarily occurring from July through November (Poytress and Carrillo 2010, 2011, 2012). Emigration of winter-run Chinook salmon juveniles past Knights Landing, located approximately 155.5 river miles downstream of the RBDD, reportedly occurs between November and March, peaking in December, with some emigration continuing through May in some years (Snider and Titus 2000).

Juvenile Chinook salmon are nearshore obligate feeders foraging in shallow areas with protective cover, such as eelgrass in tidally influenced sandy beaches and other vegetated zones (Healey et al.

1991). Invertebrates including cladocerans, copepods, amphipods, and larvae of diptera, as well as small arachnids and ants are common prey items (Kjelson et al. 1982b, MacFarlane and Norton 2002). Upon reaching the ocean, juvenile Chinook salmon feed voraciously on larval and juvenile fishes, plankton, and terrestrial insects (Healey et al. 1991, MacFarlane and Norton 2002). Chinook salmon grow rapidly in the ocean environment, with growth rates dependent on water temperatures and food availability.

Table 89. Temporal distribution of Chinook salmon, Sacramento winter-run ESU in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)	Present										Present	
Spawning				Present								
Incubation (eggs)				Present								
Emergence (alevin to fry phases						Present						
Rearing and migration (juveniles)	Present							Present				

Population Dynamics

Abundance. Over the last 10 years of available data (2003-2013), the abundance of spawning winter-run Chinook adults ranged from a low of 738 in 2011 to a high of 17,197 in 2007, with an average of 6,298 (Figure 8).

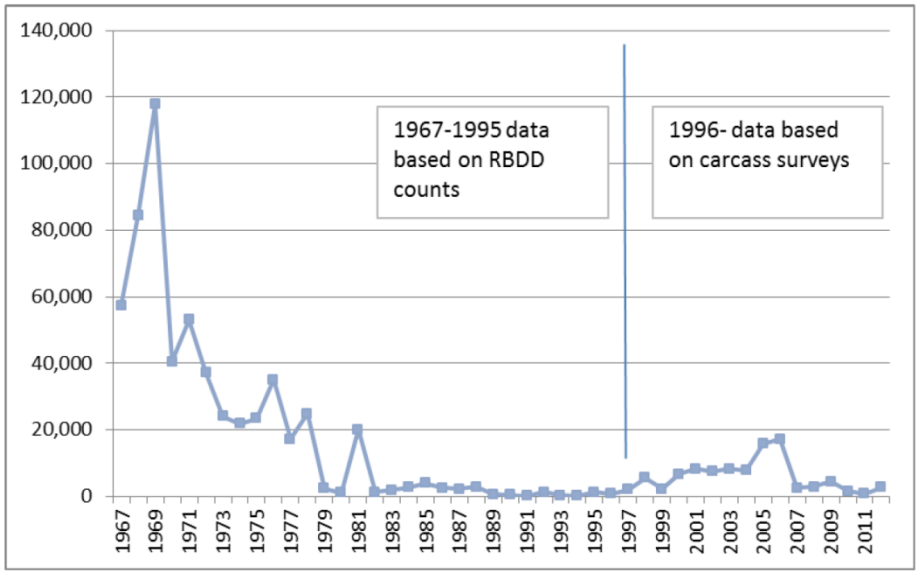


Figure 8. Estimated Sacramento River winter-run Chinook salmon run size (1967-2012)

Productivity / Population Growth Rate. The population declined from an escapement of near 100,000 in the late 1960s to fewer than 200 in the early 1990s (Good et al. 2005a). More recent population estimates of 8,218 (2004), 15,730 (2005), and 17,153 (2006) show a 3-year average of 13,700 returning winter-run Chinook salmon (CDFW Website 2007). However, the run size decreased to 2,542 in 2007 and 2,850 in 2008. Monitoring data indicated that approximately 5.6% of winter-run Chinook salmon eggs spawned in the Sacramento River in 2014 survived to the fry life stage (3 to nearly 10 times lower than in previous years). The ongoing drought has made 2015 another challenging year for winter-run Chinook salmon (NMFS 2016g).

Genetic Diversity. The rising proportion of hatchery fish among returning adults threatens to increase the risk of extinction. Lindley et al. (2007) recommend that in order to maintain a low risk of genetic introgression with hatchery fish, no more than 5% of the naturally-spawning population should be composed of hatchery fish. Since 2001, hatchery origin winter-run Chinook salmon have made up more than 5% of the run, and in 2005 the contribution of hatchery fish exceeded 18% (Lindley et al. 2007).

Distribution. The range of winter-run Chinook salmon has been greatly reduced by Keswick and Shasta dams on the Sacramento River and by hydroelectric development on Battle Creek. Currently, winter-run Chinook salmon spawning is limited to the main-stem Sacramento River between Keswick Dam (River Mile [RM] 302) and the RBDD (RM 243) where the naturally-spawning population is artificially maintained by cool water releases from the dams. Within the Sacramento River, the spatial distribution of spawners is largely governed by water year type and the ability of the Central Valley Project to manage water temperatures (NMFS 2014b).

Designated Critical Habitat. NMFS designated critical habitat for the Sacramento winter-run Chinook on June 16, 1993 (58 FR 33212). It includes: the Sacramento River from Keswick Dam, Shasta County (river mile 302) to Chipps Island (river mile 0) at the westward margin of the Sacramento-San Joaquin Delta, and other specified estuarine waters**.** Physical and biological features that are essential for the conservation of Sacramento winter-run Chinook salmon, based on the best available information, include (1) access from the Pacific Ocean to appropriate spawning areas in the upper Sacramento River; (2) the availability of clean gravel for spawning substrate; (3) adequate river flows for successful spawning, incubation of eggs, fry development and emergence, and downstream transport of juveniles; (4) water temperatures between 42.5 and 57.5 °F (5.8 and 14.1 degrees Celsius (°C)) for successful spawning, egg incubation, and fry development; (5) habitat and adequate prey free of contaminants; (6) riparian habitat that provides for successful juvenile development and survival; and (7) access of juveniles downstream from the spawning grounds to San Francisco Bay and the Pacific Ocean (58 FR 33212).

The current condition of PBFs for the Sacramento River Winter-run Chinook salmon indicates that they are not currently functioning or are degraded. Their conditions are likely to maintain low population abundances across the ESU. Spawning and rearing PBFs are especially degraded by high water temperature caused by the loss of access to historic spawning areas in the upper watersheds where water maintains lower temperatures. The rearing PBF is further degraded by floodplain habitat disconnected from the mainstems of larger rivers throughout the Sacramento River watershed. The migration PBF is also degraded by the lack of natural cover along the migration corridors. Rearing and migration PBFs are further affected by pollutants entering the surface waters and riverine sediments as contaminated stormwater runoff, aerial drift and deposition, and via point source discharges. Juvenile migration is obstructed by water diversions along Sacramento River and by two large state and federal water-export facilities in the Sacramento-San Joaquin Delta.

Recovery Goals. Recovery goals, objectives and criteria for the Sacramento River winter-run Chinook are fully outlined in the 2014 Recovery Plan (NMFS 2014b). In order to achieve the downlisting criteria, the species would need to be composed of two populations – one viable and one at moderate extinction risk. Having a second population would improve the species' viability,

particularly through increased spatial structure and abundance, but further improvement would be needed to reach the goal of recovery. To delist winter-run Chinook salmon, three viable populations are needed. Thus, the downlisting criteria represent an initial key step along the path to recovering winter-run Chinook salmon.

6.2.7 Chinook salmon, Snake River fall-run

Table 90. Chinook salmon, Snake River fall-run ESU; overview table

Species	Common Name	Distinct Population Segments (DPS)	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus tshawytscha	Chinook Salmon	Snake River fall-run	Threatened	2022	2005 70 FR 37160 2014 79 FR 20802	2017	1993 58 FR 68543

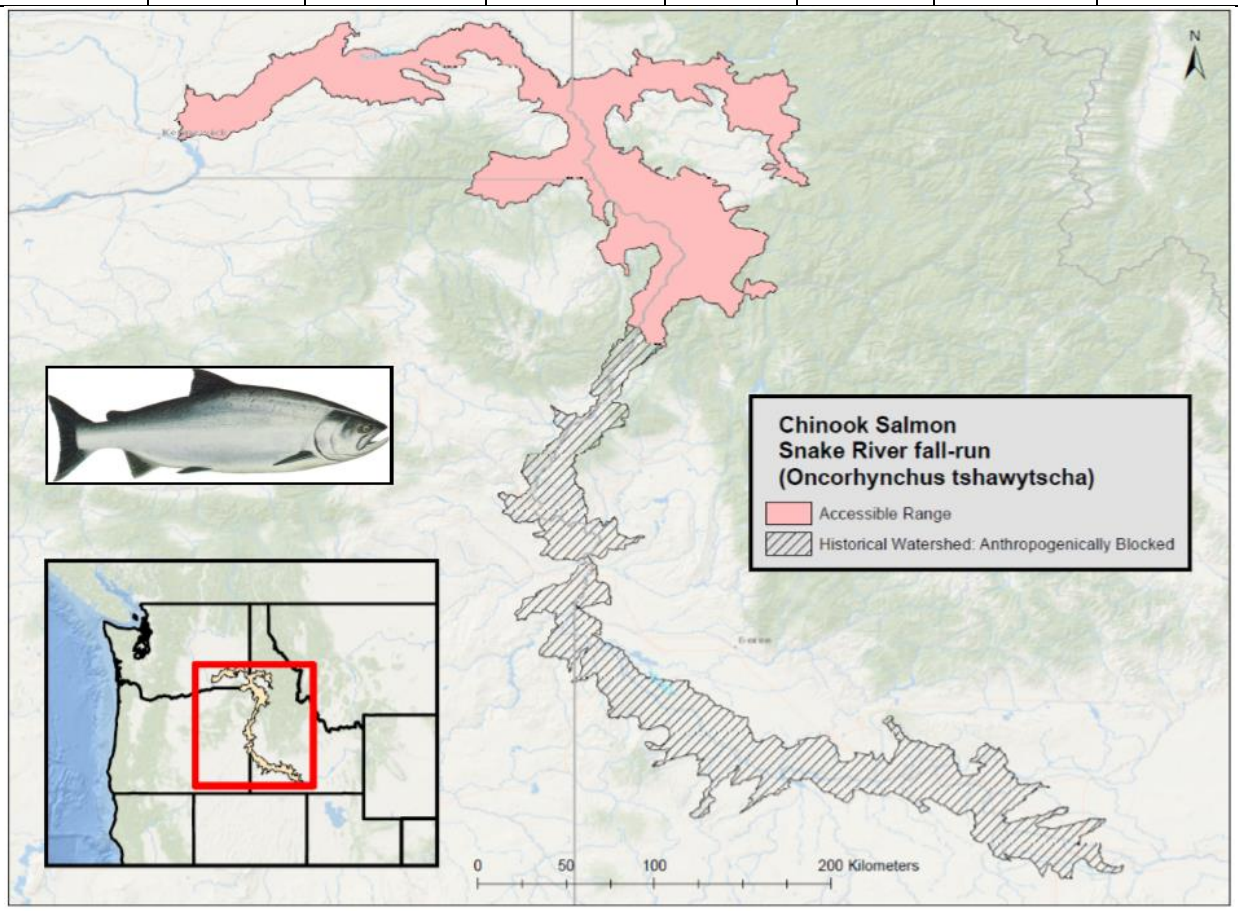


Figure 9. Chinook salmon, Snake River fall-run ESU range and designated critical habitat

Species Description. Chinook salmon are the largest of the Pacific salmon. Spawning adults are olive to dark maroon in color, without conspicuous streaking or blotches on the sides. Spawning males are darker than females, and have a hooked jaw and slightly humped back. They can be distinguished from other spawning salmon by the color pattern, particularly the spotting on the back and tail, and by the dark, solid black gums of the lower jaw (Moyle 2002c). NMFS first listed Snake River fall Chinook salmon as a threatened species under the ESA on April 22, 1992 (57 FR 14658).

NMFS reaffirmed the listing status in June 28, 2005 (70 FR 37160), and reaffirmed the status again in its 2014 (79 FR 20802). Snake River fall Chinook salmon historically spawned throughout the 600-mile reach of the mainstem Snake River from its mouth upstream to Shoshone Falls, a 212-ft high natural barrier near Twin Falls, Idaho (RM 614.7). The Northwest Fisheries Science Center's review (Ford 2022) found that no new information has become available that would justify a change in the delineation of the SR fall-run Chinook Salmon ESU. The listed ESU currently includes all natural-origin fall-run Chinook salmon originating from the mainstem Snake River below Hells Canyon Dam (the lowest of three impassable dams that form the Hells Canyon Complex) and from the Tucannon River, Grande Ronde River, Imnaha River, Salmon River, and Clearwater River subbasins. The listed ESU also includes fall-run Chinook salmon from four artificial propagation programs (NMFS 2011a, 2015b).

Status. As late as the late 1800s, approximately 408,500 to 536,180 fall Chinook salmon are believed to have returned annually to the Snake River. The run began to decline in the late 1800s and then continued to decline through the early and mid-1900s as a result of overfishing and other human activities, including the construction of major dams. Overall, the status of Snake River fall-run Chinook salmon has clearly improved compared to the time of listing. The single extant population in the ESU is currently meeting the criteria for a rating of "viable" developed by the ICTRT, 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 Complex (NMFS 2017b). The Snake River fall-run Chinook salmon ESU therefore is considered to be at a moderate-to-low risk of extinction, with viability largely unchanged from the prior review. Supplementation and other measures since listing led to large increases in natural-origin returns, gradually at first and then, in 2013, adult spawner abundance reached over 20,000 fish (Figure 27, Table 15). From 2012–15, natural-origin returns were over 10,000 adults. Spawner abundance has declined since 2016 to 4,998 adult natural-origin spawners in 2019. In 2018, natural-origin spawner abundance was 4,916, a quarter of the return in 2013. This appears as a high negative percent change in the 5-year geometric mean but, when looking at the trend in longer time frames, across more than one brood cycle, it shows an increase in the 10-year geometric mean relative to the last status review, and a near-zero population change for the 15-year trend in abundance. The geometric mean natural adult abundance for the most recent 10 years (2010–19) is 9,034 (0.15 SE), higher than the 10-year geomean reported in the most recent status review (6,418, 0.19 SE, 2005–14; NWFSC 2015). While the population has not been able to maintain the higher returns it achieved in 2010 and 2013–15, it has maintained at or above the ICTRT defined Minimum Abundance Threshold (3,000) during climate challenges in the ocean and rivers. While the number of natural-origin fall Chinook salmon has been high, substantial uncertainty remains about the status of the species' productivity and diversity. Threats posed by straying out-of-ESU hatchery fish have declined due to improved management. Still, large reaches of historical habitat remain blocked and inundated, and the mainstem Snake and Columbia River hydropower system, while less of a constraint than in the past, continues to cause juvenile and adult losses. The number of hatchery-origin fall Chinook salmon on the spawning grounds continues to threaten natural-origin fish productivity and genetic diversity. Further, the combined and relative effects of the different threats across the life cycle ─ including threats from climate change ─ remain poorly understood (NMFS 2011a, 2015b). The overall low risk rating for the ESU remains unchanged from that reported in the 2016 5-year status review. As also reported in the 2016 5-year status review, while the extinction risk status of the ESU has

improved since it was listed in 1992, and while the ESU is at low risk, it is still not meeting its recovery goals (NMFS 2016a, 2017). The implementation of sound management actions to address hydropower, habitat, hatcheries, harvest, and predation remain essential to the recovery of this ESU. The ESA Snake River Fall Chinook Salmon Recovery Plan (NMFS 2017) will be the primary guide for identifying future actions to target and address limiting factors and threats for this ESU.

Life History. Snake River fall-run Chinook return to the Columbia River in August and September, pass Bonneville Dam from mid-August to the end of September, and enter the Snake River between early September and mid-October (DART 2013). Once they reach the Snake River, fall Chinook salmon generally travel to one of five major spawning areas and spawn from late October through early December (Connor et al. 2014).

Upon emergence from the gravel, most young fall Chinook salmon move to shoreline riverine habitat (recovery plan). Some fall Chinook salmon smolts sustain active migration after passing Lower Granite Dam and enter the ocean as subyearlings, whereas some delay seaward migration and enter the ocean as yearlings (Connor et al. 2005, McMichael et al. 2008, NMFS 2015b). Snake River fall Chinook salmon can be present in the estuary as juveniles in winter, as fry from March to May, and as fingerlings throughout the summer and fall (Fresh et al. 2005, Roegner et al. 2012, Teel et al. 2014).

Once in the Northern California Current, dispersal patterns differ for yearlings and subyearlings. Subyearlings migrate more slowly, are found closer to shore in shallower water, and do not disperse as far north as yearlings (Trudel et al. 2009, Tucker et al. 2011, Sharma and Quinn 2012, Fisher et al. 2014). Snake River basin fall Chinook salmon spend one to four years in the Pacific Ocean, depending on gender and age at the time of ocean entry (Connor et al. 2005).

Juvenile Chinook salmon are nearshore obligate feeders foraging in shallow areas with protective cover, such as eelgrass in tidally influenced sandy beaches and other vegetated zones (Healey et al. 1991). Invertebrates including cladocerans, copepods, amphipods, and larvae of diptera, as well as small arachnids and ants are common prey items (Kjelson et al. 1982b, MacFarlane and Norton 2002). Upon reaching the ocean, juvenile Chinook salmon feed voraciously on larval and juvenile fishes, plankton, and terrestrial insects (Healey et al. 1991). Chinook salmon grow rapidly in the ocean environment, with growth rates dependent on water temperatures and food availability.

Table 91. Temporal distribution of Chinook salmon, Snake River fall-run ESU in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)								Present				
Spawning										Present		
Incubation (eggs)	Present									Present		
Emergence (alevin to fry phases	Present											Present
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance. The naturally spawning fall Chinook salmon in the lower Snake River have included both returns originating from naturally spawning parents and from returning hatchery releases. The geometric mean natural origin adult abundance for the most recent 10 years (2010–19) is 9,034 (0.15 SE) (NMFS WCR 2022), higher than the 10-year geomean reported in the most recent status review (6,418, 0.19 SE, 2005–14; NWFSC 2015).

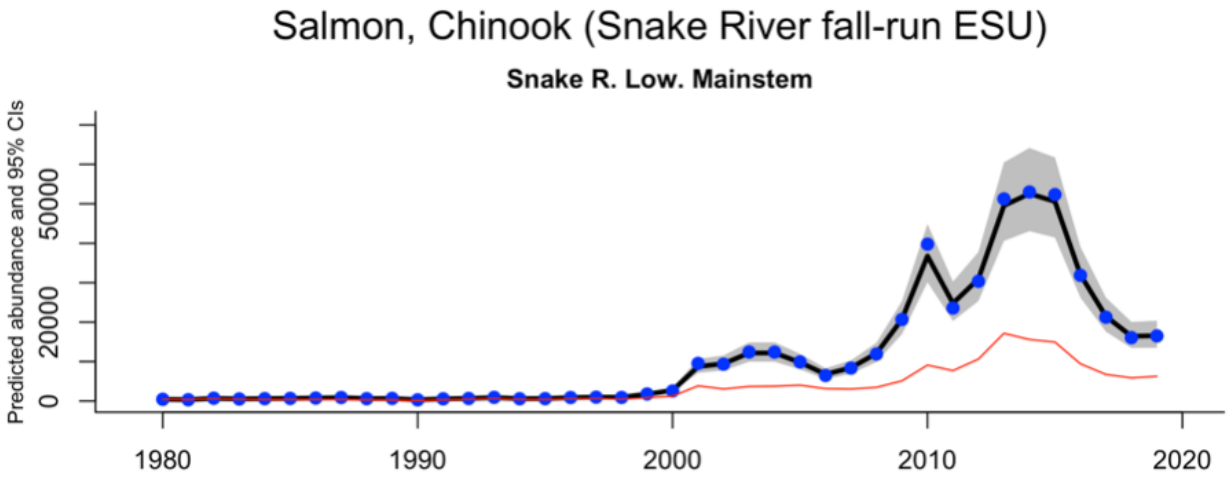


Figure 10. Smoothed trend in estimated total abundance (thick black line, with 95% confidence interval in gray) and natural (thin red line) population spawning abundance. In portions of a time series where a population has no annual estimates but smoothed spawning abundance is estimated from correlations with other populations, the smoothed estimate is shown in light gray. Points show the annual raw spawning abundance estimates. For some trends, the smoothed estimate may be influenced by earlier data points not included in the plot (from NMFS 2022a).

Productivity / Population Growth Rate. Productivity, as seen in broodyear returns-per-spawner, has been below replacement (1:1) in recent years, and a longer-term, 20-year geometric mean raw productivity is 0.63 (Figure 28)—likely an underestimate of intrinsic productivity. While below-replacement returns are concerning, the long-term (15-year) abundance trend is stable and the population remains well above the minimum abundance threshold set by the ICTRT.

Genetic Diversity. Genetic samples from the aggregate population in recent years indicate that composite genetic diversity is being maintained and that the Snake River Fall Chinook hatchery stock is similar to the natural component of the population, an indication that the actions taken to reduce the potential introgression of out-of-basin hatchery strays has been effective. Overall, the current genetic diversity of the population represents a change from historical conditions and, applying the Interior Columbia Technical Recovery Team (ICTRT) guidelines, the rating for this metric is moderate risk (NMFS 2015b).

Distribution. The extant Lower Snake River Fall Chinook salmon population consists of a spatially complex set of five historical major spawning areas (Cooney et al. 2007), each of which consists of a set of relatively discrete spawning patches of varying size. The primary Major spawning area (MaSA) in the extant Lower Mainstem Snake River population is the 96-km Upper Mainstem Snake River Reach, extending upriver from the confluence of the Salmon River to the Hells Canyon Dam site, where the canyon walls narrow and strongly confine the river bed. A second mainstem Snake River MaSA, the Lower Mainstem Snake River Reach, extends 69 km downstream from the

Salmon River confluence to the upper end of the contemporary Lower Granite Dam pool. The lower mainstem reaches of two major tributaries to the mainstem Snake River, the Grande Ronde and the Clearwater Rivers, were also identified by the ICTRT as MaSAs. Both of these river systems currently support fall Chinook salmon spawning in the lower reaches. In addition, there is some historical evidence for production of late spawning Chinook salmon in spatially isolated reaches in upriver tributaries to each of these systems (NMFS 2015b).

Designated Critical Habitat. NMFS designated critical habitat for SR Fall-run Chinook salmon on December 28, 1993 (58 FR 68543). PBFs considered essential for the conservation of Chinook salmon, Snake River fall-run ESU are shown in Table 92.

Table 92. Essential features of critical habitats designated for SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, SR sockeye salmon, SONC coho salmon, and corresponding species life history events.

Essential Features Site	Essential Features Site Attribute	Species Life History Event
Spawning and juvenile rearing areas	Access (sockeye) Cover/shelter Food (juvenile rearing) Riparian vegetation Space (Chinook, coho) Spawning gravel Water quality Water temp (sockeye) Water quantity	Adult spawning Embryo incubation Alevin growth and development Fry emergence from gravel Fry/parr/smolt growth and development
Adult and juvenile migration corridors	Cover/shelter Food (juvenile) Riparian vegetation Safe passage Space Substrate Water quality Water quantity Water temperature Water velocity	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Areas for growth and development to adulthood	Ocean areas – not identified	Nearshore juvenile rearing Subadult rearing Adult growth and sexual maturation Adult spawning migration

The major degraded PBFs within critical habitat designated for SR Fall-run Chinook salmon include: (1) safe passage for juvenile migration which is reduced by the presence of the Snake and Columbia River hydropower system within the lower mainstem; (2) rearing habitat water quality altered by influx of contaminants and changing seasonal temperature regimes caused by water flow management; and (3) spawning/rearing habitat PBF attributes (spawning areas with gravel, water quality, cover/shelter, riparian vegetation, and space to support egg incubation and larval growth and development) that are reduced in quantity (80% loss) and quality due to the mainstem lower Snake River hydropower system.

Water quality impairments in the designated critical habitat are common within the range of this ESU. Pollutants such as petroleum products, pesticides, fertilizers, and sediment in the form of turbidity enter the surface waters and riverine sediments from the headwaters of the Snake, Salmon, and Clearwater Rivers to the Columbia River estuary; traveling along with contaminated stormwater runoff, aerial drift and deposition, and via point source discharges. Some contaminants such as mercury and pentachlorophenol enter the aquatic food web after reaching water and may be concentrated or even biomagnified in the salmon tissue. This species also requires migration corridors with adequate passage conditions (water quality and quantity available at specific times) to allow access to the various habitats required to complete their life cycle.

Recovery Goals. Recovery goals, objectives and criteria for the Snake River fall-run Chinook are fully outlined in the 2017 Recovery Plan (NMFS 2017c). ESA recovery goals should support conservation of natural fish and the ecosystems upon which they depend. Thus, the ESA recovery goal for Snake River fall Chinook salmon is that: the ecosystems upon which Snake River fall Chinook salmon depend are conserved such that the ESU is self-sustaining in the wild and no longer needs ESA protection.

6.2.8 Chinook salmon, Snake River spring/summer-run ESU

Table 93. Chinook salmon, Snake River spring/summer-run ESU; overview table

Species	Common Name	Distinct Population Segments (DPS)	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus tshawytscha	Chinook Salmon	Snake River Spring and Summer run	Threatened	2022	2005 70 FR 37160 2014 79 FR 20802	2017	1999 64 FR 57399

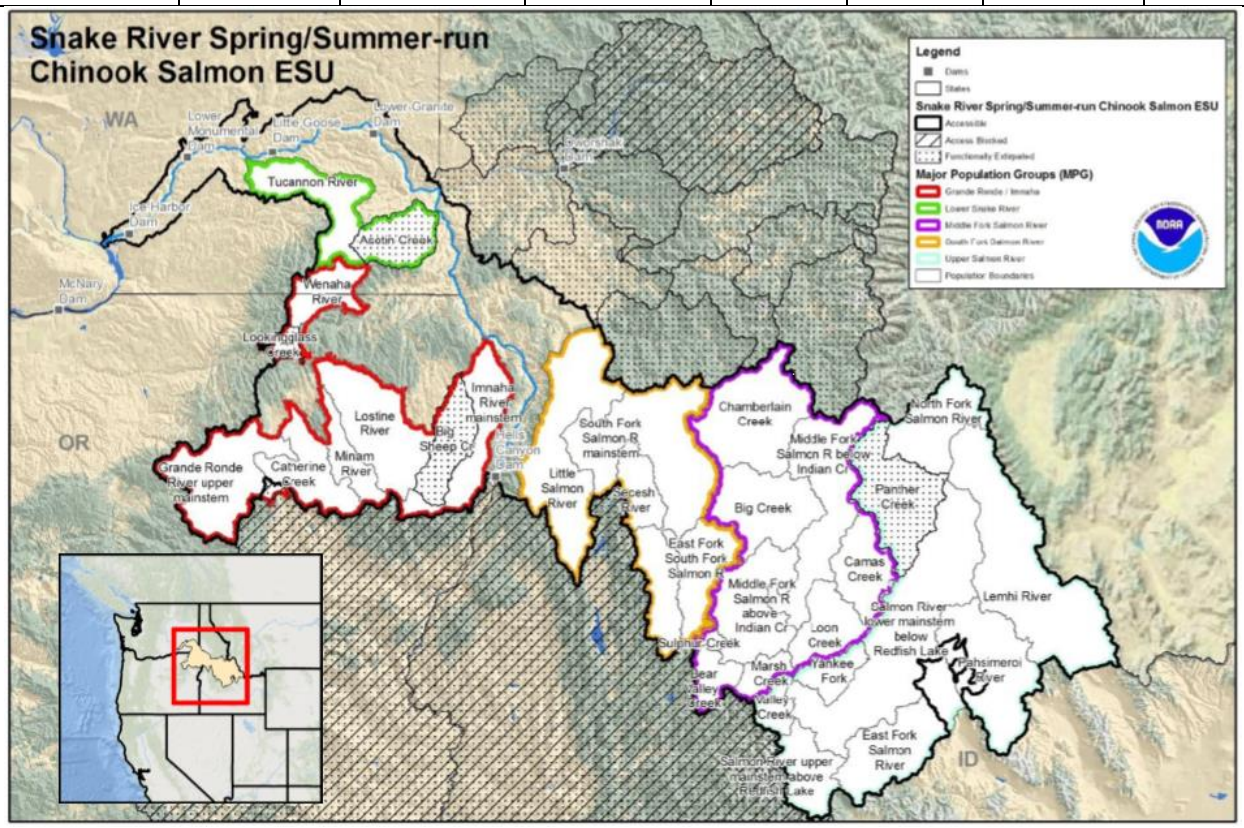


Figure 11. Chinook salmon, Snake River spring/summer-run ESU range and designated critical habitat

Species Description. Chinook salmon are the largest of the Pacific salmon. Spawning adults are olive to dark maroon in color, without conspicuous streaking or blotches on the sides. Spawning males are darker than females, and have a hooked jaw and slightly humped back. They can be distinguished from other spawning salmon by the color pattern, particularly the spotting on the back and tail, and by the dark, solid black gums of the lower jaw (Moyle 2002c). The 2022 Status Update found no new information that would justify a change in the delineation of the Snake River spring/summer Chinook salmon ESU (Ford 2022). The Snake River spring/summer-run Chinook salmon ESU includes all naturally spawned populations of spring/summer-run Chinook salmon in

the mainstem Snake River and the Tucannon, Grande Ronde, Imnaha, and Salmon River sub-basins, as well as in 15 artificial propagation programs (NMFS 2022a).

Status. The historical run of Chinook in the Snake River likely exceeded one million adult spawners annually in the late 1800s, by the 1950s the run had declined to near 100,000 adults per year. The adult counts fluctuated throughout the 1980s but then declined further, reaching a low of 2,200 adult spawners in 1995. Currently, the majority of extant populations in the Snake River spring/summer Chinook salmon ESU remain at high overall risk of extinction, with a low probability of persistence within 100 years. Factors cited in the 1991 status review as contributing to the species' decline since the late 1800s include overfishing, irrigation diversions, logging, mining, grazing, obstacles to migration, hydropower development, and questionable management practices and decisions (Matthews and Waples 1991). In addition, new threats ─ such as those posed by toxic contamination, increased predation by non-native species, and effects due to climate change ─ are emerging (NMFS 2016a).

Life History. Adult spring-run Chinook salmon destined for the Snake River return to the Columbia River from the ocean in early spring and pass Bonneville Dam beginning in early March and ending May 31st. Snake River summer-run Chinook salmon return to the Columbia River from June through July. Adults from both runs hold in deep pools in the mainstem Columbia and Snake Rivers and the lower ends of the spawning tributaries until late summer, when they migrate into the higher elevation spawning reaches. Generally, Snake River spring-run Chinook salmon spawn in mid- through late August. Snake River summer-run Chinook salmon spawn approximately one month later than spring-run fish and tend to spawn lower in the tributary drainages, although their spawning areas often overlap with those of spring-run spawners

The eggs that Snake River spring and summer Chinook salmon deposit in late summer and early fall incubate over the following winter, and hatch in late winter and early spring. Juveniles rear through the summer, overwinter, and typically migrate to sea in the spring of their second year of life, although some juveniles may spend an additional year in freshwater. Depending on the tributary and the specific habitat conditions, juveniles may migrate extensively from natal reaches into alternative summer-rearing or overwintering areas. Most yearling fish are thought to spend relatively little time in the estuary compared to sub-yearling ocean-type fish, however there is considerable variation in residence times in different habitats and in the timing of estuarine and ocean entry among individual fish (McElhany et al. 2000, Holsman et al. 2012).
Snake River spring/summer-run Chinook salmon range over a large area in the northeast Pacific Ocean, including coastal areas off Washington, British Columbia, and southeast Alaska, the continental shelf off central British Columbia, and the Gulf of Alaska (NMFS 2016e). Most of the fish spend two or three years in the ocean before returning to tributary spawning grounds primarily as 4- and 5-year-old fish. A small fraction of the fish spend only one year in the ocean and return as 3-year-old "jacks," heavily predominated by males (Good et al. 2005a).

Juvenile Chinook salmon are nearshore obligate feeders foraging in shallow areas with protective cover, such as eelgrass in tidally influenced sandy beaches and other vegetated zones (Healey et al. 1991). Invertebrates including cladocerans, copepods, amphipods, and larvae of diptera, as well as small arachnids and ants are common prey items (Kjelson et al. 1982b, MacFarlane and Norton 2002). Upon reaching the ocean, juvenile Chinook salmon feed voraciously on larval and juvenile

fishes, plankton, and terrestrial insects (Healey et al. 1991, MacFarlane and Norton 2002). Chinook salmon grow rapidly in the ocean environment, with growth rates dependent on water temperatures and food availability.

Table 94. Temporal distribution of Chinook salmon, Snake River spring/summer-run ESU in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)			Present									
Spawning								Present				
Incubation (eggs)								Present				
Emergence (alevin to fry phases	Present									Present		
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance / Productivity

Spring/summer-run Chinook salmon ESU populations are summarized in 5-year increments. The most recent 5-year geometric mean abundance estimates for 26 of the 27 populations are lower than the corresponding estimates for the previous 5-year period by varying degrees; the estimate for the 27th population was a slight increase from a very low abundance in the prior 5-year period. Data show a consistent and marked pattern of declining population size, with the recent 5-year abundance levels for the 27 populations declining by an average of 55%. Medium-term (15-year) population trends in total spawner abundance were positive over the period 1990–2005 for all of the population natural-origin abundance series, and are all declining over the more recent time interval (2004–19). The consistent and sharp declines for all populations in the ESU are concerning, as the abundances for some populations are approaching similar levels to those of the early 1990s when the ESU was listed.

Lower Snake River Major Population Group (MPG): Abundance and productivity remain the major concern for the Tucannon River population. Natural spawning abundance (10-year geometric mean) has decreased and remains well below the minimum abundance threshold for the single extant population in this MPG. Poor natural productivity continues to be a major concern.

Grande Ronde/Imnaha MPG: The Wenaha River, Lostine/Wallowa River and Minam River populations showed substantial decreases in natural abundance relative to the previous ICTRT review, and each remains below their respective minimum abundance thresholds. The Catherine Creek and Upper Grande Ronde populations each remain in a critically depressed state. Geometric mean productivity estimates remain relatively low for all populations in the MPG.
South Fork Salmon River MPG: Natural spawning abundance (10-year geometric mean) estimates decreased for the populations with available data series. Viability ratings based on the combined estimates of abundance and productivity remain at high risk, although the survival/capacity gaps relative to moderate and low risk viability curves are smaller than for other ESU populations.

Middle Fork Salmon River MPG: Natural-origin abundance and productivity remains extremely low for populations within this MPG.

Upper Salmon River MPG: Abundance and productivity estimates for populations within this MPG remain at very low levels relative to viability objectives and all are in decline.
Genetic Diversity / Spatial Structure

Lower Snake River MPG: The integrated spatial structure/diversity risk rating for the Lower Snake River MPG is moderate.

Grande Ronde/Imnaha MPG: The Upper Grande Ronde population is rated at high risk for spatial structure and diversity while the remaining populations are rated at moderate.

South Fork Salmon River MPG: Spatial structure/diversity risks are currently rated moderate for the South Fork Mainstem population (relatively high proportion of hatchery spawners) and low for the Secesh River and East Fork South Fork populations.

Middle Fork Salmon River MPG: Spatial structure/diversity risk ratings for Middle Fork Salmon River MPG populations are generally moderate. This primarily is driven by moderate ratings for genetic structure assigned by the ICTRT because of uncertainty arising from the lack of direct genetic samples from within the component populations.

Upper Salmon River MPG: Spatial structure/diversity risk ratings vary considerably across the Upper Salmon River MPG. Four of the eight populations are rated at low or moderate risk for overall spatial structure and diversity and could achieve viable status with improvements in average abundance/productivity. The high spatial structure/diversity risk rating for the Lemhi population is driven by a substantial loss of access to tributary spawning/rearing habitats and the associated reduction in life-history diversity. High risk ratings for Pahsimeroi River, East Fork Salmon River, and Yankee Fork Salmon River are driven by a combination of habitat loss and diversity concerns related to low natural abundance combined with chronically high proportions of hatchery spawners in natural areas.

Distribution. The Snake River spring/summer Chinook salmon ESU includes all naturally spawned populations of spring/summer Chinook salmon in the mainstem Snake River and the Tucannon River, Grand Ronde River, Imnaha River, and Salmon River subbasins. The ESU is broken into five major population groups (MPG). Together, the MPGs contain 28 extant independent naturally spawning populations, three functionally extirpated populations, and one extirpated population. The Upper Salmon River MPG contains eight extant populations and one extirpated population. The Middle Fork Salmon River MPG contains nine extant populations. The South Fork Salmon River MPG contains four extant populations. The Grande Ronde/Imnaha Rivers MPG contains six extant populations, with two functionally extirpated populations. The Lower Snake River MPG contains one extant population and one functionally extirpated population. The South Fork and Middle Fork Salmon Rivers and Grand Ronde currently support most of the natural spring/summer Chinook salmon production in the Snake River drainage (NMFS 2016e).

Designated Critical Habitat. Critical habitat for Snake River spring/summer Chinook salmon was designated on December 28, 1993 (58 FR 68543) and revised slightly on October 25, 1999 (64 FR 57399). PBFs considered essential for the conservation of Chinook salmon, Snake River spring/summer-run ESU are shown in Table 92.

Spawning and juvenile rearing PBFs are regionally degraded by changes in flow quantity, water quality, and loss of cover. Juvenile and adult migrations are obstructed by reduced access that has resulted from altered flow regimes from hydroelectric dams. According to the ICBTRT, the Panther Creek population was extirpated because of legacy and modern mining-related pollutants creating a chemical barrier to fish passage (Chapman and Julius 2005).

Presence of cool water that is relatively free of contaminants is particularly important for the spring/summer run life history as adults hold over the summer and juveniles may rear for a whole year in the river. Water quality impairments are common in the range of the critical habitat designated for this ESU. Pollutants such as petroleum products, pesticides, fertilizers, and sediment in the form of turbidity enter the surface waters and riverine bottom substrate from the headwaters of the Snake, Salmon, and Clearwater Rivers to the Columbia River estuary as contaminated stormwater runoff, aerial drift and deposition, and via point source discharges. Some contaminants such as mercury and pentachlorophenol enter the aquatic food web after reaching water and may be concentrated or even biomagnified in the salmon tissue. This species also requires migration corridors with adequate passage conditions (water quality and quantity available at specific times) to allow access to the various habitats required to complete their life cycle.

Recovery Goals. Recovery goals, scenarios and criteria for the Snake River spring and summer-run Chinook salmon are fully outlined in the recovery plan issued in 2017 (NMFS 2017d). The status levels targeted for populations within an ESU or DPS are referred to collectively as the "recovery scenario" for the ESU or DPS. NMFS has incorporated the viability criteria into viable recovery scenarios for each Snake River spring/summer Chinook salmon and steelhead MPG. The criteria should be met for an MPG to be considered Viable, or low (5% or less) risk of extinction, and thus contribute to the larger objective of ESU or DPS viability. These criteria are:

- At least one-half the populations historically present (minimum of two populations) should meet viability criteria (5% or less risk of extinction over 100 years).
- At least one population should be highly viable (less than 1% risk of extinction).
- Viable populations within an MPG should include some populations classified as "Very Large'" or "Large," and "Intermediate" reflecting proportions historically present.
- All major life history strategies historically present should be represented among the populations that meet viability criteria.
- Remaining populations within an MPG should be maintained (25% or less risk of extinction) with sufficient abundance, productivity, spatial structure, and diversity to provide for ecological functions and to preserve options for ESU or DPS recovery.
- For MPGs with only one population, this population must be highly viable (less than 1% risk of extinction).

6.2.9 Chinook salmon, Upper Columbia River spring-run ESU

Table 95. Chinook salmon, Upper Columbia River spring-run ESU; overview table

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat

Oncorhynchus tshawytscha	Chinook salmon	Upper Columbia River spring-run ESU	Endangered	2022	70 FR 37160	2007	70 FR 52630

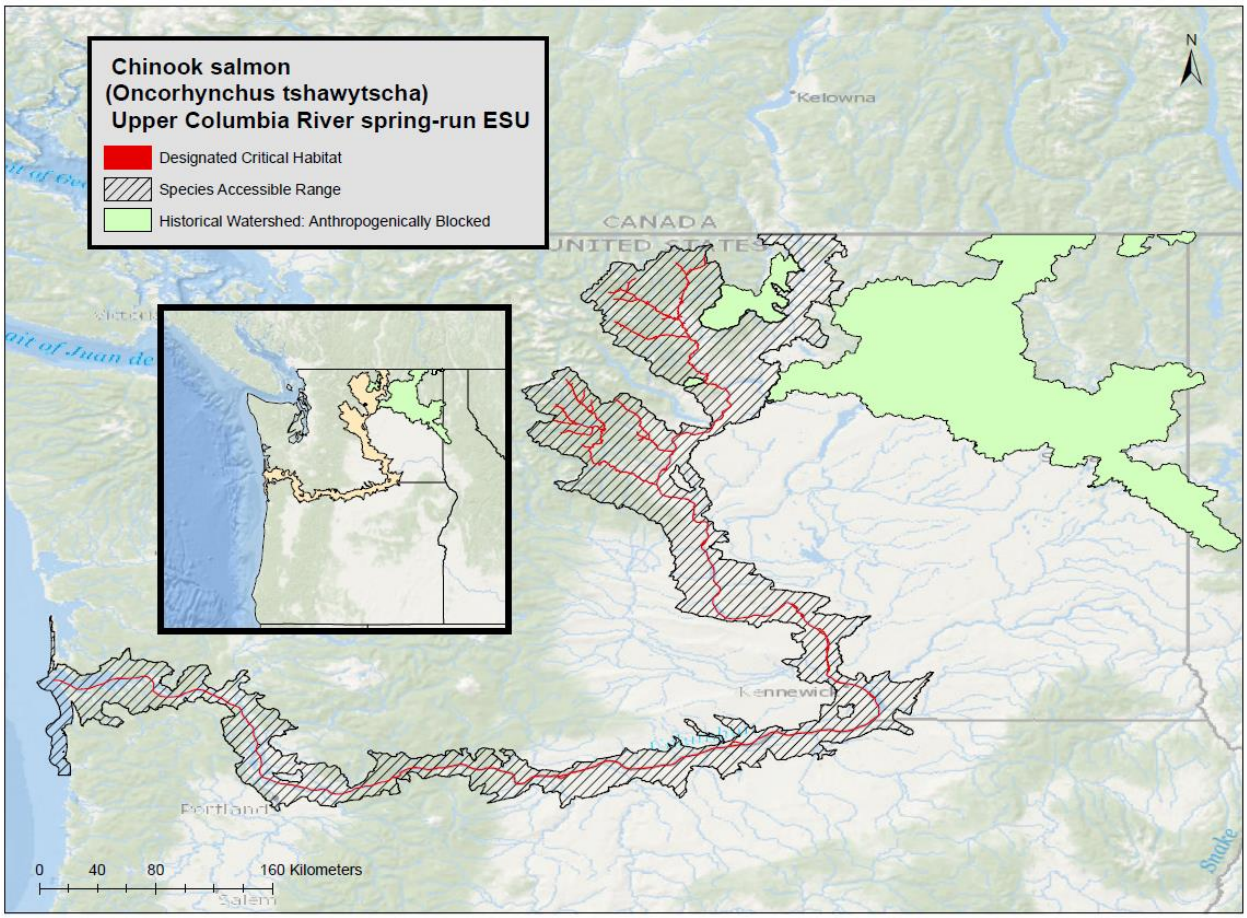


Figure 12. Chinook salmon, Upper Columbia River spring-run ESU range and designated critical habitat

Species Description. Chinook salmon are the largest of the Pacific salmon. Spawning adults are olive to dark maroon in color, without conspicuous streaking or blotches on the sides. Spawning males are darker than females, and have a hooked jaw and slightly humped back. They can be distinguished from other spawning salmon by the color pattern, particularly the spotting on the back and tail, and by the dark, solid black gums of the lower jaw (Moyle 2002c). Upper Columbia River spring-run Chinook salmon ESU was listed as an endangered species under the ESA on March 24, 1999 (64 FR 14308). NMFS reaffirmed the listing on June 28, 2005 (70 FR 37160). This ESU includes naturally spawned spring-run Chinook salmon originating from Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam (excluding the Okanogan River subbasin). Also, spring-run Chinook salmon from six artificial propagation programs. The Northwest Fisheries Science Center's review (Ford 2022) found that no new information had become available that would justify a change in the delineation of the UCR spring-run Chinook salmon ESU.

Status. The Upper Columbia spring Chinook ESU includes three extant populations (Wenatchee, Entiat, and Methow), as well as one extinct population in the Okanogan subbasin (ICBTRT 2003). All three populations continued to be rated at low risk for spatial structure but at high risk for diversity criteria. Large-scale supplementation efforts in the Methow and Wenatchee Rivers are ongoing, intended to counter short-term demographic risks given current average survival levels and the associated year-to-year variability. Under the current recovery plan, habitat protection and restoration actions are being implemented that are directed at key limiting factors. Although the status of the ESU has improved relative to measures available at the time of listing, all three populations remain at high risk (NWFSC 2015). The Northwest Fisheries Science Center's review of updated information (Ford 2022) does not indicate a change in the biological risk category for this species since the time of the last 5-year review (NWFSC 2015). Analysis of the ESA section 4(a)(1) factors indicates that the collective risk to the UCR Spring-run Chinook salmon's persistence has not changed significantly since our previous 5-year review for the UCR spring-run Chinook salmon ESU.

Life History. Adult spring Chinook in the Upper Columbia Basin begin returning from the ocean in the early spring, with the run into the Columbia River peaking in mid-May. Spring Chinook enter the Upper Columbia tributaries from April through July. After migration, they hold in freshwater tributaries until spawning occurs in the late summer, peaking in mid to late August. Juvenile spring Chinook spend a year in freshwater before migrating to salt water in the spring of their second year of life. Most Upper Columbia spring Chinook return as adults after two or three years in the ocean. Some precocious males, or jacks, return after one winter at sea. A few other males mature sexually in freshwater without migrating to the sea. However, four and five year old fish that have spent two and three years at sea, respectively, dominate the run. Fecundity ranges from 4,200 to 5,900 eggs, depending on the age and size of the female.

Juvenile Chinook salmon are nearshore obligate feeders foraging in shallow areas with protective cover, such as eelgrass in tidally influenced sandy beaches and other vegetated zones (Healey et al. 1991). Invertebrates including cladocerans, copepods, amphipods, and larvae of diptera, as well as small arachnids and ants are common prey items (Kjelson et al. 1982b, MacFarlane and Norton 2002). Upon reaching the ocean, juvenile Chinook salmon feed voraciously on larval and juvenile fishes, plankton, and terrestrial insects (Healey et al. 1991, MacFarlane and Norton 2002). Chinook salmon grow rapidly in the ocean environment, with growth rates dependent on water temperatures and food availability.

Table 96. Temporal distribution of Chinook salmon, Upper Columbia River spring-run ESU in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)			Present									
Spawning							Present					
Incubation (eggs)								Present				
Emergence (alevin to fry phases)	Present										Present	
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance. For all populations, average abundance over the recent 10-year period is below the average abundance thresholds that the ICTRT identifies as a minimum for low risk (ICTRT 2008b, a, c). All three populations in the UCR spring-run Chinook salmon ESU remain at high overall risk. Natural origin abundance has decreased over the levels reported in the prior review for all populations in this ESU, in many cases sharply. The abundance data for the entire ESU show a downward trend over the last five years, with the recent 5-year abundance levels for all three populations declining by an average of 48%. The consistent and sharp declines for all populations in the ESU are concerning. Relatively low ocean survivals in recent years were a major factor in recent abundance patterns.

Productivity / Population Growth Rate. Using the updated data series for this review, the short-term (5-year) trend in wild spawners has been strongly negative for all three extant populations. Longer-term (15-year) trends are also negative for all three populations, although the 95% confidence intervals in each case include 0. In general, both total and natural-origin escapements for all three populations increased sharply from 1999 through 2002 and have shown substantial year-to-year variations in the years following, with peaks around 2001 and 2010 and declines after 2010. Average natural-origin returns remain well below ICTRT minimum threshold levels. The smolt to adult ratio estimates for the range of brood years 2002–15. Over the period of record, the geometric mean SAR for the Entiat and Methow River populations (~3%) represents a low, but reasonable marine survival, with the Wenatchee River SAR of ~1.5% being on the low end, as 2% is roughly a replacement rate (ICTRT 2008b, a, c).

Genetic Diversity. The ICTRT characterizes the diversity risk to all Upper Columbia River (UCR) Spring-run Chinook populations as “high”. The high risk is a result of reduced genetic diversity from homogenization of populations that occurred under the Grand Coulee Fish Maintenance Project in 1939-1943.

Distribution. Spring Chinook currently spawn and rear in the upper main Wenatchee River upstream from the mouth of the Chiwawa River, overlapping with summer Chinook in that area (Peven et al. 1994). The primary spawning areas of spring Chinook in the Wenatchee subbasin include Nason Creek and the Chiwawa, Little Wenatchee, and White rivers. (Hamstreet and Carie 2003) described the current spawning distribution for spring Chinook in the Entiat subbasin as the Entiat River (river mile 16.2 to 28.9) and the Mad River (river mile 32 1.5-5.0). Spring Chinook of the Methow population currently spawn in the mainstem Methow River and the Twisp, Chewuch, and five Lost drainages (Scribner et al. 1993, Humling and Snow 2005). A few also spawn in Gold, Wolf, six and Early Winters creeks.

Designated Critical Habitat. NMFS designated critical habitat for Upper Columbia River Spring-run Chinook salmon on September 2, 2005 (70 FR 52630). It includes all Columbia River estuarine areas and river reaches proceeding upstream to Chief Joseph Dam and several tributary subbasins. PBFs considered essential for the conservation of Chinook salmon, Upper Columbia River spring-run ESU are described in Appendix B.

Spawning and rearing PBFs are somewhat degraded in tributary systems by urbanization in lower reaches, grazing in the middle reaches, and irrigation and diversion in the major upper drainages. These activities have resulted in excess erosion of fine sediment and silt that smother spawning

gravel; reduction in flow quantity necessary for successful incubation, formation of physical rearing conditions, and juvenile mobility. Moreover siltation further affects critical habitat by reducing water quality through contaminated agricultural runoff; and removing natural cover. Adult and juvenile migration PBFs are heavily degraded by Columbia River Federal dam projects and a number of mid-Columbia River Public Utility District dam projects also obstruct the migration corridor.

Recovery Goals. Recovery goals, objectives and detailed criteria for the Central Valley spring-run Chinook are fully outlined in the 2016 Recovery Plan (NMFS 2007c). The general recovery objectives are:

- Increase the abundance of naturally produced spring Chinook spawners within each population in the Upper Columbia ESU to levels considered viable.
- Productivity 21 Increase the productivity (spawner:spawner ratios and smolts/redds) of naturally produced spring Chinook within each population to levels that result in low risk of extinction.
- Restore the distribution of naturally produced spring Chinook to previously occupied areas (where practical) and allow natural patterns of genetic and phenotypic diversity to be expressed.

6.2.10 Chinook salmon, Upper Willamette River ESU

Table 97. Chinook salmon, Upper Willamette River ESU; overview table

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus tshawytscha	Chinook salmon	Upper Willamette River ESU	Threatened	2022	70 FR 37160	2011	70 FR 52630

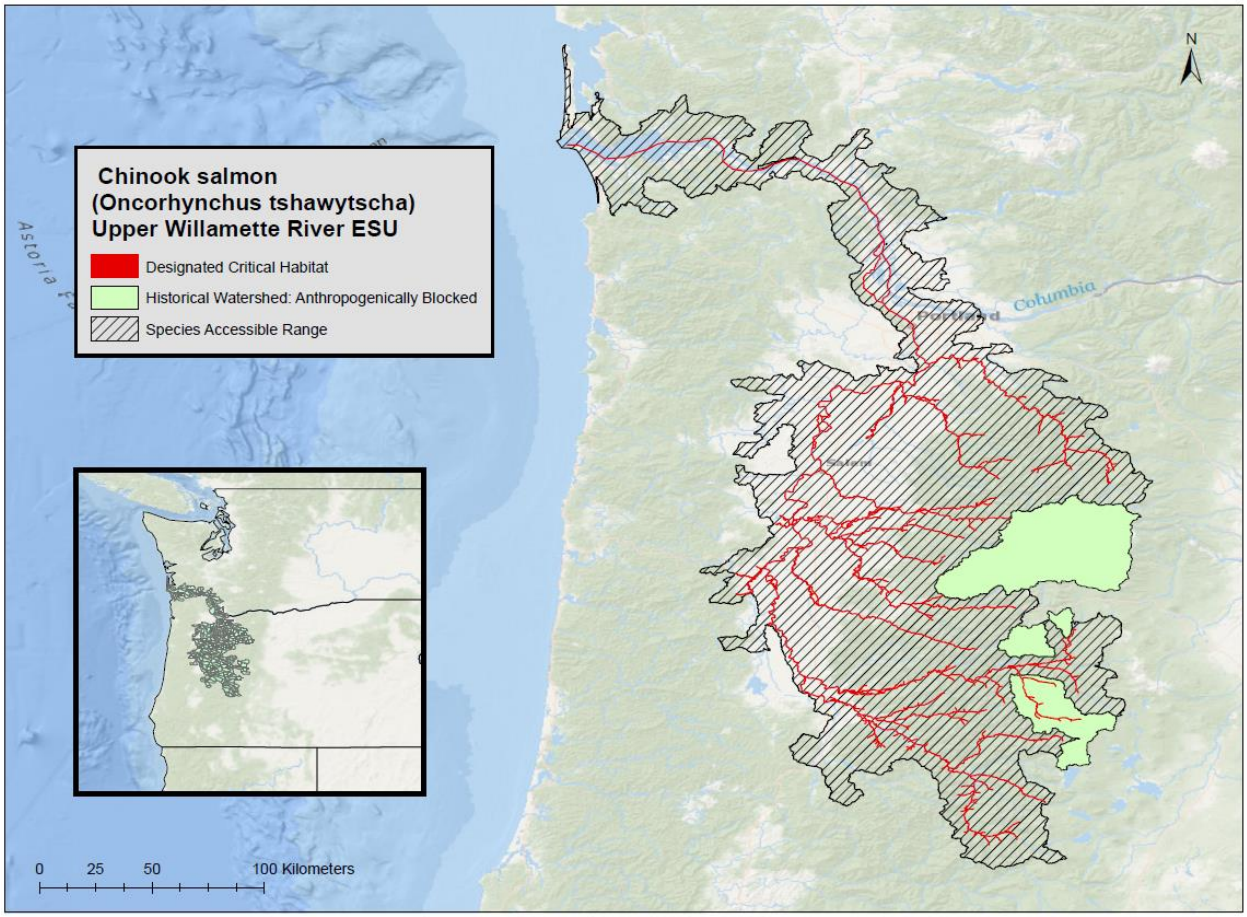


Figure 13. Chinook salmon, Upper Willamette River ESU range and designated critical habitat

Species Description. Chinook salmon are the largest of the Pacific salmon. Spawning adults are olive to dark maroon in color, without conspicuous streaking or blotches on the sides. Spawning males are darker than females, and have a hooked jaw and slightly humped back. They can be distinguished from other spawning salmon by the color pattern, particularly the spotting on the back and tail, and by the dark, solid black gums of the lower jaw (Moyle 2002c). Upper Willamette River Chinook salmon ESU was listed as a threatened species under the ESA on March 24, 1999 (64 FR 14308). NMFS reaffirmed the listing on June 28, 2005 (70 FR 37160). This ESU includes naturally spawned spring-run Chinook salmon originating from the Clackamas River and from the Willamette River and its tributaries above Willamette Falls. Also, spring-run Chinook salmon from six artificial propagation programs.

Status. The Upper Willamette River Chinook ESU is considered to be extremely depressed, likely numbering less than 10,000 adult spawners compared to a historical abundance estimate of 300,000 (Myers et al. 2003). There are seven demographically independent populations of spring-run Chinook salmon in the Upper Willamette River (UWR) Chinook salmon ESU: Clackamas, Molalla, North Santiam, South Santiam, Calapooia, McKenzie, and the Middle Fork Willamette (Myers et al. 2006). Currently, significant natural production occurs in only the Clackamas and McKenzie populations (McElhany et al. 2007a). Juvenile spring Chinook produced by hatchery programs are released throughout many of the subbasins and adult Chinook returns to the ESU are typically 80-90% hatchery origin fish. Access to historical spawning and rearing areas is restricted by large dams in the four historically most productive tributaries, and in the absence of effective passage programs will continue to be confined to more lowland reaches where land development, water temperatures, and water quality may be limiting. Pre-spawning mortality levels are generally high in the lower tributary reaches where water temperatures and fish densities are generally the highest.

Life history. Upper Willamette River Chinook salmon exhibit an earlier time of entry into the Columbia River than other spring-run Chinook salmon ESUs (Myers et al. 1998b). Adults appear in the lower Willamette River in February, but the majority of the run ascends Willamette Falls in April and May, with a peak in mid- to late May. However, present-day salmon ascend the Willamette Falls via a fish ladder. Consequently, the migration of spring Chinook salmon over Willamette Falls extends into July and August (overlapping with the beginning of the introduced fall-run of Chinook salmon).

The adults hold in deep pools over summer and spawn in late fall or early winter when winter storms augment river flows. Fry may emerge from February to March and sometimes as late as June (Myers et al. 2006). Juvenile migration varies with three distinct juvenile emigration “runs”: fry migration in late winter and early spring; sub-yearling (0 yr +) migration in fall to early winter; and yearlings (1 yr +) migrating in late winter to spring. Sub-yearlings and yearlings rear in the mainstem Willamette River where they also use floodplain wetlands in the lower Willamette River during the winter-spring floodplain inundation period.

Juvenile Chinook salmon are nearshore obligate feeders foraging in shallow areas with protective cover, such as eelgrass in tidally influenced sandy beaches and other vegetated zones (Healey et al. 1991). Invertebrates including cladocerans, copepods, amphipods, and larvae of diptera, as well as small arachnids and ants are common prey items (Kjelson et al. 1982b, MacFarlane and Norton 2002). Upon reaching the ocean, juvenile Chinook salmon feed voraciously on larval and juvenile fishes, plankton, and terrestrial insects (Healey et al. 1991, MacFarlane and Norton 2002). Chinook salmon grow rapidly in the ocean environment, with growth rates dependent on water temperatures and food availability.

Table 98. Temporal distribution of Chinook salmon, Upper Willamette River ESU in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)					Present							
Spawning								Present				
Incubation (eggs)									Present			
Emergence (alevin to fry phases)	Present										Present	
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance. The UWR Chinook ESU is considered to be extremely depressed, likely numbering less than 10,000 adult spawners compared to a historical abundance estimate of 300,000 (Myers et al. 2003). Abundance levels for all but one of the seven DIPs in this ESU remain well below their recovery goals. The Clackamas River DIP currently exceeds its abundance recovery goal and its pHOS goal (<10% hatchery-origin fish). Alternatively, the Calapooia River may be functionally extinct, and the Molalla River remains critically low (there is considerable uncertainty in the level of natural production in the Molalla River). Abundances in the North and South Santiam Rivers have declined since the last review, with natural-origin abundances in the low hundreds of fish. The Middle Fork Willamette River is at a very low abundance, even with the inclusion of natural-origin spring-run Chinook salmon spawning in Fall Creek. While returns to Fall Creek Dam number in the low hundreds, prespawn mortality rates are very high in the basin; however, the Fall Creek program does provide valuable information on juvenile fish passage through operational drawdown. With the exception of the Clackamas River, the proportions of natural-origin spawners in the remainder of the ESU are well below those identified in the recovery goals. While the Clackamas River appears to be able to sustain above recovery goal abundances, even during relatively poor ocean and freshwater conditions, the remainder of the ESU is well short of its recovery goal.

Productivity / Population Growth Rate. The spring Chinook salmon population in the McKenzie River is the only remaining self-sustaining naturally reproducing independent population. Within the recent review period, the average natural-origin abundance in the McKenzie River has increased by 13%, to a 5-year geomean of 1,664. This improvement in abundance marks a reversal of long-term declines. Still, the long-term trend in abundance (2015–19) is –2%. The McKenzie River has been a bellwether for natural production in the upper Willamette River basin, with the majority of historical spawning habitat still accessible. Natural-origin spawners represent the majority of spawners, 57%, especially in the upper reaches (NAI 2020). The other natural-origin populations in this ESU have very low current abundances, and long- and short-term population trends are negative. Cohorts returning from 2015–19 were strongly influenced by warmer-than-normal and less-productive ocean conditions, in addition to warmer- and drier-than-normal freshwater conditions. The 5-year average abundance geomean for 2015–19 was 6,916 natural-origin (unmarked) adults, a 31% decrease from the previous period. While there was a substantial downward trend in total and natural-origin spring-run abundance at Willamette Falls, there were some indications of improving abundance in 2019 and 2020. Improvements in abundance corresponded with improved ocean and freshwater conditions, as well as changes in pinniped predation. Over the last 15 years, the long-term trend for natural-origin returns was –4%, suggesting an overall decline in those populations above Willamette Falls.

Genetic Diversity. Access of fall-run Chinook salmon to the upper Willamette River and the mixing of hatchery stocks within the ESU have threatened the genetic integrity and diversity of the species. Much of the genetic diversity that existed between populations has been homogenized (Myers et al. 2006). While hatchery populations were most similar to natural Chinook salmon from the same basin, they tended to present greater allelic richness. It is not clear whether this is due to the small effective population size of naturally spawning populations, or the legacy of interhatchery transfers between basins (Johnson and Friesen 2014).

Distribution. Radio-tagging results from 2014 suggest that few fish strayed into west-side tributaries (no detections) and relatively fewer fish were unaccounted for between Willamette Falls and the tributaries (12.9% of clipped fish and 5.3% of unclipped fish) (Jepson et al. 2015). In contrast to most of the other populations in this ESU, McKenzie River Chinook salmon have access to much of their historical spawning habitat, although access to historically high quality habitat above Cougar Dam (South Fork McKenzie River) is still limited by poor downstream juvenile passage. Similarly, natural-origin returns to the Clackamas River have remained flat, despite adults having access to much of their historical spawning habitat. Although returning adults have access to most of the Calapooia and Molalla basin, habitat conditions are such that the productivity of these systems is very low. Natural-origin spawners in the Middle Fork Willamette River in the last 10 years consisted solely of adults returning to Fall Creek. While these fish contribute to the Demographically Independent Populations (DIP) and ESU, at best the contribution will be minor. Finally, improvements were noted in the North and South Santiam DIPs. The increase in abundance in both DIPs was in contrast to the other DIPs and the counts at Willamette Falls. While spring-run Chinook salmon in the South Santiam DIP have access to some of their historical spawning habitat, natural origin spawners in the North Santiam are still confined to below Detroit Dam and subject to relatively high prespawning mortality rates (NWFSC 2015).

Designated Critical Habitat. NMFS designated critical habitat for this species on September 2, 2005 (70 FR 52630). Designated critical habitat includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Willamette River as well as specific stream reaches in a number of subbasins. PBFs considered essential for the conservation of Chinook salmon, Upper Willamette River ESU are described in Appendix B.

The current condition of PBFs of the UWR Chinook salmon critical habitat indicates that migration and rearing PBFs are not currently functioning or are degraded. These conditions impact their ability to serve their intended role for species conservation. The migration PBF is degraded by dams altering migration timing and water management altering the water quantity necessary for mobility and survival. Migration, rearing, and estuary PBFs are also degraded by loss of riparian vegetation and instream cover. Pollutants such as petroleum products, fertilizers, pesticides, and fine sediment enter the stream through runoff, point source discharge, drift during application, and non-point discharge where agricultural and urban development occurs. Degraded water quality in the lower Willamette River where important floodplain rearing habitat is present affects the ability of this habitat to sustain its role to conserve the species.

Recovery Goals. Recovery goals, objectives and detailed criteria for the Upper Willamette River Chinook are fully outlined in the 2011 Recovery Plan (NMFS 2011c). The 2011 recovery plan outlines five potential scenario options for meeting the viability criteria for recovery. Of the five scenarios, scenario one reportedly represented the most balanced approach given limitations in

some populations. The approach in this Plan to achieve ESU delisting of UWR Chinook salmon is to: recover the McKenzie (core and genetic legacy population) and the Clackamas populations to an extinction risk status of very low risk (beyond minimal viability thresholds); to recover the North Santiam and Middle Fork Willamette populations (core populations) to an extinction risk status of low risk; to recover the South Santiam population to moderate risk; and to improve the status of the remaining populations from very high risk to high risk.

6.2.11 Coho salmon, Central California Coast ESU

Table 99. Coho salmon, central California coast ESU; overview table

Species	Common Name	ESU	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus kisutch	Coho salmon	Central California Coast	Endangered	2023	2005 70 FR 37160	2012	1999 64 FR 24049

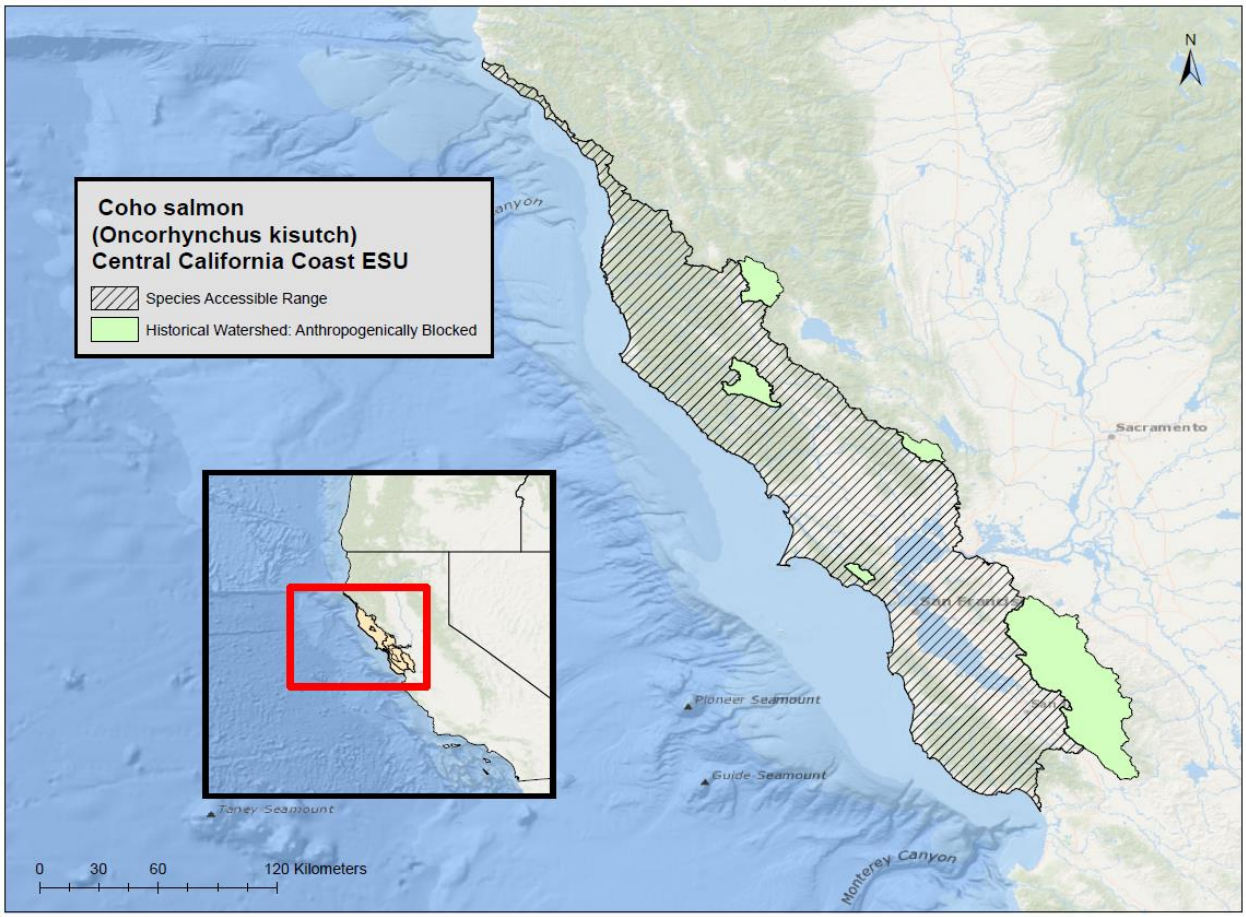


Figure 14. Coho salmon, central California coast ESU range

Species Description. Coho salmon are an anadromous species (i.e., adults migrate from marine to freshwater streams and rivers to spawn). Adult coho salmon are typically about two ft long and eight pounds. Coho have backs that are metallic blue or green, silver sides, and light bellies; spawners are dark with reddish sides; and when coho salmon are in the ocean, they have small black spots on the back and upper portion of the tail. Central California coast coho salmon ESU was listed as threatened under the ESA on October 31, 1996 (64 FR 56138). NMFS re-classified the ESU as endangered on June 28, 2005 (70 FR 37160). This ESU includes naturally spawned coho salmon originating from rivers south of Punta Gorda, California to and including Aptos Creek, as well as such coho salmon originating from tributaries to San Francisco Bay. Also, coho salmon from three artificial propagation programs are included in this ESU.

Status. The low survival of juveniles in freshwater, in combination with poor ocean conditions, has led to the precipitous declines of Central California Coast (CCC) coho salmon populations. Most independent CCC coho salmon populations remain at critically low levels, with those in the southern Santa Cruz Mountains strata likely extirpated. Data suggests some populations show a slight positive trend in annual escapement, but the improvement is not statistically significant. Overall, all CCC coho salmon populations remain, at best, a slight fraction of their recovery target levels, and, aside from the Santa Cruz Mountains strata, the continued extirpation of dependent populations continues to threaten the ESU's future survival and recovery. The evaluation of current habitat conditions and ongoing and future threats led to the conclusion that summer and winter rearing survival are very low due to impaired instream habitats. These impairments were due to a lack of complexity formed by instream wood, high sediment loads, lack of refugia habitats during winter, low summer flows and high instream temperatures. Additionally, populations throughout the ESU, but particularly at the southern end of the range, are likely to be significantly impacted by climate change in the future (NMFS 2012a).

Life History. Central California Coast coho salmon typically enter freshwater from November through January, and spawn into February or early March (Moyle 2002a). The upstream migration towards spawning areas coincides with large increases in stream flow (Hassler 1987). Coho salmon often are not able to enter freshwater until heavy rains have caused breaching of sand bars that form at the mouths of many coastal California streams. Spawning occurs in streams with direct flow to the ocean, or in large river tributaries (Moyle 2002c). Female coho salmon choose a site to spawn at the head of a riffle, just downstream of a pool where water flow changes from slow to turbulent, and where medium to small size gravel is abundant (Moyle 2002c).

Eggs incubate in redds from November through April, and hatch into "alevins" after a period of 35-50 days (Shapovalov and Taft 1954b). The period of incubation is inversely related to water temperature. Alevins remain in the gravel for two to 10 weeks then emerge into the water column as young juveniles, known as "fry". Juveniles, or fry, form schools in shallow water along the undercut banks of the stream to avoid predation. The juveniles feed heavily during this time, and as they grow they set up individual territories. Juveniles are voracious feeders, ingesting any organism that moves or drifts over their holding area. The juvenile's diet is mainly aquatic insect larvae and terrestrial insects, but small fish are taken when available (Moyle 2002a).

After one year in freshwater juvenile coho salmon undergo physiological transformation into "smolts" for outmigration to the ocean. Smolts may spend time residing in the estuarine habitat prior to ocean entry, to allow for the transition to the saline environment. After entering the ocean, the immature salmon initially remain in the nearshore waters close to their natal stream. They gradually move northward, generally staying over the continental shelf (Brown et al. 1994). After approximately two years at sea, adult coho salmon move slowly homeward. Adults begin their freshwater migration upstream after heavy fall or winter rains breach the sandbars at the mouths of coastal streams (Sandercock 1991) and/or flows are sufficient to reach upstream spawning areas.

Table 100. Temporal distribution of Coho salmon, central California coast ESU in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)	Present										Present	
Spawning	Present										Present	
Incubation (eggs)	Present											Present
Emergence (alevin to fry phases)		Present										Present
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance. Limited information exists on the abundance of coho salmon within the CCC coho salmon ESU. About 200,000 to 500,000 coho salmon were produced statewide in the 1940s (Good et al. 2005b). This escapement declined to about 99,000 by the 1960s with approximately 56,000 (56%) originating from streams within the CCC coho salmon ESU. The estimated number of coho salmon produced within the ESU in 2011 was between 2,000 and 3,000 wild adults (Gallagher et al. 2010).

Productivity / Population Growth Rate. Within the Lost Coast – Navarro Point stratum, current population sizes range from 4% to 12% of proposed recovery targets, with two populations (Albion River and Big River, respectively) at or below their high-risk depensation thresholds. Most independent populations show positive but non-significant population trends. Dependent populations within the stratum have declined significantly since 2011. Similar results were obtained immediately south within the Navarro Point – Gualala Point stratum, where two of the three largest independent populations, the Navarro and Garcia rivers, have averaged 257 and 46 adult returns, respectively, during the 2005 – 2011 years (both populations are at or below their high-risk depensation threshold). Data from the three dependent populations within the stratum (Brush, Greenwood and Elk creeks) suggest little to no adult coho salmon escapement since 2011. In the Russian River and Lagunitas Creek watersheds, which are the two largest within the Central Coast strata, recent coho salmon population trends suggest limited improvement, although both populations remain well below recovery targets. Likewise, most dependent populations within the strata remain at very low levels, although excess broodstock adults from the Russian River and Olema Creek were recently stocked into Salmon Creek and the subsequent capture of juvenile fish indicates successful reproduction occurred. Finally, recent sampling within Pescadero Creek and San Lorenzo River, the only two independent populations within the Santa Cruz Mountains strata, suggest coho salmon have likely been extirpated within both basins. A bright spot appears to be the recent improvement in abundance and spatial distribution noted within the strata's dependent populations; Scott Creek experienced the largest coho salmon run in a decade during 2014/15, and researchers' recently detected juvenile coho salmon within four dependent watersheds where they were previously thought to be extirpated (San Vincente, Waddell, Soquel and Laguna creeks).

Genetic Diversity. Hatchery raised smolts have been released infrequently but occasionally in large numbers in rivers throughout the ESU (Bjorkstedt et al. 2005). Releases have included transfer of stocks within California and between California and other Pacific states as well as smolts raised from eggs collected from native stocks. However, genetic studies show little homogenization of populations, *i.e.*, transfer of stocks between basins have had little effect on the geographic genetic

structure of CCC coho salmon (Sonoma County Water Agency (SCWA) 2002). The CCC coho salmon likely has considerable diversity in local adaptations given that the ESU spans a large latitudinal diversity in geology and ecoregions, and includes both coastal and inland river basins.

Distribution. The TRT identified 11 "functionally independent", one "potentially independent" and 64 "dependent" populations in the CCC coho salmon ESU (Bjorkstedt *et al.*, 2005 with modifications described in Spence *et al.* 2008). The 75 populations were grouped into five Diversity Strata. ESU spatial structure has been substantially modified due to lack of viable source populations and loss of dependent populations. One of the two historically independent populations in the Santa Cruz mountains (*i.e.,* South of the Golden Gate Bridge) is extirpated (Good et al. 2005b, Spence et al. 2008a). Coho salmon are considered effectively extirpated from the San Francisco Bay (NMFS 2001, Spence et al. 2008a). The Russian River is of particular importance for preventing the extinction and contributing to the recovery of CCC coho salmon (NOAA 2013). The Russian River population, once the largest and most dominant source population in the ESU, is now at high risk of extinction because of low abundance and failed productivity (Spence et al. 2008a). The Lost Coast to Navarro Point to the north contains the majority of coho salmon remaining in the ESU.

Designated Critical Habitat. Critical habitat for the CCC coho salmon ESU was designated on May 5, 1999 (64 FR 24049). It encompasses accessible reaches of all rivers (including estuarine areas and tributaries) between Punta Gorda and the San Lorenzo River (inclusive) in California. Critical habitat for this species also includes two streams entering San Francisco Bay: Arroyo Corte Madera Del Presidio and Corte Madera Creek. PBFs considered essential for the conservation of Coho salmon, central California coast ESU are:

Within the range of both ESUs, the species' life cycle can be separated into five essential habitat types:

- Juvenile summer and winter rearing areas;
- juvenile migration corridors;
- areas for growth and development to adulthood;
- adult migration corridors; and
- spawning areas.

Essential features of coho critical habitat include adequate

- substrate,
- water quality,
- water quantity,
- water temperature,
- water velocity,
- cover/shelter,
- food,
- riparian vegetation,
- space, and
- safe passage conditions.

NMFS (2008a) evaluated the condition of each habitat attribute in terms of its current condition relative to its role and function in the conservation of the species. The assessment of habitat for this

species showed a distinct trend of increasing degradation in quality and quantity of all PBFs as the habitat progresses south through the species range, with the area from the Lost Coast to the Navarro Point supporting most of the more favorable habitats and the Santa Cruz Mountains supporting the least. However, all populations are generally degraded regarding spawning and incubation substrate, and juvenile rearing habitat. Elevated water temperatures occur in many streams across the entire ESU.

Recovery Goals See the 2012 Recovery Plan for complete down listing/delisting criteria for each of the following recovery goals (NMFS 2012a):

- Prevent extinction by protecting existing populations and their habitats;
- Maintain current distribution of coho salmon and restore their distribution to previously occupied areas essential to their recovery;
- Increase abundance of coho salmon to viable population levels, including the expression of all life history forms and strategies;
- Conserve existing genetic diversity and provide opportunities for interchange of genetic material between and within meta populations;
- Maintain and restore suitable freshwater and estuarine habitat conditions and characteristics for all life history stages so viable populations can be sustained naturally;
- Ensure all factors that led to the listing of the species have been ameliorated; and
- Develop and maintain a program of monitoring, research, and evaluation that advances understanding of the complex array of factors associated with coho salmon survival and recovery and which allows for adaptively managing our approach to recovery over time.

6.2.12 Coho salmon, Lower Columbia River ESU

Table 101. Coho salmon, lower Columbia River ESU; overview table

Species	Common Name	ESU	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus kisutch	Coho salmon	Lower Columbia River	Threatened	2022	2005 70 FR 37160	2013	81 FR 9251

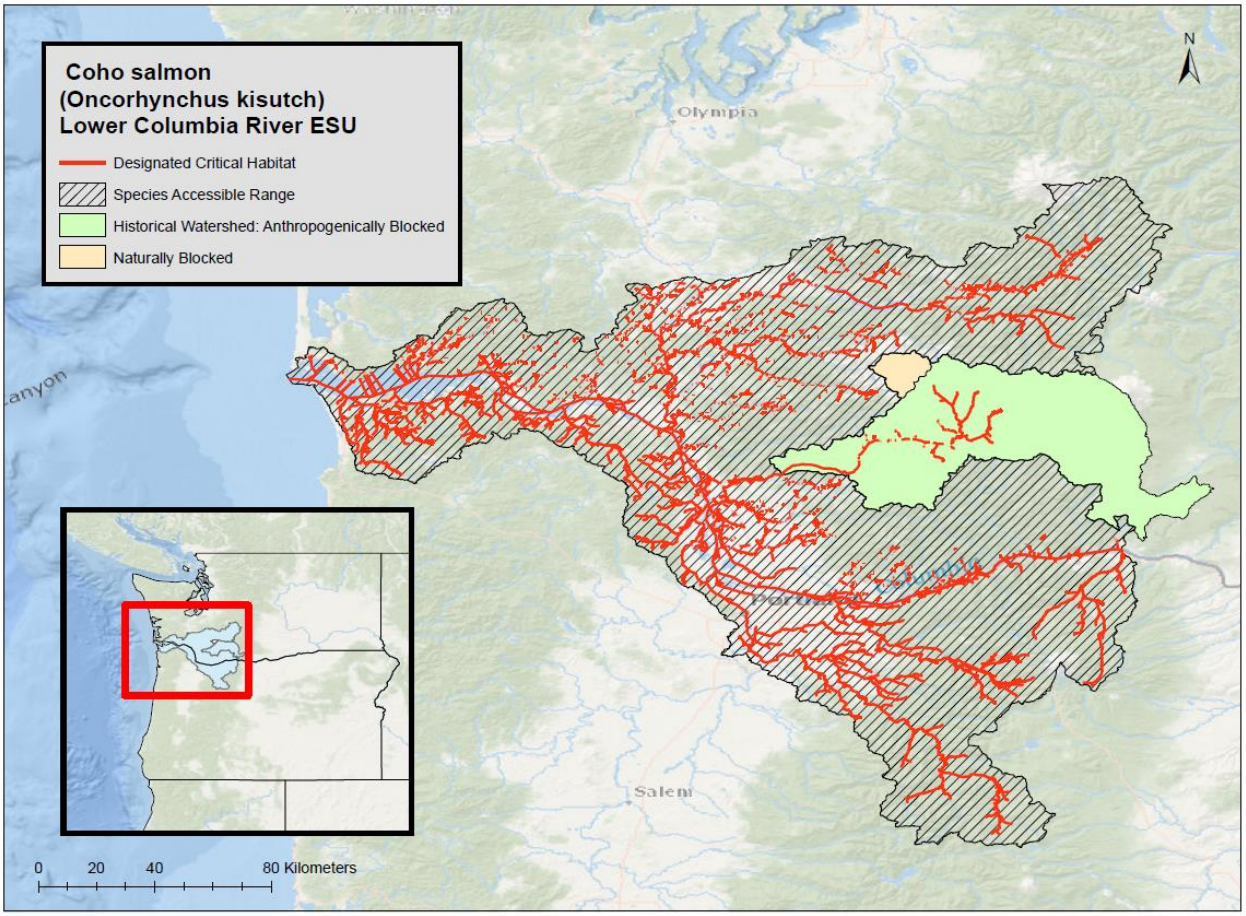


Figure 15. Coho salmon, lower Columbia River ESU range and designated critical habitat

Species Description. Coho salmon are an anadromous species (i.e., adults migrate from marine to freshwater streams and rivers to spawn). Adult coho salmon are typically about two ft long and eight pounds. Coho have backs that are metallic blue or green, silver sides, and light bellies; spawners are dark with reddish sides; and when coho salmon are in the ocean, they have small black spots on the back and upper portion of the tail. Lower Columbia River coho salmon ESU was listed as threatened under the ESA on June 28, 2005 (70 FR 37160). (Ford 2022) found that no new information had become available that would justify a change in the delineation of the LCR Coho Salmon ESU. This ESU includes naturally spawned coho salmon originating from the Columbia River and its tributaries downstream from the Big White Salmon and Hood Rivers (inclusive) and any such fish originating from the Willamette River and its tributaries below Willamette Falls. Myers et al. (2006) identified three MPGs (Coastal, Cascade, and Gorge), containing a total of 24

demographically independent populations (DIPs), in the Lower Columbia River coho salmon ESU. Also, coho salmon from 21 artificial propagation programs are included in this ESU.

Status. For the individual populations within the LCR Coho Salmon ESU, overall abundance trends for the ESU are generally negative. Natural spawner and total abundances have decreased in almost all DIPs. The risk of extinction spans the full range from low to very high. Overall, the LCR Coho Salmon ESU's risk of extinction was found to have increased since the previous review period. The NWFSC determined the ESU remains at moderate risk of extinction (Ford 2022). Abundances are still at low levels and the majority of the DIPs 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. Based on the 2022 Status Update, no reclassification for the LCR Coho Salmon ESU is warranted. Therefore, the LCR Coho Salmon ESU remain listed as threatened.

Life History. Lower Columbia River coho salmon are typically categorized into early- and late-returning stocks. Early-returning (Type S) adult coho salmon enter the Columbia River in mid-August and begin entering tributaries in early September, with peak spawning from mid-October to early November. Late-returning (Type N) coho salmon pass through the lower Columbia from late September through December and enter tributaries from October through January. Most spawning occurs from November to January, but some occurs as late as March (LCFRB 2010b).

Coho salmon typically spawn in small to medium, low- to-moderate elevation streams from valley bottoms to stream headwaters. Coho salmon construct redds in gravel and small cobble substrate in pool tailouts, riffles, and glides, with sufficient flow depth for spawning activity (NMFS 2013b). Eggs incubate over late fall and winter for about 45 to 140 days, depending on water temperature, with longer incubation in colder water. Fry may thus emerge from early spring to early summer (ODFW 2010). Juveniles typically rear in freshwater for more than a year. After emergence, coho salmon fry move to shallow, low-velocity rearing areas, primarily along the stream edges and inside channels. Juvenile coho salmon favor pool habitat and often congregate in quiet backwaters, side channels, and small creeks with riparian cover and woody debris. Side-channel rearing areas are particularly critical for overwinter survival, which is a key regulator of freshwater productivity (LCFRB 2010b).

Most juvenile coho salmon migrate seaward as smolts in April to June, typically during their second year. Salmon that have stream-type life histories, such as coho, typically do not linger for extended periods in the Columbia River estuary, but the estuary is a critical habitat used for feeding during the physiological adjustment to salt water. Juvenile coho salmon are present in the Columbia River estuary from March to August. Columbia River coho salmon typically range throughout the nearshore ocean over the continental shelf off of the Oregon and Washington coasts. Early-returning (Type S) coho salmon are typically found in ocean waters south of the Columbia River mouth. Late-returning (Type N) coho salmon are typically found in ocean waters north of the Columbia River mouth. Most coho salmon sexually mature at age 3, except for a small percentage of males (called "jacks") who return to natal waters at age two, after only five to seven months in the ocean (LCFRB 2010b).

Table 102. Temporal distribution of Coho salmon, lower Columbia River ESU in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)	Present								Present			
Spawning	Present									Present		
Incubation (eggs)	Present									Present		
Emergence (alevin to fry phases)			Present									
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance. In contrast to the previous status review update, which occurred at a time of near-record returns for several populations, the ESU's abundance has declined during the last five years. Only six of the 23 populations for which we have data appear to be above their recovery goals. This includes the Youngs Bay and Big Creek DIPs, which have very low recovery goals, and the Tilton River and Salmon Creek DIPs, which were not assigned goals but have relatively high abundances. Of the remaining DIPs in the ESU, three are at 50–99% of their recovery goals, seven are at 10–50% of their recovery goals, and seven are at <10% of their recovery goals (this includes the Lower Gorge DIP, for which there are no data, but it is assumed that the abundance is low). Hatchery production has been relatively stable, and the proportion of hatchery-origin fish on the spawning grounds has increased for some populations and decreased for others. The transition from segregated hatchery programs to integrated local broodstock programs should reduce the risks from domestication and non-native introgression. Spatial structure has improved incrementally, with improved passage programs at several major dams.

Overall abundance trends for the Lower Columbia River coho salmon ESU are generally negative. Natural spawner and total abundances have decreased in almost all DIPs, and Coastal and Gorge MPG populations are all at low levels, with significant numbers of hatchery-origin coho salmon on the spawning grounds. Improvements in spatial structure and diversity have been slight, and overshadowed by declines in abundance and productivity. In light of the poor ocean and freshwater conditions that occurred during much of this recent review period, it should be noted that some of the populations exhibited resilience and only experienced relatively small declines in abundance. Some populations were exhibiting positive productivity trends during the last year of review, representing the return of the progeny from the 2016 adult return. For individual populations, the risk of extinction spans the full range, from "low" to "very high." Overall, the Lower Columbia River coho salmon ESU remains at "moderate" risk, and viability is largely unchanged from the prior status review.

Both short- and long-term trends for almost all coho salmon populations in the Coastal MPG were negative during the 2015–19 review period for six of the seven Coastal MPG populations that were analyzed. Only the Mill/Abernathy/Germany DIP abundance was stable, with a 5-year geomean of 685. Average natural-origin abundances were in the hundreds of fish, with the exception of the Youngs Bay and likely Big Creek DIPs. Given the propensity of coho salmon to spawn in smaller tributaries and the year-long freshwater residence of juveniles, the poor freshwater conditions during this period likely affected coho salmon in the Coastal MPG more than in the larger rivers of the Cascade MPG.

Cascade MPG experienced a marked decline in abundance following the "boom" year of 2014. The 5-year geometric means for these populations were in the high hundreds to low thousands, with the exception of the Kalama River and Washougal River DIPs. Population trends were strongly negative, with the exception of the small Kalama River and Salmon Creek populations. The Salmon Creek DIP experienced a slight decline in 5-year geometric abundance (4% decline), but maintains a relatively high absolute abundance for a relatively small basin with a 5-year geomean of 1,546. While recent returns of unmarked fish to the Clackamas River have shown a marked decline since the 2014–15 record return year, when 10,670 spawners were counted, the 21% decline is one of the smallest in the MPG. The long-term (15-year) trend for this population is slightly positive, and the current 5-year geomean of 2,889 is still the largest abundance in the ESU. The six populations in the Cowlitz River basin account for the majority of naturally spawning coho salmon in the MPG, with the Lower Cowlitz River late coho salmon DIP 5-year geomean of 2,622. In the Cowlitz River basin, those coho salmon populations that relied on dam passage programs (Upper Cowlitz/Cispus Rivers and Tilton River) exhibited a greater decline relative to those populations located below the high-head dams (Lower Cowlitz River, North and South Fork Toutle rivers, and Coweeman River). Natural-origin abundances in the Gorge MPG are low; the two populations available (Hood River, and Washington Upper Gorge Tributaries/White Salmon River) both had geomeans of less than 50 (Table 32). Hatchery-origin fish contribute a large proportion of the total number of spawners, most notably in the Hood River. The trend was strongly negative in the Hood River and slightly positive in the White Salmon River. With the exception of the Hood and White Salmon Rivers, much of the spawning habitat is in small independent tributaries to the Columbia River and, in many cases, the accessibility is relatively poor.

Productivity / Population Growth Rate. Both the long- and short-term trend, and lambda for the natural origin (late-run) portion of the Clackamas River coho salmon are negative but with large confidence intervals (Good et al. 2005b). The short-term trend for the Sandy River population is close to one, indicating a relatively stable population during the years 1990 to 2002 (Good et al. 2005b). The long-term trend (1977 to 2002) for this same population shows that the population has been decreasing (trend=0.54); there is a 43% probability that the median population growth rate (lambda) was less than 1. Both short- and long-term trends for almost all coho salmon populations were negative during the 2015–19 review period for six of the seven Coastal MPG populations that were analyzed (Table 32). Improvements in diversity and spatial structure noted in the 2022 Status Update have been slight and overshadowed by declines in abundances and productivity. In light of the poor ocean and freshwater conditions that occurred during much of this recent review period, it should be noted that some of the populations exhibited resilience and only experienced relatively small declines in abundance and even positive productivity trends during the last year of review (2019).

Genetic Diversity. The spatial structure of some populations is constrained by migration barriers (such as tributary dams) and development in lowland areas. Low abundance, past stock transfers, other legacy hatchery effects, and ongoing hatchery straying may have reduced genetic diversity within and among coho salmon populations (LCFRB 2010a, ODFW 2010). It is likely that hatchery effects have also decreased population productivity. Hatchery releases have remained relatively steady at 10–17 million since the 2005 BRT report, with approximately 14 million coho salmon juveniles released in 2019. Many of the populations in the ESU contain a substantial number of hatchery-origin spawners. Production has been shifted into localized areas (e.g., Youngs Bay, Big

Creek, and Deep Creek) in order to reduce the influence of hatchery fish in other nearby populations.

Distribution. The Lower Columbia River coho salmon ESU historically consisted of a total of 24 independent populations. Because NMFS had not yet listed the ESU in 2003 when the WLC TRT designated core and genetic legacy populations for other ESUs, there are no such designations for Lower Columbia River coho salmon. However, the Clackamas and Sandy subbasins contain the only populations in the ESU that have clear records of continuous natural spawning (McElhany et al. 2007b).

Designated Critical Habitat. Critical habitat for the lower Columbia River coho salmon ESU was designated on February 24, 2016 (81 FR 9252). PBFs considered essential for the conservation of Coho salmon, lower Columbia River ESU are described in Appendix B.

Reduced complexity, connectivity, quantity, and quality of habitat used for spawning, rearing, foraging, and migrating continues to be a concern for all four lower Columbia River listed species. 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 (LCFRB 2010b, ODFW 2010, NMFS 2013b). Toxic contamination through the production, use, and disposal of numerous chemicals from multiple sources including industrial, agricultural, medical and pharmaceutical, and common household uses that enter the Columbia River in wastewater treatment plant effluent, stormwater runoff, and nonpoint source pollution is a growing concern (Morace 2012).

Recovery Goals. NMFS has developed the following delisting criteria for the Lower Columbia River coho salmon ESU:

- All strata that historically existed have a high probability of persistence or have a probability of persistence consistent with their historical condition.

For populations within the below listed MPGs, NMFS recommend the following recovery actions over the next five years:

Coast MPGs

- Implement projects that increase the amount of side channel/pool rearing habitat for Grays/Chinook River coho.
- Promote projects that reduce flashy stream conditions to improve spawning habitat for Grays/Chinook River coho.
- Implement projects to increase summer and winter rearing habitat complexity for Mill/Abernathy/Germany Creek coho.
- Implement additional habitat improvement projects in the Elochoman River and Abernathy, Mill, and Germany creeks, and their tributaries to augment spawning (chum) and rearing (coho) habitat.

Cascade MPGs

- Reestablish and improve passage on multiple rivers to benefit multiple populations from the Cascade MPGs, such as the North Fork Lewis River (NF Lewis River spring Chinook, NF Lewis River winter steelhead, NF Lewis River coho), and Cowlitz River (Upper Cowlitz River spring Chinook, Upper Cowlitz River fall Chinook, Upper Cowlitz River coho, Upper Cowlitz River winter steelhead).
- Work with county and city jurisdictions to protect watershed hydrology from long-term development impacts (floodplain development and groundwater withdrawals). Focus these efforts on high growth rate watersheds along the I-5 and I-205 corridors, including the East Fork Lewis River, North Fork Lewis River, Coweeman River, Kalama River, Washougal River, Salmon Creek, and Lower Cowlitz tributaries.

Gorge MPGs

- Pacific salmon and steelhead recovery partners are encouraged to develop and implement a long-term management strategy to reduce pinniped predation on Pacific salmon and steelhead in the Columbia River basin by removing, reducing, and-or minimizing the use of manmade haul outs used by pinnipeds in select areas (e.g., river mouths/migratory pinch points).
- Pacific salmon and steelhead recovery partners are encouraged to expand, develop, and implement monitoring efforts in the Columbia River basin, to identify pinniped predation interactions in select areas (e.g., river mouths/migratory pinch points) and quantitatively assess predation impacts by pinnipeds on Pacific salmon and steelhead stocks.

6.2.13 Coho salmon, Oregon Coast ESU

Table 103. Coho salmon, Oregon coast ESU; overview table

Species	Common Name	ESU	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus kisutch	Coho salmon	Oregon Coast	Threatened	2022	2011 76 FR 35755	2016	2008 73 FR 7816

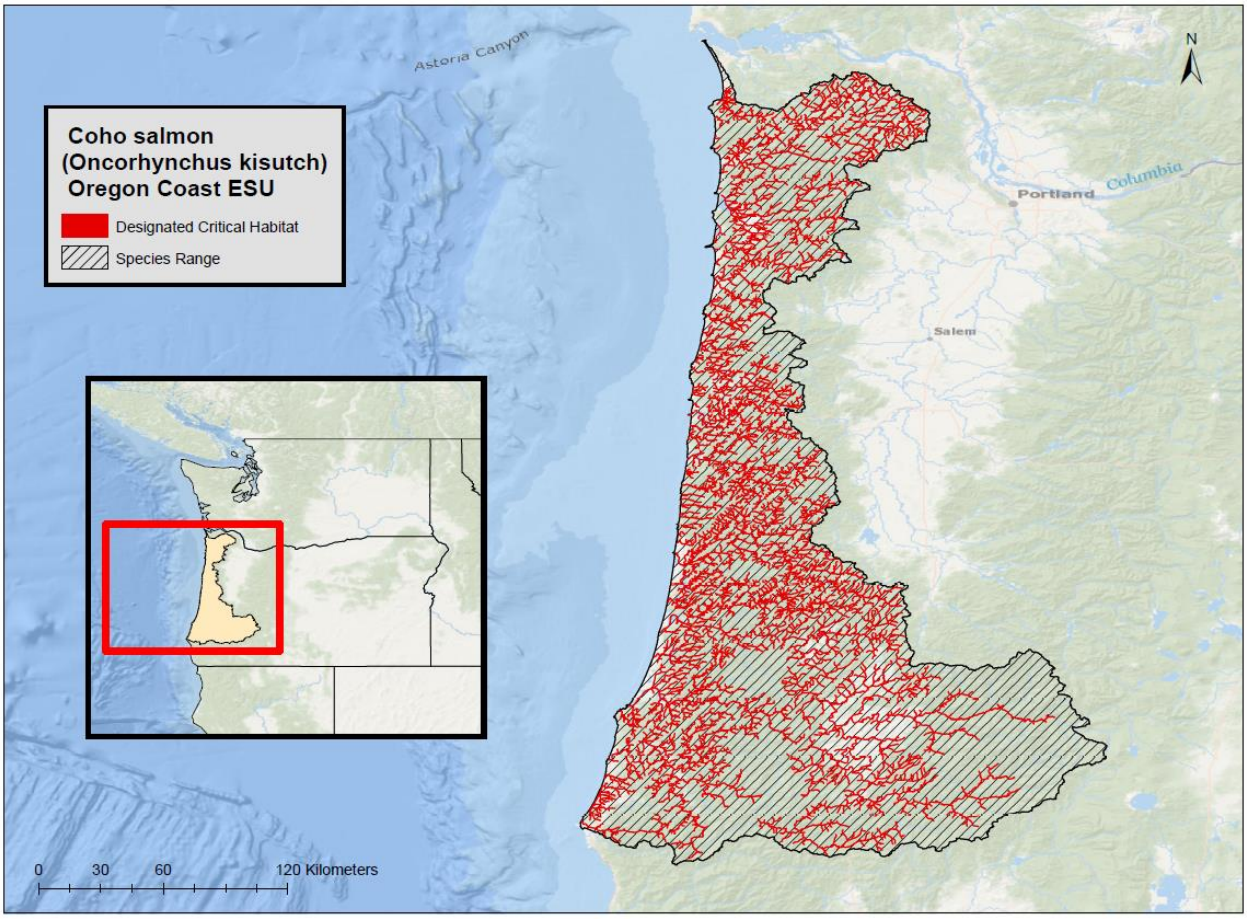


Figure 16. Coho salmon, Oregon coast ESU range and designated critical habitat

Species Description. Coho salmon are an anadromous species (i.e., adults migrate from marine to freshwater streams and rivers to spawn). Adult coho salmon are typically about two ft long and 8 pounds. Coho have backs that are metallic blue or green, silver sides, and light bellies; spawners are dark with reddish sides; and when coho salmon are in the ocean, they have small black spots on the back and upper portion of the tail. Oregon coast coho salmon ESU was listed as threatened under the ESA on August 10, 1998 (63 FR 42587). The 2022 Status Update found no new information that would justify a change in the delineation of the OC coho salmon ESU (Ford 2022). The listing was revisited and confirmed as threatened on June 20, 2011 (76 FR 35755). This ESU consists of five strata and includes naturally spawned coho salmon originating from coastal rivers south of the Columbia River and north of Cape Blanco, and also coho salmon from one artificial propagation program: Cow Creek Hatchery Program. The strata include: the North Coast, the Mid Coast, the

Lakes, the Umpqua, and the Mid-South Coast. These strata in turn are made up of several independent populations and each must meet viability standards.

Status. Findings by the NWFSC (2015a) and ODFW (2016) show many positive improvements to Oregon Coast coho salmon in recent years, including positive long-term abundance trends and escapement. Results from the NWFSC recent review show that while Oregon Coast coho salmon spawner abundance varies by time and population, the total abundance of spawners within the ESU has been generally increasing since 1999, with total abundance exceeding 280,000 spawners in three of the last five years. Overall, the NWFSC (2015a) found that increases in Oregon Coast coho salmon ESU scores for persistence and sustainability clearly indicate that the biological status of the ESU is improving, due in large part to management decisions (reduced harvest and hatchery releases). It determined, however, that Oregon Coast coho salmon abundance remains strongly correlated with marine survival rates. After considering the biological viability of the OC coho salmon ESU during the 2015-2020 downturn in ocean conditions and low marine productivity with the current status of its ESA section 4(a)(1) factors, the 2022 assessment concludes that the risk to the species' persistence has improved since the 2016 5-year review. However, further implementation of sound management actions, habitat restoration and protection efforts must continue to improve population and species viability.

Life History. The anadromous life cycle of coho salmon begins in their home stream where they emerge from eggs as 'alevins' (a larval life stage dependent on food stored in a yolk sac). These very small fish require cool, slow moving freshwater streams with quiet areas such as backwater pools, beaver ponds, and side channels (Reeves et al. 1989) to survive and grow through summer and winter seasons. Current production of coho salmon smolts in the Oregon Coast coho salmon ESU is particularly limited by the availability of complex stream habitat that provides the shelter for overwintering juveniles during periods when flows are high, water temperatures are low, and food availability is limited (ODFW 2007).

The Oregon Coast coho salmon follow a yearling-type life history strategy, with most juvenile coho salmon migrating to the ocean as smolts in the spring, typically from as late as March into June. Coho salmon smolts outmigrating from freshwater reaches may feed and grow in lower mainstem and estuarine habitats for a period of days or weeks before entering the nearshore ocean environment. The areas can serve as acclimation areas, allowing coho salmon juveniles to adapt to saltwater. Research shows that substantial numbers of coho fry may also emigrate downstream from natal streams into tidally influenced lower river wetlands and estuarine habitat (Chapman 1962, Koski 2009, Bass 2010).

Oregon Coast coho salmon tend to make relatively short ocean migrations. Coho from this ESU are present in the ocean from northern California to southern British Columbia, and even fish from a given population can be widely dispersed in the coastal ocean, but the bulk of the ocean harvest of coho salmon from this ESU are found off the Oregon coast. The majority of coho salmon adults return to spawn as 3–year-old fish, having spent about 18 months in freshwater and 18 months in saltwater (Sandercock 1991). The primary exceptions to this pattern are ''jacks,'' sexually mature males that return to freshwater to spawn after only five to seven months in the ocean.

Table 104. Temporal distribution of Coho salmon, Oregon coast ESU in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)	Present									Present		
Spawning	Present									Present		
Incubation (eggs)	Present									Present		
Emergence (alevin to fry phases)	Present											Present
Rearing and migration (juveniles)	Present											

Population Dynamics - Updated Biological Risk Summary (from the 2022 Status Review). The ODFW's 12-year assessment of the Oregon Coast Coho Conservation Plan (ODFW 2021) highlights favorable improvements for OC coho salmon overall, consistent with the Ford (2022) assessment. It notes the strong role that ocean conditions play on adult returns to the ESU, including recent low abundances associated with strong marine heat waves.

The latest ESU scores for persistence (high certainty of ESU persistence) and sustainability (low to moderate certainty of ESU sustainability) also demonstrate that the biological status of the ESU has decreased slightly since the 2016 review (high certainty of persistence, moderate certainty of sustainability), which covered a period of favorable ocean conditions and high marine survival rates. However, current ESU scores have improved relative to the 2012 assessment (moderate certainty of persistence, low to moderate certainty of sustainability). This improvement occurred despite similar or better abundances and marine survival rates during the earlier period, suggesting continued benefits due to management decisions to reduce both harvest and hatchery releases.

Despite these somewhat optimistic results for OC coho salmon, it is unclear what the future will bring. A recent assessment of the vulnerability of ESA-listed salmonid species to climate change indicated that OC coho salmon had high overall vulnerability, high biological sensitivity and climate exposure, but only moderate adaptive capacity (Crozier et al. 2019). Because young coho spend a full year in freshwater before ocean entry, the juvenile freshwater stage was considered to be highly vulnerable. The ESU also scored high in sensitivity at the marine stage due to expected changes due to ocean acidification. These results are consistent with the climate change assessment by Wainwright and Weitkamp (2013), which indicated OC coho salmon will likely be negatively affected by climate change at all stages of the life cycle. Overall, the OC coho salmon ESU is at moderate-to-low risk of extinction, with viability largely unchanged from the prior review.

Abundance. The spawner abundance within the Oregon Coast coho salmon ESU varies by time and population. The large populations (abundances >6,000 spawners since 2015) include Nehalem, Tillamook Bay, Alsea, Siuslaw, Lower Umpqua, Coos, and Coquille. The total abundance of spawners within the ESU generally increased between 1999 and 2014, before dropping in 2015 and remaining low. Five-year geometric mean natural raw spawner abundances increased from 17–7,228 per population in the 1990–94 time period to 189–23,741 for the 2010–14 time period, the highest in the time series. Populations decreased during the most recent period (2015–19), to 67–6,740. All populations exhibited a substantial decrease in the geometric mean abundance between the previous 5-year period (2010–14) and the current one (2015–19), ranging from –55% (Siletz) to –75%.

Productivity / Population Growth Rate.

Patterns of natural spawner abundances, including short- and long-term trends for dependent populations in the North and Mid Coasts, were similar to larger independent populations. Short-term trends declined by –59% and –51%, respectively, between the two 5-year periods (2010–14 and 2015–19; Table 65). Long-term trends were slightly positive (0.02 and 0.05, respectively) during the 2004–19 period, although the 15-year trend confidence intervals included zero. Spawner-to-spawner ratios show the same cycle of positive and negative periods displayed by independent populations. Given that small populations are more likely to "wink out" than large populations due to stochastic processes, these patterns suggest small dependent populations on the Oregon Coast were not unduly impacted by unfavorable ocean conditions and respond much like their larger neighbors. This synchrony suggests the overriding importance of marine survival to recruitment and escapement of Oregon Coast coho salmon (NWFSC 2015a).

Genetic Diversity. While the 2008 biological review team status review concluded that there was low certainty that ESU-level genetic diversity was sufficient for long-term sustainability in the ESU (Wainwright et al. 2008), the recent NWFSC review suggests this is an unlikely outcome. The observed upward trends in abundance and productivity and downward trends in hatchery influence make decreases in genetic or life history diversity or loss of dependent populations in recent years unlikely (NWFSC 2015a).

Distribution. The geographic setting for the Oregon Coast coho salmon ESU includes the Pacific Ocean and the freshwater habitat (rivers, streams, and lakes) along the Oregon Coast from the Necanicum River near Seaside on the north to the Sixes River near Port Orford on the south. The Oregon/Northern California Coasts Technical Recovery Team identified 56 historical populations that function collectively to form the Oregon Coast coho salmon ESU. The team classified 21 of the populations as independent because they occur in basins with sufficient historical habitat to have persisted through several hundred years of normal variations in marine and freshwater conditions (NMFS 2016f).

Designated Critical Habitat. NMFS designated critical habitat for Oregon Coast coho salmon on February 11, 2008 (73 FR 7816). PBFs considered essential for the conservation of Coho salmon, Oregon coast ESU are described in Appendix B.

Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development.

The spawning PBF has been impacted in many watersheds from the inclusion of fine sediment into spawning gravel from timber harvest and forestry related activities, agriculture, and grazing. These activities have also diminished the channels' rearing and overwintering capacity by reducing the amount of large woody debris in stream channels, removing riparian vegetation, disconnecting floodplains from stream channels, and changing the quantity and dynamics of stream flows. The rearing PBF has been degraded by elevated water temperatures in 29 of the 80 HUC five watersheds; rearing PBF within the Nehalem, North Umpqua, and the inland watersheds of the Umpqua subbasins have elevated stream temperatures. Water quality is impacted by contaminants from agriculture and urban areas in low lying areas in the Umpqua subbasins, and in coastal watersheds within the Siletz/Yaquina, Siltcoos, and Coos subbasins. Reductions in water quality have been observed in 12 watersheds due to contaminants and excessive nutrition. The migration

PBF has been impacted throughout the ESU by culverts and road crossings that restrict passage. As described above the PBFs vary widely throughout the critical habitat area designated for OC coho salmon, with many watersheds heavily impacted with low quality PBFs while habitat in other coho salmon bearing watersheds having sufficient quality for supporting the conservation purpose of designated critical habitat. While marine survival is important for Oregon Coast coho salmon (Falcy and Suring 2018), so is high-quality freshwater habitat for juvenile rearing, adult spawning, and egg incubation. These are also habitats that humans control and influence through their actions across the landscape. Of particular importance to Oregon Coast coho salmon BRTs and TRTs (Wainwright et al. 2008, Stout et al. 2012) are the need for American beaver (*Castor canadensis*) within the ESU. Beavers are a keystone species that has wide-ranging impacts on stream ecosystems, because their dams create pools that serve as high-quality habitat for a number of plant, invertebrate, and vertebrate species, including juvenile coho salmon. However, widespread historical removal of beavers has resulted in beaver populations that are a small fraction of their historical abundance (Pollock et al. 2003, 2015). Loss of high-quality beaver-associated habitat has been identified as limiting the production of Oregon Coast coho salmon (see review in Stout et al. 2012).

Recovery Goals. See the 2016 Recovery Plan for detailed descriptions of the recovery goals and delisting criteria (NMFS 2016f). In the simplest terms, NMFS will remove the Oregon Coast coho salmon from federal protection under the ESA when we determine that:

- The species has achieved a biological status consistent with recovery—the best available information indicates it has sufficient abundance, population growth rate, population spatial structure, and diversity to indicate it has met the biological recovery goals.
- Factors that led to ESA listing have been reduced or eliminated to the point where federal protection under the ESA is no longer needed, and there is reasonable certainty that the relevant regulatory mechanisms are adequate to protect Oregon Coast coho salmon sustainability.

6.2.14 Coho salmon, Southern Oregon/Northern California Coast ESU

Table 105. Coho salmon, Southern Oregon/Northern California ESU; overview table

Species	Common Name	ESU	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus kisutch	Coho salmon	Southern Oregon / Northern California Coast	Threatened	2016	2005 70 FR 37160	2014	1999 64 FR 24049

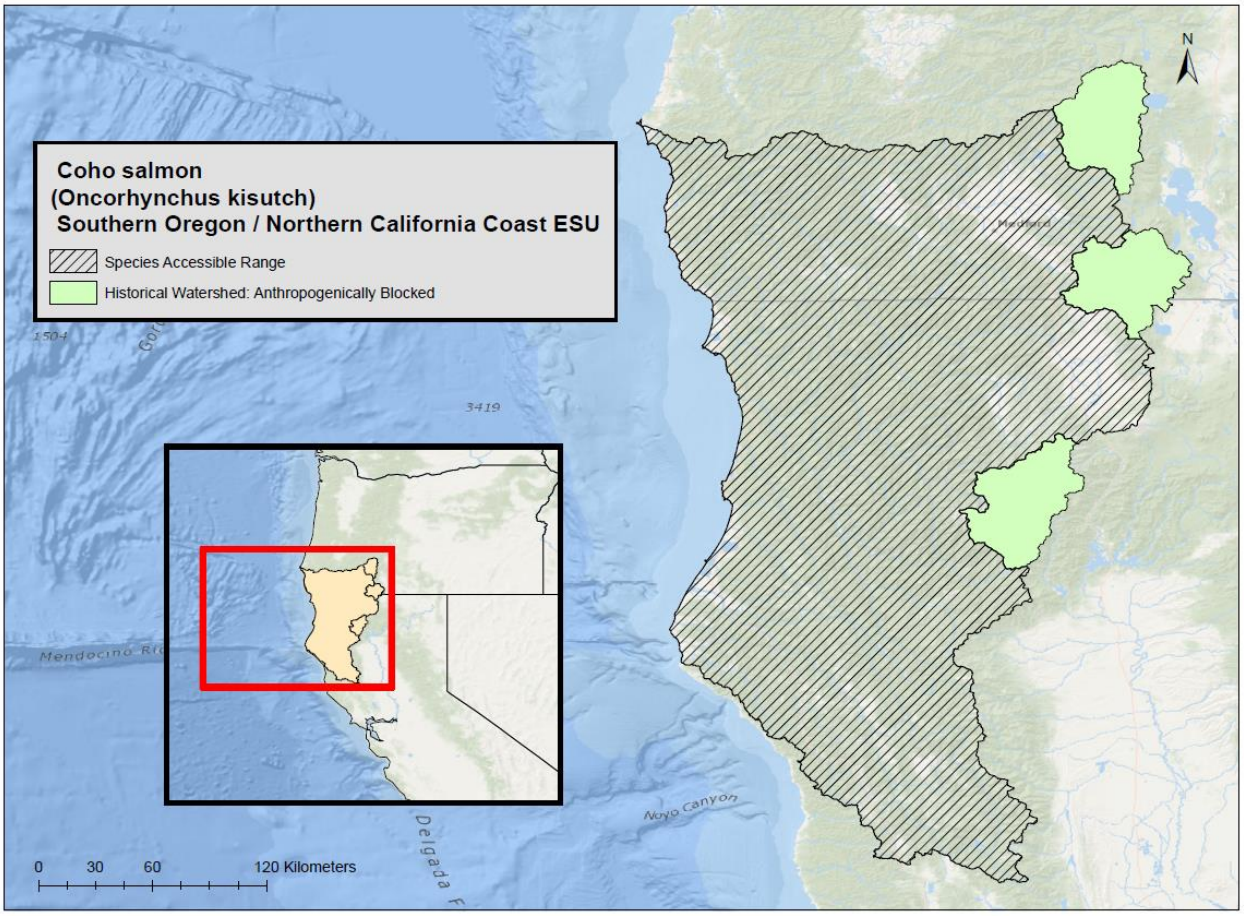


Figure 17. Coho salmon, Southern Oregon/Northern California Coast ESU range and designated critical habitat

Species Description. Coho salmon are an anadromous species (i.e., adults migrate from marine to freshwater streams and rivers to spawn). Adult coho salmon are typically about two ft long and 8 pounds. Coho have backs that are metallic blue or green, silver sides, and light bellies; spawners are dark with reddish sides; and when coho salmon are in the ocean, they have small black spots on the back and upper portion of the tail. Southern Oregon / Northern California Coast (SONCC) coho salmon ESU was listed as threatened under the ESA on May 6, 1997 (62 FR 24588). The listing was revisited and confirmed as threatened on June 28, 2005 (70 FR 37160). This ESU includes naturally spawned coho salmon originating from coastal streams and rivers between Cape Blanco, Oregon, and Punta Gorda, California. Also, coho salmon from three artificial propagation programs.

Status. Though population-level estimates of abundance for most independent populations are lacking, the best available data indicate that none of the seven diversity strata appears to support a single viable population as defined by the SONCC coho salmon technical recovery team's viability criteria (low extinction risk; Williams et al. (2008)). Further, 24 out of 31 independent populations are at high risk of extinction and six are at moderate risk of extinction. Based on the above discussion of the population viability parameters, and qualitative viability criteria presented in Williams et al. (2008), NMFS concludes that the SONCC coho salmon ESU is currently not viable and is at high risk of extinction. The primary causes of the decline are likely long-standing human-caused conditions (e.g., harvest and habitat degradation), which exacerbated the impacts of adverse environmental conditions (e.g., drought and poor ocean conditions) (60 FR 38011; July 25, 1995).

Life History. Coho salmon is an anadromous fish species that generally exhibits a relatively simple 3-year life cycle. Adults typically begin their freshwater spawning migration in the late summer and fall, spawn by mid-winter, and then die. The run and spawning times vary between and within populations. Depending on river temperatures, eggs incubate in ''redds'' (gravel nests excavated by spawning females) for 1.5 to four months before hatching as ''alevins'' (a larval life stage dependent on food stored in a yolk sac). Once most of the yolk sac is absorbed, the 30 to 35 mm fish (then termed "fry") begin emerging from the gravel in search of shallow stream margins for foraging and safety (Council 2004). Coho salmon fry typically transition to the juvenile stage by about mid-June when they are about 50 to 60 mm, and both stages are collectively referred to as "young of the year." Juveniles develop vertical dark bands or "parr marks", and begin partitioning available instream habitat through aggressive agonistic interactions with other juvenile fish (Quinn 2005). Juveniles rear in fresh water for up to 15 months, then migrate to the ocean as ''smolts'' in the spring. Coho salmon typically spend two growing seasons in the ocean before returning to their natal stream to spawn as three year-olds. Some precocious males, called ''jacks,'' return to spawn after only six months at sea (NMFS 2014a).

Table 106. Temporal distribution of Coho salmon, Southern Oregon/Northern California ESU in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)									Present			
Spawning										Present		
Incubation (eggs)	Present									Present		
Emergence (alevin to fry phases)	Present											Present
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance. Population-level estimates of abundance for most independent populations are lacking. The best available data indicate that none of the seven diversity strata appears to support a single viable population (1 at low risk of extinction) as defined by in the viability criteria. In fact, most of the 30 independent populations in the ESU are at high risk of extinction for abundance because they are below or likely below their depensation threshold (NMFS 2014a).

Productivity / Population Growth Rate. Available data show that the 95% confidence intervals for the slope of the population growth rate regression line include zero for many populations, indicating that whether the slope is negative or positive cannot be determined. However, there is 95% confidence that the slope of the regression line is negative, indicating a decreasing trend, for Mill Creek in the Smith River and Freshwater Creek in Humboldt Bay Tributaries. In contrast, there is 95% confidence that the slope of the regression line is positive, indicating an increasing trend, at Gold Ray Dam in the Upper Rogue River(NMFS 2014a).

Genetic Diversity. The primary factors affecting the genetic and life-history diversity of SONCC coho salmon appear to be low population abundance and the influence of hatcheries and out-of-basin introductions. The ESU's current genetic variability and variation in life-history likely contribute significantly to long-term risk of extinction. Given the recent trends in abundance across the ESU, the genetic and life-history diversity of populations is likely very low and is inadequate to contribute to a viable ESU (NMFS 2014a).

Distribution. The SONCC Coho Salmon ESU includes all naturally spawned populations of coho salmon in coastal streams between Cape Blanco, Oregon and Punta Gorda, California, as well as coho salmon produced by three artificial propagation programs: Cole Rivers Hatchery, Trinity River Hatchery, and Iron Gate Hatchery. The ESU is comprised of 40 populations within seven diversity strata. Recent information for SONCC coho salmon indicates that their distribution within the ESU has been reduced and fragmented, as evidenced by an increasing number of previously occupied streams from which they are now absent. However, extant populations can still be found in all major river basins within the ESU (70 FR 37160; June 28, 2005).

Designated Critical Habitat. NMFS designated critical habitat for the SONCC coho salmon on May 5, 1999 (64 FR 24049). PBFs considered essential for the conservation of Coho salmon, Southern Oregon/Northern California ESU are shown in Appendix B.

Critical habitat designated for the SONCC coho salmon is generally of good quality in northern coastal streams. Spawning PBF has been degraded throughout the ESU by logging activities that have increased fines in spawning gravel. Rearing PBF has been considerably degraded in many inland watersheds from the loss of riparian vegetation resulting in unsuitably high water temperatures. Rearing and juvenile migration PBFs have been reduced from the disconnection of floodplains and off-channel habitat in low gradient reaches of streams, consequently reducing winter rearing capacity.

Recovery Goals. See the 2014 recovery plan for complete down listing/delisting criteria for this ESU (NMFS 2014a).

6.2.15 Sockeye salmon, Snake River ESU

Table 107. Sockeye salmon, Snake River ESU; overview table

Species	Common Name	ESU	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus nerka	Sockeye salmon	Snake River	Endangered	2022	2005 70 FR 37160	2015	1993 58 FR 68543

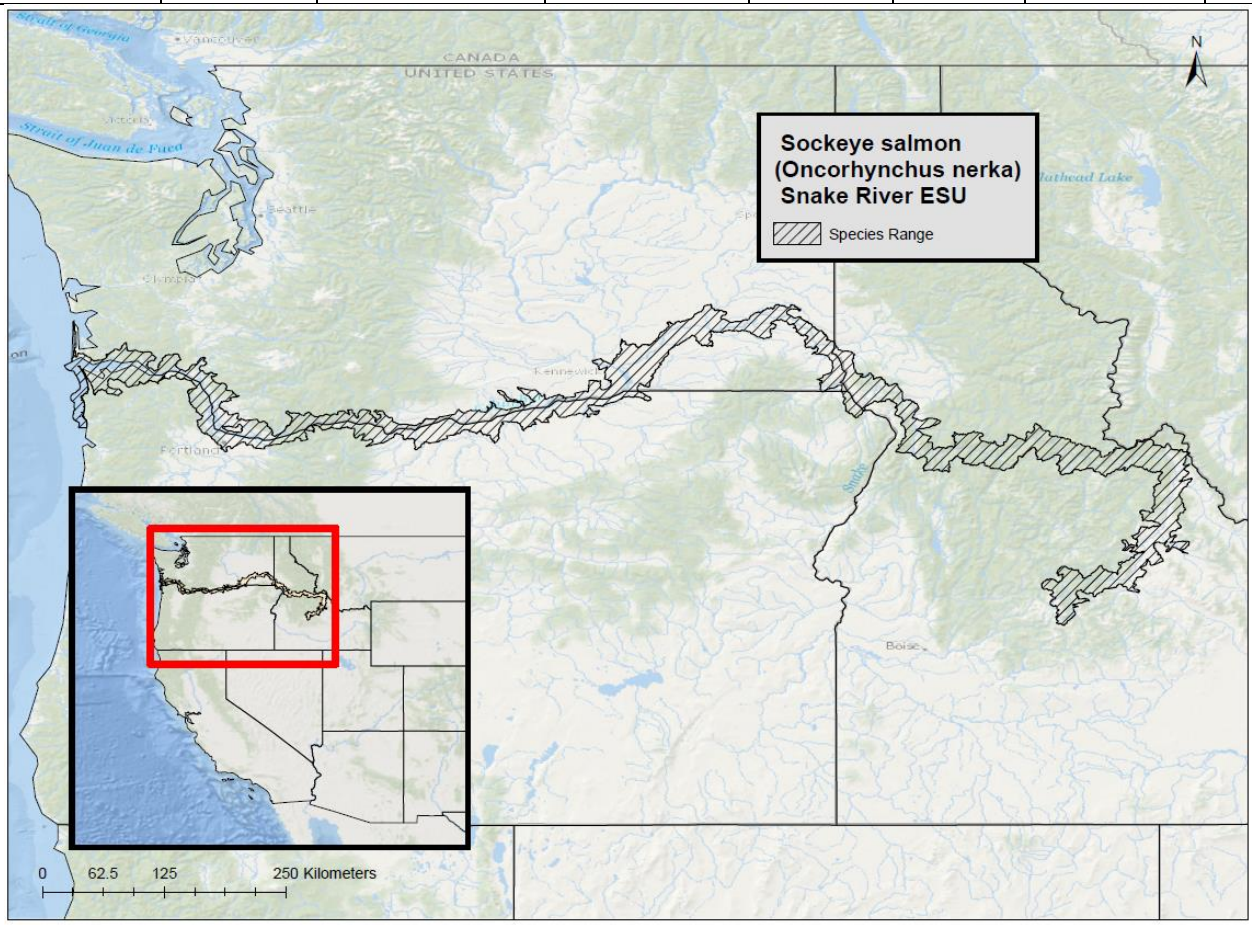


Figure 18. Sockeye salmon, Snake River ESU range and designated critical habitat

Species Description. The sockeye salmon is an anadromous species (i.e., adults migrate from marine to freshwater streams and rivers to spawn), although some sockeye spend their entire lives (about five years) in freshwater. Adult sockeye salmon are about three ft long and 8 pounds. Sockeyes are bluish black with silver sides when they are in the ocean, and they turn bright red with a green head when they are spawning. On November 20, 1991 NMFS listed the Snake River sockeye salmon ESU as endangered (70 FR 37160) and reaffirmed the ESU's status as endangered on June 28, 2005 (70 FR 37160). This ESU includes naturally spawned anadromous and residual sockeye salmon originating from the Snake River basin, as well as sockeye salmon from the Redfish Lake Captive Broodstock Program and the Snake River Sockeye Salmon Hatchery Program (USOFR 2005a, 2020, 85 FR 81822). Since 2016 update, NMFS added a new smolt production program to the ESU because the Redfish Lake Captive Broodstock Program currently produces the

eggs used in the new smolt production program. Therefore, the smolts produced for this new hatchery program are a category 1a (Jones 2015) and should be included in the SR sockeye salmon ESU. We therefore listed this program under Idaho Department of Fish and Game's program name, the "Snake River Sockeye Salmon Hatchery Program."

Status. The Snake River sockeye salmon ESU includes only one population comprised of all anadromous and residual sockeye salmon from the Snake River Basin, Idaho, as well as artificially propagated sockeye salmon from the Redfish Lake captive propagation program. Historical evidence indicates that the Snake River sockeye once had a range of life history patterns, with spawning populations present in several of the small lakes in the Sawtooth Basin (NMFS 2011a). NMFS listed the Snake River sockeye salmon ESU because of habitat loss and degradation from the combined effects of damming and hydropower development, overexploitation, fisheries management practices, and poor ocean conditions. Recent effects of climate change, such as reduced stream flows and increased water temperatures, are limiting Snake River ESU productivity (NMFS 2016j). Adults produced through the captive propagation program currently support the entire ESU. This ESU is still at extremely high risk across all four basic risk measures (abundance, productivity, spatial structure, and diversity) and would likely have a very low resilience to additional perturbations. Habitat improvement projects have slightly decreased the risk to the species, but habitat concerns and water temperature issues remain. Overall, although the status of the Snake River sockeye salmon ESU appears to be improving, there is no indication that the biological risk category has changed (NWFSC 2015c).

Life History. Most sockeye salmon exhibit a lake-type life history (i.e., they spawn and rear in or near lakes), though some exhibit a river-type life history. Spawning generally occurs in late summer and fall, but timing can vary greatly among populations. In lakes, sockeye salmon commonly spawn along "beaches" where underground seepage provides fresh oxygenated water. Females spawn in three to five redds (nests) over a couple of days. Incubation period is a function of water temperature and generally lasts 100-200 days (Burgner 1991). Sockeye salmon spawn once, generally in late summer and fall, and then die (semelparity).

Sockeye salmon fry primarily rear in lakes; river-emerged and stream-emerged fry migrate into lakes to rear. In the early fry stage from spring to early summer, juveniles forage exclusively in the warmer littoral (i.e., shoreline) zone where they depend mostly on fly larvae and pupae, copepods, and water fleas. Sub-yearling sockeye salmon move from the littoral habitat to a pelagic (i.e., open water) existence where they feed on larger zooplankton; however, flies may still make up a substantial portion of their diet. From one to three years after emergence, juvenile sockeye salmon generally rear in lakes, though some river-spawned sockeye may migrate to sea in their first year. Juvenile sockeye salmon feeding behaviors change as they transition through life stages after emergence to the time of smoltification. Distribution in lakes and prey preference is a dynamic process that changes daily and yearly depending on many factors including water temperature, prey abundance, presence of predators and competitors, and size of the juvenile. Peak emigration to the ocean occurs in mid-April to early May in southern sockeye populations (lower than 52ºN latitude) and as late as early July in northern populations (62ºN latitude) (Burgner 1991). Adult sockeye salmon return to their natal lakes to spawn after spending one to four years at sea. The diet of adult salmon consists of amphipods, copepods, squid and other fish.

Table 108. Temporal distribution of Sockeye salmon, Snake River ESU in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)	Present											
Spawning									Present			
Incubation (eggs)	Present								Present			
Emergence (alevin to fry phases	Present											Present
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance / Productivity. For the Snake River ESU, the only extant population at the time of listing occurred in Redfish Lake. Adult returns to Redfish Lake during the period 1954 through 1966 ranged from 11 to 4,361 spawners (Bjornn et al. 1968). In 1985, 1986, and 1987, 11, 29, and 16 returning adult sockeye, respectively, were counted at the Redfish Lake weir. Since 1987, only 18 natural-origin sockeye salmon have returned to the Stanley Basin. The first adult returns from the captive broodstock program returned to the Stanley Basin in 1999. From 1999 through 2005, 345 captive brood adults that had migrated to the ocean returned to the Stanley Basin, and returns increased to over 600 in 2008 and more than 700 returning adults in 2009. Annual adult releases during 2011-2014 averaged over 1,200 (NWFSC 2015c). Adult returns of sockeye salmon crashed in 2015, and natural returns have remained low. The low returns of fish collected at the Redfish Lake and Sawtooth Hatchery weirs have limited anadromous releases into Redfish Lake to 311 anadromous hatchery fish in 2016. No natural anadromous fish have been released since 2014, as they are required to be spawned in the captive broodstock program under NMFS Section 10 Permit 1454. Captive adult releases have continued to support spawning in Redfish Lake. Smolt-to-adult return rates suggest that volitional spawning within Redfish Lake appears to be important to the success of the Snake River sockeye salmon captive broodstock-based hatchery program (Kozfkay et al. 2019).While increased abundance of hatchery-reared Snake River sockeye salmon has reduced the risk of loss, levels of naturally-produced sockeye salmon returns have remained extremely low (Ford 2011, NWFSC 2015c). Substantial increases in survival rates across life history stages must occur to re-establish sustainable natural production (Hebdon et al. 2004, Keefer et al. 2008). In terms of natural production, the Snake River sockeye salmon 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. Current climate change modeling supports the "extremely high risk" rating with the potential for extirpation in the near future (Crozier et al. 2020). The viability of the Snake River sockeye salmon ESU therefore has likely declined since the time of the prior review, and the extinction risk category remains "high."

Genetic Diversity. For the Snake River ESU, the Sawtooth Hatchery is focusing on genetic conservation (NMFS 2016b). An overrepresentation of genes from the anadromous population in Redfish Lake exists, but inbreeding is low, which is a sign of a successful captive broodstock program (Kalinowski et al. 2012).

Distribution. The Snake River sockeye salmon ESU includes only one population comprised of all anadromous and residual sockeye salmon from the Snake River Basin, Idaho, as well as artificially propagated sockeye salmon from the Redfish Lake captive propagation program. At present,

anadromous returns are dominated by production from the captive spawning component. The ongoing reintroduction program is still in the phase of building sufficient returns to allow for large-scale reintroduction into Redfish Lake, the initial target for restoring natural production (NMFS 2015). Initial releases of adult returns directly into Redfish Lake have been observed spawning in multiple locations along the lake shore, as well as in Fishhook Creek (NMFS 2015). There is some evidence of very low levels of early timed returns in some recent years from outmigrating, naturally produced Alturas Lake smolts. At this stage of the recovery efforts, the ESU remains rated at "high risk" for both spatial structure and diversity.

Designated Critical Habitat. NMFS designated critical habitat for Snake River sockeye salmon on December 28, 1993 (58 FR 68543). The critical habitat encompasses the waters, waterway bottoms, and adjacent riparian zones of specified lakes and river reaches in the Columbia River that are or were accessible to salmon of this ESU (except reaches above impassable natural falls, and Dworshak and Hells Canyon Dams). Specific PBFs are shown in Appendix B.

Recovery Goals. See the 2015 recovery plan (NMFS 2015c) for the Snake River sockeye salmon ESU for complete down-listing/delisting criteria for recovery goals for the species. Broadly, recovery plan goals emphasize restoring historical lake populations and improving water quality and quantity in lakes and migration corridors.

6.2.16 Steelhead, California Central Valley DPS

Table 109. Steelhead, California Central Valley DPS; overview table

Species	Common Name	DPS	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus mykiss	Steelhead Trout	California Central Valley	Threatened	2016	2006 71 FR 834	2014	2005 70 FR 52488

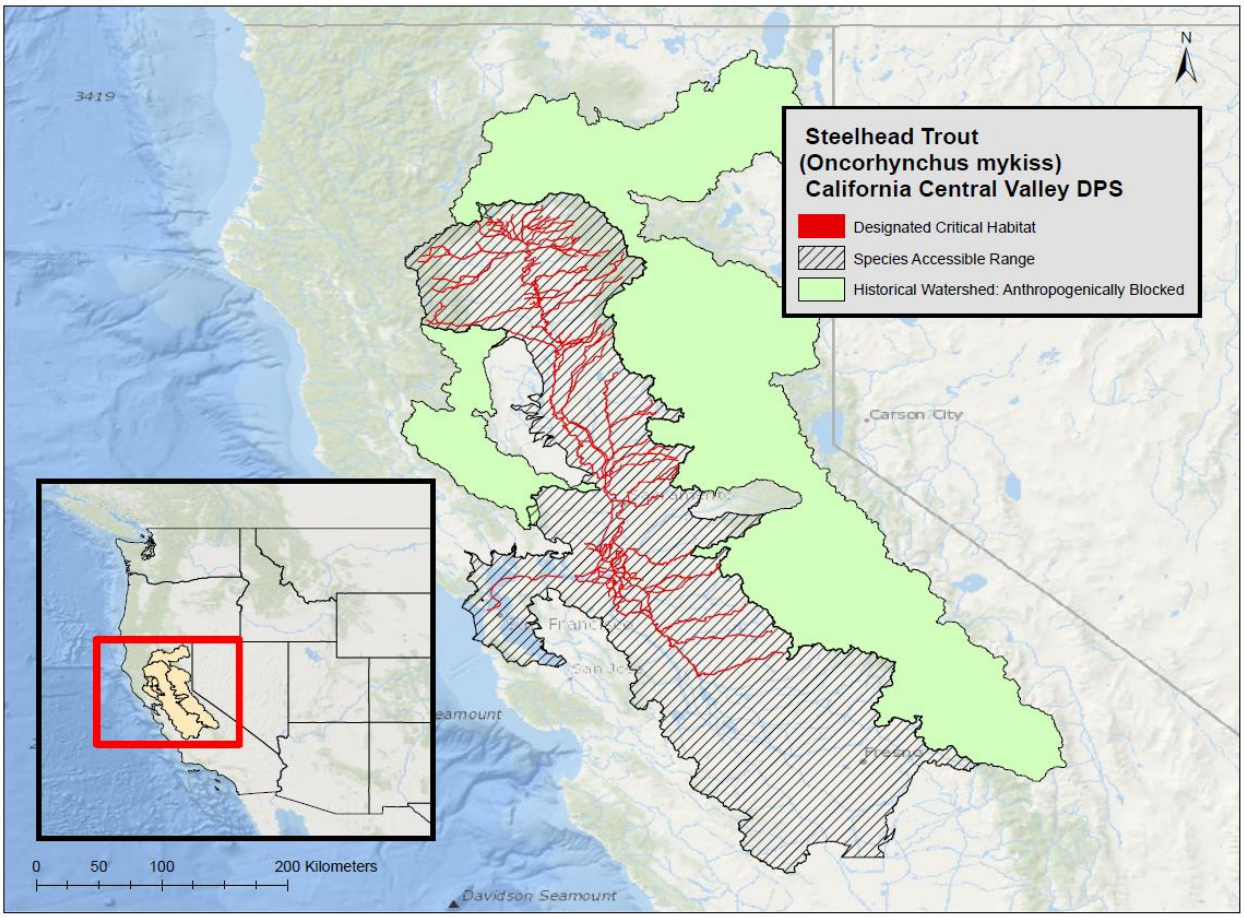


Figure 19. Steelhead, California Central Valley DPS range and designated critical habitat

Species Description. Steelhead are dark-olive in color, shading to silvery-white on the underside with a speckled body and a pink-red stripe along their sides. Those migrating to the ocean develop a slimmer profile, becoming silvery in color, and typically growing larger than rainbow trout that remain in fresh water. Steelhead trout grow to 55 pounds (25 kg) in weight and 45 inches (120 cm) in length, though the average size is much smaller. On March 19, 1998 NMFS listed the California Central Valley (CCV) DPS of steelhead as threatened (63 FR 13347) and reaffirmed the DPS's status as threatened on January 5, 2006 (71 FR 834). This DPS includes naturally spawned anadromous O. mykiss (steelhead) originating below natural and manmade impassable barriers from the Sacramento and San Joaquin Rivers and their tributaries; excludes such fish originating from San Francisco and San Pablo Bays and their tributaries. This DPS includes steelhead from two artificial propagation programs.

Status. Many watersheds in the Central Valley are experiencing decreased abundance of CCV steelhead. Dam removal and habitat restoration efforts in Clear Creek appear to be benefiting CCV steelhead as recent increases in non-clipped (wild) abundance have been observed. Despite the positive trend in Clear Creek, all other concerns raised in the previous status review remain, including low adult abundances, loss and degradation of a large percentage of the historic spawning and rearing habitat, and domination of smolt production by hatchery fish. Many other planned restoration and reintroduction efforts have yet to be implemented or completed, or are focused on Chinook salmon, and have yet to yield demonstrable improvements in habitat, let alone documented increases in naturally produced steelhead. There are indications that natural production of steelhead continues to decline and is now at a very low level. 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. CCV steelhead is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Life History. Central Valley steelhead spawn downstream of dams on every major tributary within the Sacramento and San Joaquin River systems. The female steelhead selects a site with good intergravel flow, digs a redd with her tail, usually in the coarse gravel of the tail of a pool or in a riffle, and deposits eggs while an attendant male fertilizes them. The preferred water temperature range for steelhead spawning is reported to be 30°F to 52°F (Gallagher 2000). Following deposition of fertilized eggs in the redd, they are covered with loose gravel. The eggs hatch in three to four weeks at 50°F to 59°F, and fry emerge from the gravel four to six weeks later (Shapovalov and Taft 1954). Regardless of life history strategy, for the first year or two of life steelhead are found in cool, clear, fast flowing permanent streams and rivers where riffles predominate over pools, there is ample cover from riparian vegetation or undercut banks, and invertebrate life is diverse and abundant (Moyle 2002c). The smallest fish are most often found in riffles, intermediate size fish in runs, and larger fish in pools.

Steelhead typically migrate to marine waters after spending two years in fresh water. They reside in marine waters for typically two or three years prior to returning to their natal stream to spawn as 4- or 5-year olds. Unlike Pacific salmon, steelhead are capable of spawning more than once before they die. However, it is rare for steelhead to spawn more than twice before dying, and most that do so are females (Moyle 2002c). Currently, Central Valley steelhead are considered “ocean-maturing” (also known as winter) steelhead, although summer steelhead may have been present prior to construction of large dams. Ocean maturing steelhead enter fresh water with well-developed gonads and spawn shortly after river entry. Central Valley steelhead enter fresh water from August through April. They hold until flows are high enough in tributaries to enter for spawning (Moyle 2002c). Steelhead adults typically spawn from December through April, with peaks from January through March in small streams and tributaries where cool, well oxygenated water is available year-round (Hallock et al. 1961b, McEwan 2001).

Table 110. Temporal distribution of Steelhead, California Central Valley DPS in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)	Present						Present					
Spawning	Present											Present
Incubation (eggs)	Present											Present
Emergence (alevin to fry phases)	Present											
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance. Historic CCV steelhead run size may have approached 1-2 million adults annually (McEwan 2001). By the early 1960s, the steelhead run size had declined to about 40,000 adults (McEwan 2001). Over the past 30 years, the naturally spawned steelhead populations in the upper Sacramento River have declined substantially. Hallock *et al.* (1961a) estimated an average of 20,540 adult steelhead in the Sacramento River, upstream of the Feather River, through the 1960s. Steelhead were counted at the RBDD up until 1993. Counts at the dam declined from an average of 11,187 for the period of 1967 to 1977, to an average of approximately 2,000 through the early 1990s. An estimated total annual run size for the entire Sacramento-San Joaquin system was no more than 10,000 adults during the early 1990s (McEwan and Jackson 1996, McEwan 2001). Based on catch ratios at Chipps Island in the Delta and using some generous assumptions regarding survival, the average number of CCV steelhead females spawning naturally in the entire Central Valley during the years 1980 to 2000 was estimated at about 3,600 (Good et al. 2005b).

Productivity / Population Growth Rate. CCV steelhead lack annual monitoring data for calculating trends and lambda. However, the RBDD counts and redd counts up to 1993 and later sporadic data show that the DPS has had a significant long-term downward trend in abundance (NMFS 2009a).

Genetic Diversity / Distribution. The CCV steelhead distribution ranged over a wide variety of environmental conditions and likely contained biologically significant amounts of spatially structured genetic diversity (Lindley et al. 2006). Thus, the loss of populations and reduction in abundances have reduced the large diversity that existed within the DPS. The genetic diversity of the majority of CCV steelhead spawning runs is also compromised by hatchery-origin fish. Designated Critical Habitat. NMFS designated critical habitat for CCV steelhead on September 2, 2005 (70 FR 52488). PBFs considered essential for the conservation of Steelhead, California Central Valley DPS are described in Appendix B.

Recovery Goals. See the 2014 recovery plan (NMFS 2014b) for the California Central Valley steelhead DPS for complete down-listing/delisting criteria for recovery goals for the species. The delisting criteria for this DPS are:

- One population in the Northwestern California Diversity Group at low risk of extinction
- Two populations in the Basalt and Porous Lava Flow Diversity Group at low risk of extinction
- Four populations in the Northern Sierra Diversity Group at low risk of extinction
- Two populations in the Southern Sierra Diversity Group at low risk of extinction

- Maintain multiple populations at moderate risk of extinction

The current condition of CCV steelhead critical habitat is degraded, and does not provide the conservation value necessary for species recovery. In addition, the Sacramento-San Joaquin River Delta, as part of CCV steelhead designated critical habitat, provides very little function necessary for juvenile CCV steelhead rearing and physiological transition to salt water.

The spawning PBF is subject to variations in flows and temperatures, particularly over the summer months. Some complex, productive habitats with floodplains remain in the system and flood bypasses (*i.e.*, Yolo and Sutter bypasses). However, the rearing PBF is degraded by the channelized, leveed, and riprapped river reaches and sloughs that are common in the Sacramento-San Joaquin system and which typically have low habitat complexity, low abundance of food organisms, and offer little protection from either fish or avian predators. Stream channels commonly have elevated temperatures.

The current conditions of migration corridors are substantially degraded. Both migration and rearing PBFs are affected by dense urbanization and agriculture along the mainstems and in the Delta which contribute to reduced water quality by introducing several contaminants. In the Sacramento River, the migration corridor for both juveniles and adults is obstructed by the RBDD gates which are down from May 15 through September 15. The migration PBF is also obstructed by complex channel configuration making it more difficult for CCV steelhead to migrate successfully to the western Delta and the ocean. In addition, the state and federal government pumps and associated fish facilities change flows in the Delta which impede and obstruct a functioning migration corridor that enhances migration. The estuarine PBF, which is present in the Delta, is affected by contaminants from agricultural and urban runoff and release of wastewater treatment plants effluent.

6.2.17 Steelhead, Central California Coast DPS

Table 111. Steelhead, Central California Coast DPS; overview table

Species	Common Name	DPS	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus mykiss	Steelhead Trout	Central California Coast	Threatened	2016	2006 71 FR 834	2016	2005 70 FR 52488

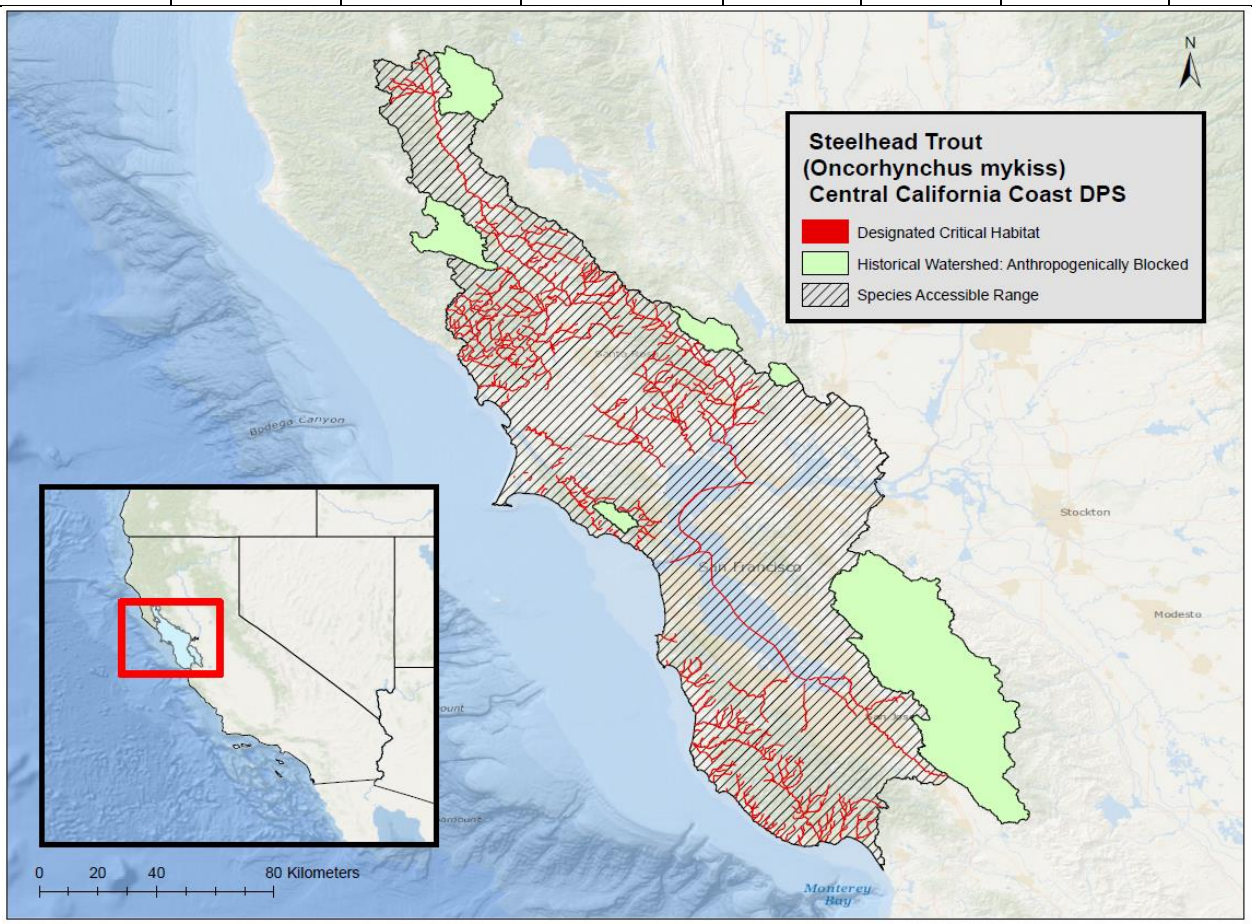


Figure 20. Steelhead, Central California Coast DPS range and designated critical habitat

Species Description. Steelhead are dark-olive in color, shading to silvery-white on the underside with a speckled body and a pink-red stripe along their sides. Those migrating to the ocean develop a slimmer profile, becoming silvery in color, and typically growing larger than rainbow trout that remain in fresh water. Steelhead trout grow to 55 pounds (25 kg) in weight and 45 inches (120 cm) in length, though the average size is much smaller. On August 18, 1997 NMFS listed the Central California Coast (CCC) DPS of steelhead as threatened (62 FR 43937) and reaffirmed the DPS's status as threatened on January 5, 2006 (71 FR 834). This DPS includes all naturally spawned populations of steelhead (and their progeny) in streams from the Russian River to Aptos Creek, Santa Cruz County, California (inclusive). It also includes the drainages of San Francisco and San Pablo Bays.

Status. The CCC steelhead consisted of nine historic functionally independent populations and 23 potentially independent populations (Bjorkstedt et al. 2005). Of the historic functionally independent populations, at least two are extirpated while most of the remaining are nearly extirpated. Current runs in the basins that originally contained the two largest steelhead populations for CCC steelhead, the San Lorenzo and the Russian Rivers, both have been estimated at less than 15% of their abundances just 30 years earlier (Good et al. 2005b). The Russian River is of particular importance for preventing the extinction and contributing to the recovery of CCC steelhead (NOAA 2013). Steelhead access to significant portions of the upper Russian River has also been blocked (Busby et al. 1996, NMFS 2008a).

Life History. The DPS is entirely composed of winter-run fish, as are those DPSs to the south. Adults return to the Russian River and migrate upstream from December – April, and smolts emigrate between March – May) (Shapovalov and Taft 1954a, Hayes et al. 2004). Most spawning takes place from January through April. While age at smoltification typically ranges for one to four years, recent studies indicate that growth rates in Soquel Creek likely prevent juveniles from undergoing smoltification until age two (Sogard et al. 2009). Survival in fresh water reaches tends to be higher in summer and lower from winter through spring for year classes 0 and one (Sogard et al. 2009). Larger individuals also survive more readily than do smaller fish within year classes (Sogard et al. 2009). Greater movement of juveniles in fresh water has been observed in winter and spring versus summer and fall time periods. Smaller individuals are more likely to be observed to exceed 0.3 mm per day, and are highest in winter through spring, potentially due to higher water flow rates and greater food availability (Boughton et al. 2007, Sogard et al. 2009).

Table 112. Temporal distribution of Steelhead, Central California Coast DPS in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)	Present											Present
Spawning	Present											
Incubation (eggs)	Present											
Emergence (alevin to fry phases)			Present									
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance. Historically, the entire CCC steelhead DPS may have consisted of an average runs size of 94,000 adults in the early 1960s (Good et al. 2005b). Information on current CCC steelhead populations consists of anecdotal, sporadic surveys that are limited to only smaller portions of watersheds. Presence-absence data indicated that most (82%) sampled streams (a subset of all historical steelhead streams) had extant populations of juvenile *O. mykiss* (Adams 2000, Good et al. 2005b).

Productivity / Population Growth Rate. Though the information for individual populations is limited, available information strongly suggests that no population is viable. Long-term population sustainability is extremely low for the southern populations in the Santa Cruz mountains and in the San Francisco Bay (NMFS 2008a). Declines in juvenile southern populations are consistent with the more general estimates of declining abundance in the region (Good et al. 2005b). The interior

Russian River winter-run steelhead has the largest runs with an estimate of an average of over 1,000 spawners; it may be able to be sustained over the long-term but hatchery management has eroded the population's genetic diversity (Bjorkstedt et al. 2005, NMFS 2008a). Data on abundance trends do not exist for the DPS as a whole or for individual watersheds. Thus, it is not possible to calculate long-term trends or lambda.
Genetic Diversity / Distribution. This DPS includes all naturally spawned populations of steelhead (and their progeny) in streams from the Russian River to Aptos Creek, Santa Cruz County, California (inclusive). It also includes the drainages of San Francisco and San Pablo Bays.

Designated Critical Habitat. Critical habitat was designated for this species on September 2, 2005 (70 FR 52630). It includes the Russian River watershed, coastal watersheds in Marin County, streams within the San Francisco Bay, and coastal watersheds in the Santa Cruz Mountains down to Apos Creek. PBFs considered essential for the conservation of Steelhead, Central California Coast DPS are described in Appendix B.

Streams throughout the critical habitat have reduced quality of spawning PBFs; sediment fines in spawning gravel have reduced the ability of the substrate attribute to provide well oxygenated and clean water to eggs and alevins. High proportions of fines in bottom substrate also reduce forage by limiting the production of aquatic stream insects adapted to running water. Elevated water temperatures and impaired water quality have further reduced the quality, quantity and function of the rearing PBF within most streams. These impacts have diminished the ability of designated critical habitat to conserve the CCC steelhead.

Recovery Goals. See the 2016 recovery plan (NMFS 2016c) for the Central California Coast steelhead DPS for complete down-listing/delisting criteria for recovery goals for the species. Recovery plan objectives are to:

- Reduce the present or threatened destruction, modification, or curtailment of habitat or range;
- Ameliorate utilization for commercial, recreational, scientific, or educational purposes;
- Abate disease and predation;
- Establish the adequacy of existing regulatory mechanisms for protecting CCC steelhead now and into the future (i.e., post-delisting);
- Address other natural or manmade factors affecting the continued existence of CCC steelhead;
- Ensure CCC steelhead status is at a low risk of extinction based on abundance, growth rate, spatial structure and diversity.

6.2.18 Steelhead, Lower Columbia River DPS

Table 113. Steelhead, Lower Columbia River DPS; overview table

Species	Common Name	DPS	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus mykiss	Steelhead Trout	Lower Columbia River	Threatened	2022	2006 71 FR 834	2013	2005 70 FR 52630

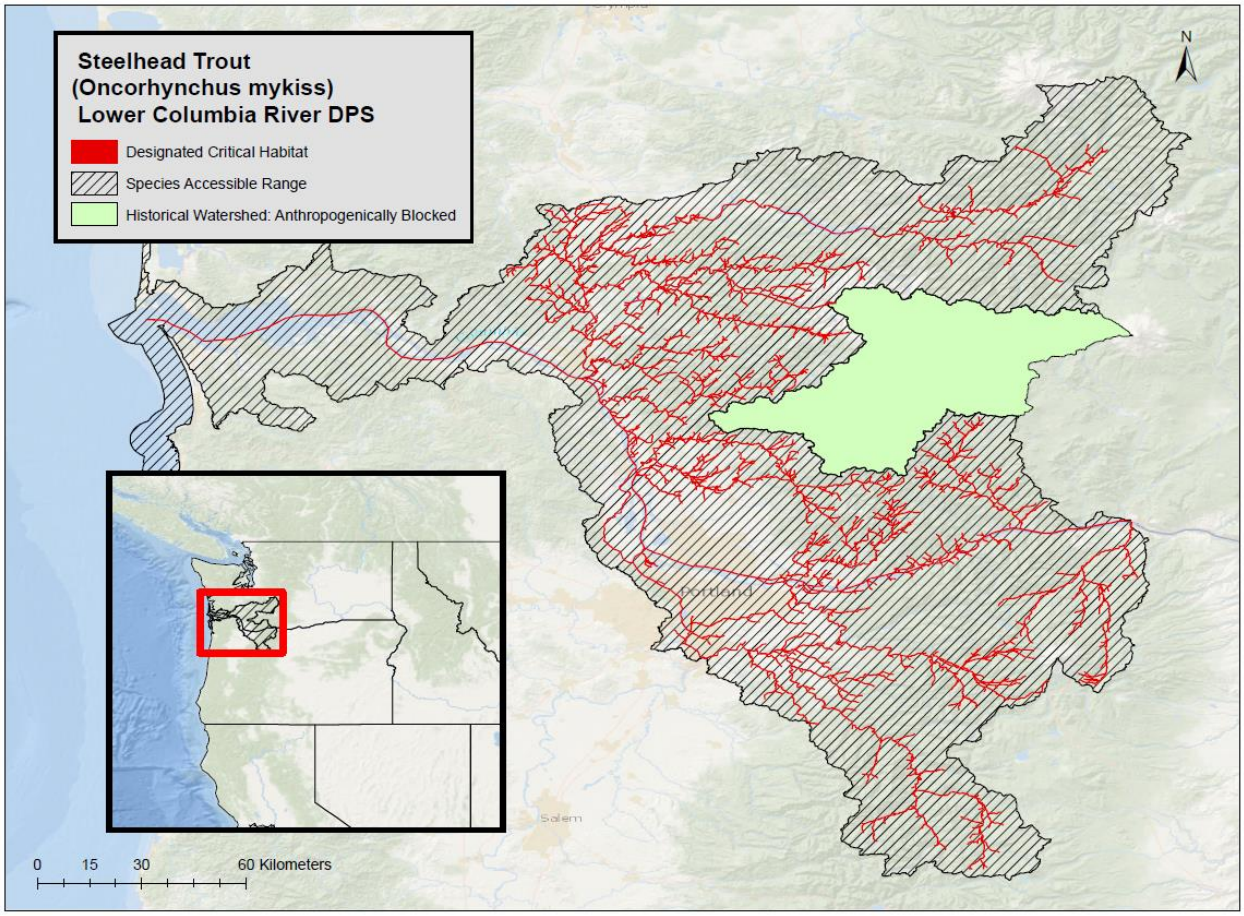


Figure 21. Steelhead, Lower Columbia River DPS range and designated critical habitat

Species Description. On March 19, 1998 NMFS listed the Lower Columbia River (LCR) DPS of steelhead as threatened (63 FR 13347) and reaffirmed the DPS's status as threatened on January 5, 2006 (71 FR 834). This DPS reaffirmed in the 2022 Status Update, includes naturally spawned anadromous *O. mykiss* (steelhead) originating below natural and manmade impassable barriers from rivers between the Cowlitz and Wind Rivers (inclusive) and the Willamette and Hood Rivers (inclusive); excludes such fish originating from the upper Willamette River basin above Willamette Falls. This DPS includes steelhead from seven artificial propagation programs. Since 2016, NMFS (1) added the recently initiated Upper Cowlitz Wild Program because the source for these fish is local, natural-origin fish from the Upper Cowlitz River, which is included in the DPS; (2) added the recently initiated Tilton River Wild Program because the source for these fish is local, natural-

origin fish from the Tilton River; and (3) removed ODFW stock numbers from the names of the Clackamas Hatchery Late Winter-run Program, Sandy Hatchery Late Winter-run Program, and Hood River Winter-run Program (85 FR 81822, December 17, 2020).

Status. Overall, the viability trend for the Lower Columbia River Steelhead DPS remains unchanged since the previous (2015) review. While a number of DIPs exhibited increases in their 5-year geometric mean, others still remain depressed, and neither the winter nor summer-run MPGs are near viability in the Gorge. Given these concerns, the Lower Columbia River Steelhead DPS is at a moderate risk of extinction (Ford 2022). The LCR steelhead had 17 historically independent winter steelhead populations and six independent summer steelhead populations (McElhany et al. 2003, Myers et al. 2006). All historic LCR steelhead populations are considered extant. However, spatial structure within the historically independent populations, especially on the Washington side, has been substantially reduced by the loss of access to the upper portions of some basins due to tributary hydropower development. The majority of winter-run steelhead populations in this DPS continue to persist at low abundances (NWFSC 2015c). Hatchery interactions remain a concern in select basins, but the overall situation is somewhat improved compared to prior reviews. Summer-run steelhead DIPs were similarly stable, but at low abundance levels. Habitat degradation continues to be a concern for most populations. Even with modest improvements in the status of several winter-run populations, none of the populations appear to be at fully viable status, and similarly none of the MPGs meet the criteria for viability. The DPS therefore continues to be at moderate risk (NWFSC 2015c). Based on the 2022 Status Update, no reclassification for the LCR Steelhead DPS is warranted. Therefore, the LCR Steelhead DPS remain listed as threatened.

Life History. The LCR steelhead DPS includes both summer- and winter-run stocks. Summer-run steelhead return sexually immature to the Columbia River from May to November, and spend several months in fresh water prior to spawning. Winter-run steelhead enter fresh water from November to April, are close to sexual maturation during freshwater entry, and spawn shortly after arrival in their natal streams. Where both races spawn in the same stream, summer-run steelhead tend to spawn at higher elevations than the winter-run. The majority of juvenile LCR steelhead remain for two years in freshwater environments before ocean entry in spring. Both winter- and summer-run adults normally return after two years in the marine environment.

Table 114. Temporal distribution of Steelhead, Lower Columbia River DPS in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)	Present											
Spawning			Present									
Incubation (eggs)			Present									
Emergence (alevin to fry phases					Present							
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance. All LCR steelhead populations declined from 1980 to 2000, with sharp declines beginning in 1995. Historical counts in some of the larger tributaries (Cowlitz, Kalama, and Sandy Rivers) suggest the population probably exceeded 20,000 spawners. During the 1990s, abundance

dropped to 1,000 to 2,000 spawners. Recent abundance estimates of natural-origin spawners range from completely extirpated for some populations above impassable barriers to over 700 spawners for the Kalama and Sandy winter-run populations. A number of the populations have a substantial fraction of hatchery-origin spawners in spawning areas. Many of the long-and short-term trends in abundance of individual populations are negative.

Productivity / Population Growth Rate. There is a difference in population stability between winter- and summer-run LCR steelhead. The winter-run steelhead in the Cascade region has the highest likelihood of being sustained as it includes a few populations with moderate abundance and positive short-term population growth rates (Good et al. 2005b, McElhany et al. 2007a). For most winter-run populations in this MPG, the trend within the 2015–19 period is strongly negative as expressed in annual productivity estimates. There is some concern that this downward trend may be indicative of something more systemic than short-term freshwater or oceanic conditions. The Gorge summer-run steelhead is at the highest risk over the long-term as the Hood River population is at high risk of being lost (McElhany et al. 2007a). Wind River and Hood River are the two DIPs in the summer run of this MPG. Hood River summer-run steelhead monitoring has been problematic since the removal of Powerdale Dam. Adult abundance in the Wind River has declined since the last review and is trending downward (Table 36, Figure 68). Recent 5-year abundance for Wind River summer-run, a designated natural steelhead gene bank, is 627, a 13% decline from the 2010–14 average (Table 36, Figure 68). The long-term (2005–19) abundance trend for the Wind River is a 2% annual decline (Table 37). Given the presence of only two summer-run DIPs in this MPG and the recent downward trend, the overall status of the MPG is uncertain.

Genetic Diversity / Distribution. This DPS includes naturally spawned anadromous O. mykiss (steelhead) originating below natural and manmade impassable barriers from rivers between the Cowlitz and Wind Rivers (inclusive) and the Willamette and Hood Rivers (inclusive); excludes such fish originating from the upper Willamette River basin above Willamette Falls. This DPS includes steelhead from seven artificial propagation programs. The WLC TRT identified 23 historical independent populations of Lower Columbia River steelhead: 17 winter-run populations and six summer-run populations, within the Cascade and Gorge ecozones.

Designated Critical Habitat. Critical habitat was designated for the LCR steelhead on September 2, 2005 (70 FR 52488). PBFs considered essential for the conservation of Steelhead, Lower Columbia River DPS are described in Appendix B.

Critical habitat is affected by reduced quality of rearing and juvenile migration PBFs within the lower portion and alluvial valleys of many watersheds; contaminants from agriculture affect both water quality and food production in these reaches of tributaries and in the mainstem Columbia River. Several dams affect adult migration PBF by obstructing the migration corridor. Watersheds which consist of a large proportion of federal lands such as is the case with the Sandy River watershed, have relatively healthy riparian corridors that support attributes of the rearing PBF such as cover, forage, and suitable water quality.

Recovery Goals. NMFS has developed the following delisting criteria for the Lower Columbia River steelhead DPS:

- All strata that historically existed have a high probability of persistence or have a probability of persistence consistent with their historical condition
- The threats criteria described in the recovery plan have been met.

Recommendations for Future Actions

- The 2022 review of the listing factors and the Northwest Fisheries Science Center's biological viability assessment, NMFS identified many recommended actions to improve factors influencing the status of the Lower Columbia River Steelhead DPS. Below are actions that provide the greatest opportunity to improve the VSP parameters, and advance their recovery.
- For all populations and all MPGs that comprise the LCR steelhead, recommended future recovery actions over the next five years include:
- Conduct systematic review and analysis of high priority Lower Columbia River mainstem and tributary area habitat needs, identified in NMFS 2013a, and compare needs to what has been accomplished.
- Conduct monitoring to evaluate ship wake stranding frequency and locations where stranding occurs and assess factors contributing to wake stranding such as location, topography, vessel speed, et cetera, to determine best practices to reduce wake stranding mortality.
- Promote riparian plantings of native canopy tree cover species opportunistically in all watersheds.
- Coordinate with EPA in an evaluation of Washington State Water Quality Standards, reflecting Oregon and Idaho consultation outcomes.

For populations within the below listed MPGs, NMFS recommend the following recovery actions over the next five years:

Cascade MPGs

- Reestablish and improve passage on multiple rivers to benefit multiple populations from the Cascade MPGs, such as the North Fork Lewis River (NF Lewis River spring Chinook, NF Lewis River winter steelhead, NF Lewis River coho), and Cowlitz River (Upper Cowlitz River spring Chinook, Upper Cowlitz River fall Chinook, Upper Cowlitz River coho, Upper Cowlitz River winter steelhead).
- Work with county and city jurisdictions to protect watershed hydrology from long-term development impacts (floodplain development and groundwater withdrawals). Focus these efforts on high growth rate watersheds along the I-5 and I-205 corridors, including the East Fork Lewis River, North Fork Lewis River, Coweeman River, Kalama River, Washougal River, Salmon Creek, and Lower Cowlitz tributaries.

Gorge MPGs

- Continue to work with partners on programs protecting instream and floodplain habitats in key chum spawning areas, such as Duncan Creek and Hamilton Creek, (e.g., evaluate if large wood debris mitigates excess winter stream flows that degrade spawning for Upper Gorge chum).
- Continue to work with partners to identify suitable chum spawning habitat streams and reaches to emplace habitat creation or enhancement projects in order to expand spatial distribution into the gorge strata.

- Improve understanding of key factors limiting recovery by evaluating summer-run Gorge steelhead losses between Bonneville Dam and Shipherd Falls.
- Implement the EPA 2021 Columbia River Cold Water Refuges Plan, for example in Woodard Creek, to benefit Upper Gorge (Wind River and White Salmon rivers) LCR fall Chinook salmon, Lower Gorge (Woodard Creek) winter steelhead, Upper Gorge (Wind River) steelhead, and Wind River summer steelhead.
- Increase channel complexity to improve juvenile rearing habitat for Wind River summer steelhead.

6.2.19 Steelhead, Middle Columbia River DPS

Table 115. Steelhead, Middle Columbia River DPS; overview table

Species	Common Name	DPS	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus mykiss	Steelhead Trout	Middle Columbia River	Threatened	2022	2006 71 FR 834	2009	2005 70 FR 52630

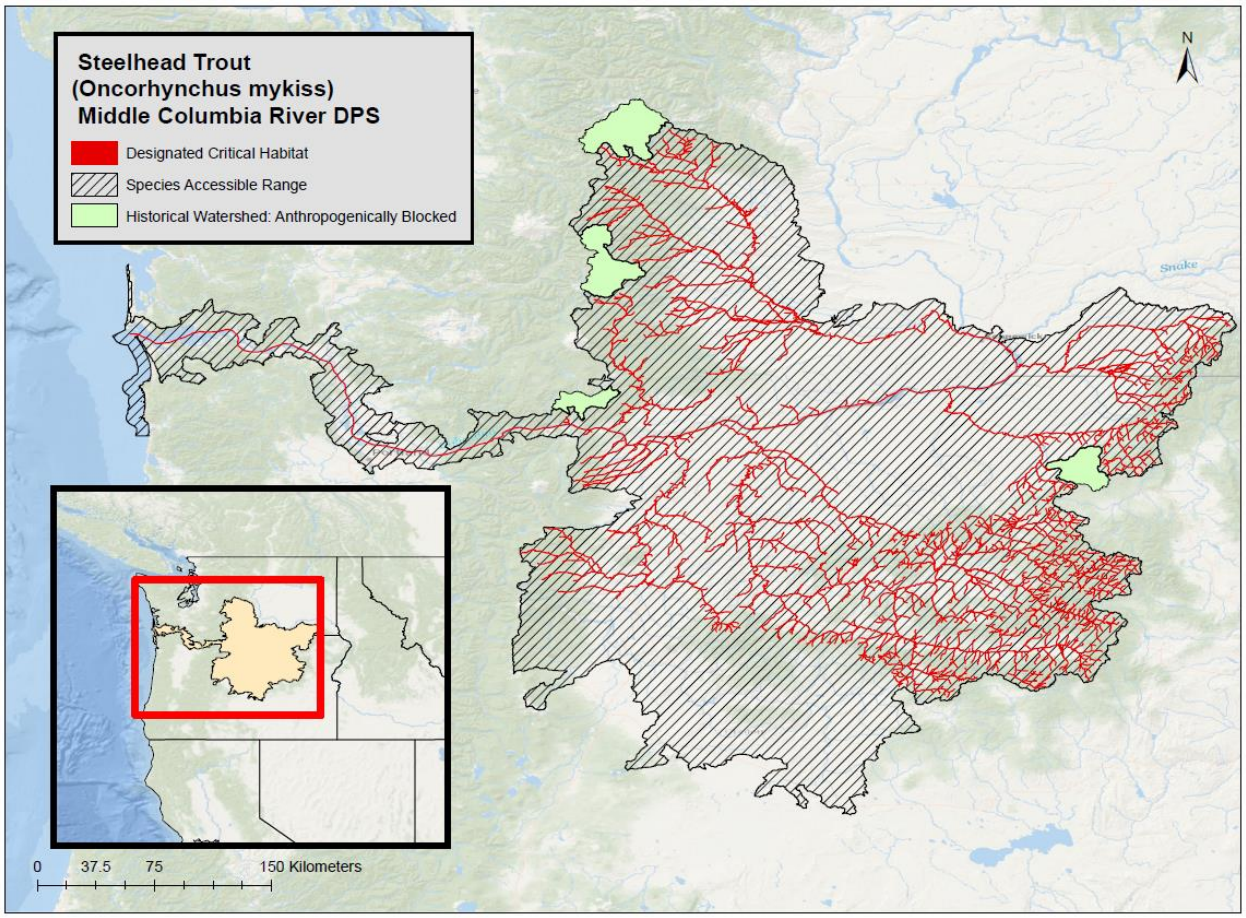


Figure 22. Steelhead, Middle Columbia River DPS range and designated critical habitat

Species Description. Steelhead are dark-olive in color, shading to silvery-white on the underside with a speckled body and a pink-red stripe along their sides. Those migrating to the ocean develop a slimmer profile, becoming silvery in color, and typically growing larger than rainbow trout that remain in fresh water. Steelhead trout grow to 55 pounds (25 kg) in weight and 45 inches (120 cm) in length, though the average size is much smaller. On March 25, 1999 NMFS listed the Middle Columbia River (MCR) DPS of steelhead as threatened (64 FR 14517) and reaffirmed the DPS's status as threatened on January 5, 2006 (71 FR 834). The MCR steelhead DPS includes all naturally spawned anadromous O. mykiss (steelhead) originating below natural and manmade impassable barriers from the Columbia River and its tributaries upstream of the Wind and Hood Rivers (exclusive) to and including the Yakima River; and excludes such fish originating from the Snake River basin. This DPS does include steelhead from four artificial propagation programs: the

Touchet River Endemic Program; Yakima River Kelt Reconditioning Program (in Satus Creek, Toppenish Creek, Naches River, and Upper Yakima River); Umatilla River Program; and the Deschutes River Program. This DPS does not include steelhead that are designated as part of an experimental population (79 FR 20802; Figure 2). For recovery planning and development of recovery criteria, the ICTRT identified independent populations within the MCR steelhead DPS and grouped them into genetically similar major population groups (MPGs) (ICTRT 2003). The DPS is composed of four MPGs: Cascades Eastern Slope Tributaries, John Day River, Yakima River, and Walla Walla and Umatilla Rivers.

Status. Based on the information identified in the 2022 Status Update, it was determined that no reclassification for the MCR steelhead DPS is appropriate, and therefore the MCR steelhead DPS should remain listed as threatened.

ESU/DPS delineation: The Northwest Fisheries Science Center's review (Ford 2022) found that except for removal of the Yakima River Kelt Reconditioning Program from the DPS, no new information has become available that would justify a change in the delineation of the MCR steelhead DPS.

The ICTRT identified 16 extant populations in four major population groups (Cascades Eastern Slopes Tributaries, John Day River, Walla Walla and Umatilla Rivers, and Yakima River) and one unaffiliated independent population (Rock Creek) (ICTRT 2003). There are two extinct populations in the Cascades Eastern Slope major population group: the White Salmon River and the Deschutes Crooked River above the Pelton/Round Butte Dam complex. Present population structure is delineated largely on geographical proximity, topography, distance, ecological similarities or differences. Using criteria for abundance and productivity, the ICTRT modeled a gaps analysis for each of the four MPGs in this DPS under three different ocean conditions and a base hydro condition (most recent 20-year survival rate). The results showed that none of the MPGs would be able to achieve a 5% or less risk of extinction over 100 years without recovery actions. It is important to consider that significant gaps in factors affecting spatial structure and diversity also contribute to the risk of extinction for these fish.

Life History. MCR steelhead populations are mostly of the summer-run type. Adult steelhead enter fresh water from June through August. The only exceptions are populations of inland winter-run steelhead which occur in the Klickitat River and Fifteenmile Creek (Busby et al. 1996). The majority of juveniles smolt and outmigrate as 2-year olds. Most of the rivers in this region produce about equal or higher numbers of adults having spent one year in the ocean as adults having spent two years. However, summer-run steelhead in Klickitat River have a life cycle more like LCR steelhead whereby the majority of returning adults have spent two years in the ocean (Busby et al. 1996). Adults may hold in the river up to a year before spawning.

Table 116. Temporal distribution of Steelhead, Middle Columbia River DPS in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)	Present											
Spawning	Present											
Incubation (eggs)	Present											
Emergence (alevin to fry phases)				Present								
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance. Historic run estimates for the Yakima River imply that annual species abundance may have exceeded 300,000 returning adults (Busby et al. 1996). The 5-year average (geometric mean) return of natural MCR steelhead for 1997 to 2001 was up from previous years' basin estimates. Returns to the Yakima River, the Deschutes River, and sections of the John Day River system were substantially higher compared to 1992 to 1997 (Good et al. 2005b). The 5-year average for these basins is 298 and 1,492 spawners, respectively (Good et al. 2005b). Total escapement and natural-origin escapements declined relative to the prior 5-year review for all five of the John Day MPG populations. Only two of the five populations in this group had a positive 15-year trend in natural-origin abundance, driven largely by peak returns in the early 2000s, despite the strong declines over the most recent 5-year period. Total spawning escapements have decreased in the most recent brood cycle for all three populations in the Umatilla/Walla Walla MPG as well. The 15-year trend in natural-origin abundance was positive for the Umatilla River population and slightly negative for Touchet River, though the trends are shallow. Population productivity was cyclical, with most populations following a similar pattern of growth and decline.

Productivity / Population Growth Rate. Good et al. (2005b) calculated that the median estimate of long-term trend over 12 indicator data sets was –2.1% per year (–6.9 to 2.9), with 11 of the 12 being negative. Long-term annual population growth rates (λ) were also negative (Good et al. 2005b). The median long-term λ was 0.98, assuming that hatchery spawners do not contribute to production, and 0.97 assuming that both hatchery- and natural-origin spawners contribute equally.

Distribution. The MCR steelhead DPS includes all naturally spawned steelhead populations below natural and manmade impassable barriers in streams from above the Wind River, Washington, and the Hood River, Oregon (exclusive), upstream to, and including, the Yakima River, Washington, excluding steelhead from the Snake River Basin. Steelhead from the Snake River basin (described later in this section) are excluded from this DPS. Seven artificial propagation programs are part of this DPS. They include: the Touchet River Endemic, Yakima River Kelt Reconditioning Program (in Satus Creek, Toppenish Creek, Naches River, and Upper Yakima River), Umatilla River, and the Deschutes River steelhead hatchery programs. These artificially propagated populations are considered no more divergent relative to the local natural populations than would be expected between closely related natural populations within the DPS. According to the ICBTRT (ICTRT 2003), this DPS is composed of 16 populations in four major population groups (Cascade Eastern Slopes Tributaries, John Day River, Walla Walla and Umatilla Rivers, and Yakima River), and one unaffiliated population (Rock Creek). Updated information on spawner and juvenile rearing distribution does not support a change in spatial structure status for Middle Columbia River

steelhead DPS populations, though the newly re-established run in the White Salmon River and the developing time series of population data from the Klickitat River and Rock Creek do warrant consideration in the DPS recovery plan. Viability indicators for within-population diversity have changed for some populations, although in most cases the changes have not been sufficient to shift composite risk ratings for a particular population.

Designated Critical Habitat. Critical habitat was designated for this species on September 2, 2005 (70 FR 52630). PBFs considered essential for the conservation of Steelhead, Middle Columbia River DPS are described in Appendix B.

The current condition of critical habitat designated for the MCR steelhead is moderately degraded. Critical habitat is affected by reduced quality of juvenile rearing and migration PBFs within many watersheds; contaminants from agriculture affect both water quality and food production in several watersheds and in the mainstem Columbia River. Loss of riparian vegetation to grazing has resulted in high water temperatures in the John Day basin. Reduced quality of the rearing PBFs has diminished its contribution to the conservation value necessary for the recovery of the species. Several dams affect adult migration PBF by obstructing the migration corridor.

Recovery Goals. See the 2009 recovery plan for the Middle Columbia River steelhead DPS for complete down-listing/delisting criteria for recovery goals for the species. There has been functionally no change in the viability ratings for the component populations, and the Middle Columbia River steelhead DPS does not currently meet the viability criteria described in the Middle Columbia River steelhead recovery plan. In addition, several of the factors cited by the 2005 BRT remain as concerns or key uncertainties. While recent (5-year) returns are declining across all populations, the declines are from relatively high returns in the previous 5-to-10 year interval, so the longer-term risk metrics that are meant to buffer against short-period changes in abundance and productivity remain unchanged. Natural-origin spawning estimates are highly variable relative to minimum abundance thresholds across the populations in the DPS. Two of the four MPGs in this DPS include at least one population rated at “low” or “very low” risk for abundance and productivity, while the other two MPGs remain in the “moderate” to “high” risk range. Updated information indicates that stray levels into the John Day River populations have decreased in recent years. Out-of-basin hatchery stray proportions, although reduced, remain high in spawning reaches within the Deschutes River basin and the Umatilla, Walla Walla, and Touchet River populations. Overall, the Middle Columbia River steelhead DPS remains at “moderate” risk of extinction, with viability unchanged from the prior review.

Significant habitat restoration and protection actions at the Federal, state, and local levels have been implemented to improve degraded habitat conditions and resolve fish passage issues described in the 2009 Middle Columbia River Steelhead Recovery Plan. While these efforts have been substantial and are expected to benefit the survival and productivity of the targeted populations, the 2022 Status Update found no evidence demonstrating that improvements in habitat conditions have led to improvements in population viability.

6.2.20 Steelhead, Northern California DPS

Table 117. Steelhead, Northern California DPS; overview table

Species	Common Name	DPS	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus mykiss	Steelhead Trout	Northern California	Threatened	2016	2006 71 FR 834	2016	2005 70 FR 52488

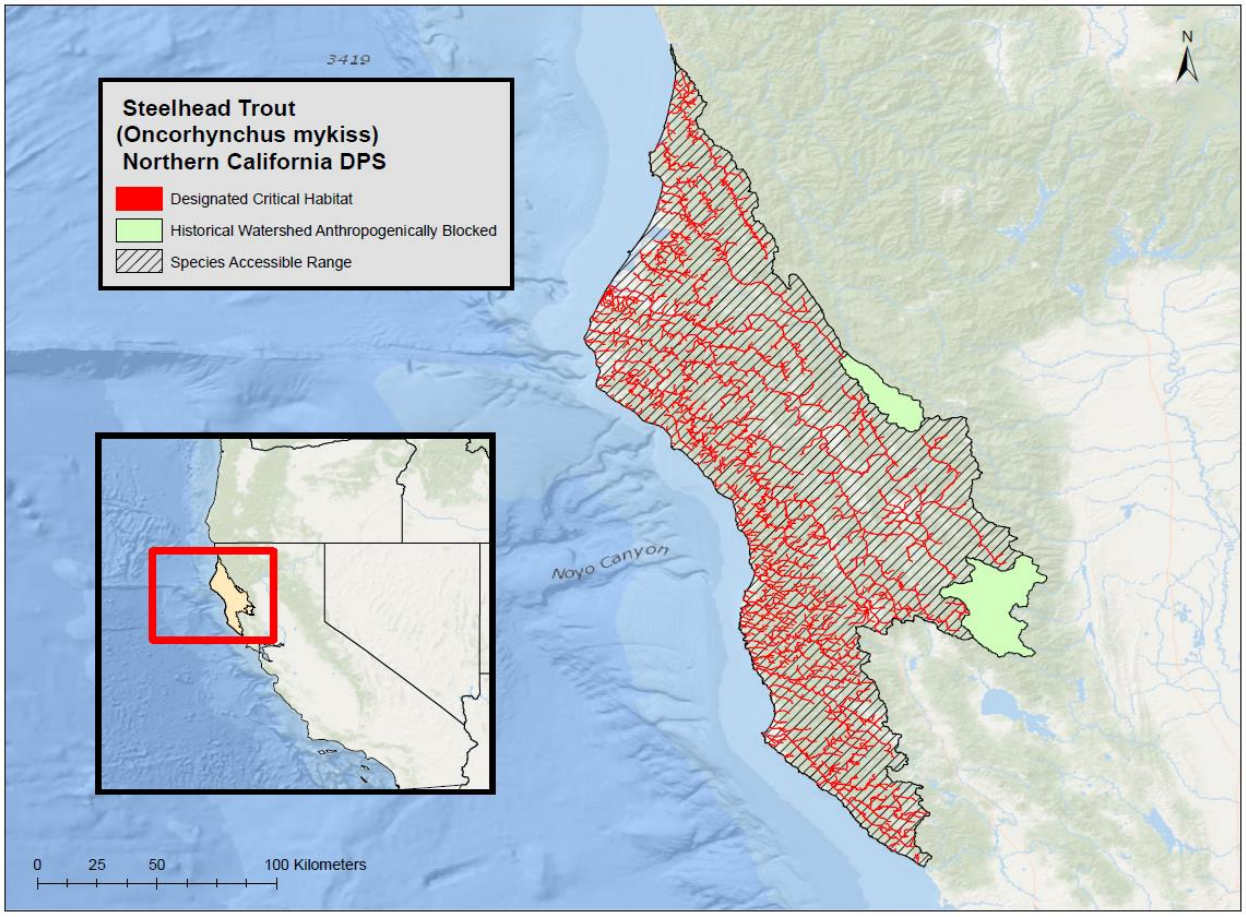


Figure 23. Steelhead, Northern California DPS range and designated critical habitat

Species Description. Steelhead are dark-olive in color, shading to silvery-white on the underside with a speckled body and a pink-red stripe along their sides. Those migrating to the ocean develop a slimmer profile, becoming silvery in color, and typically growing larger than rainbow trout that remain in fresh water. Steelhead trout grow to 55 pounds (25 kg) in weight and 45 inches (120 cm) in length, though the average size is much smaller. On June 7, 2000 NMFS listed the Northern California (NC) DPS of steelhead as threatened (65 FR 36074) and reaffirmed the DPS's status as threatened on January 5, 2006 (71 FR 834). This DPS includes naturally spawned anadromous O. mykiss (steelhead) originating below natural and manmade impassable barriers in California coastal river basins from Redwood Creek to and including the Gualala River.

Status. The available data for winter-run populations— predominantly in the North Coastal, North-Central Coastal, and Central Coastal strata— indicate that all populations are well below viability targets, most being between 5% and 13% of these goals. For the two Mendocino Coast populations with the longest time series, Pudding Creek and Noyo River, the 13-year trends have been negative and neutral, respectively (Williams et al. 2016). However, the short-term (6-year) trend has been generally positive for all independent populations in the North-Central Coastal and Central Coastal strata, including the Noyo River and Pudding Creek. Data from Van Arsdale Station likewise suggests that, although the long-term trend has been negative, run sizes of natural-origin steelhead have stabilized or are increasing. Thus, we have no strong evidence to indicate conditions for winter-run populations in the DPS have worsened appreciably since the last status review (Williams et al. 2016). Summer-run populations continue to be of significant concern because of how few populations currently exist. The Middle Fork Eel River population has remained remarkably stable for nearly five decades and is closer to its viability target than any other population in the DPS. Although the time series is short, the Van Duzen River appears to be supporting a population numbering in the low hundreds. However, the Redwood Creek and Mattole River populations appear small, and little is known about other populations including the Mad River and other tributaries of the Eel River (i.e., Larabee Creek, North Fork Eel, and South Fork Eel). Most populations for which there are population estimates available remain well below viability targets; however, the short-term increases observed for many populations, despite the occurrence of a prolonged drought in northern California, suggests this DPS is not at immediate risk of extinction.

Life History. This DPS includes both winter- and summer –run steelhead. In the Mad and Eel Rivers, immature steelhead may return to fresh water as “half-pounders” after spending only two to four months in the ocean. Generally, a half-pounder will overwinter in fresh water and return to the ocean in the following spring.

Juvenile out-migration appears more closely associated with size than age but generally, throughout their range in California, juveniles spend two years in fresh water (Busby et al. 1996). Smolts range from 14-21 cm in length. Juvenile steelhead may migrate to rear in lagoons throughout the year with a peak in the late spring/early summer and in the late fall/early winter period (Shapovalov and Taft 1954a, Zedonis 1992).

Steelhead spend anywhere from one to five years in salt water, however, 2–3 years are most common (Busby et al. 1996). Ocean distribution is not well known but coded wire tag recoveries indicate that most NC steelhead migrate north and south along the continental shelf (Barnhart 1986).

Table 118. Temporal distribution of Steelhead, Northern California DPS in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)	Present										Present	
Spawning	Present											Present
Incubation (eggs)		Present										
Emergence (alevin to fry phases			Present									
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance. Northern California steelhead historic functionally independent populations and their abundances and hatchery contributions are provided in Table 119.

Table 119. Northern California steelhead historic and recent abundance

Population	Historical Abundance	Past Spawner Abundance	Hatchery Abundance Contributions (%)
Mad River (S)	6,000	162-384	2
MF Eel River (S)	Unknown	384-1,246	0
NF Eel River (S)	Unknown	Extirpated	N/A
Mattole River (S)	Unknown	9-30*	Unknown
Redwood Creek (S)	Unknown	6*	Unknown
Van Duzen (W)	10,000	Unknown	Unknown
Mad River (W)	6,000	Unknown	Unknown
SF Eel River (W)	34,000	2743-20,657	Unknown
Mattole River (W)	12,000	Unknown	Unknown
Redwood Creek (W)	10,000	Unknown	Unknown
Humboldt Bay (W)	3,000	Unknown	Unknown
Freshwater Creek (W)		25-32	
Ten Mile River (W)	9,000	Unknown	Unknown
Noyo River (W)	8,000	186-364*	Unknown
Big River (W)	12,000	Unknown	Unknown
Navarro River (W)	16,000	Unknown	Unknown
Garcia River (W)	4,000	Unknown	Unknown
Gualala River (W)	16,000	Unknown	Unknown
Total	198,000	Unknown	

**From Spence et al. (2008). Redwood Creek abundance is the mean count over four generations. Mattole River abundances from surveys conducted between 1996 and 2005. Noyo River abundances from surveys conducted since 2000.*
Summer –run steelhead is noted with a (S) and winter-run steelhead with a (W)

Productivity / Population Growth Rate. When first listed, Good *et al.* (2005b) estimated lambda at 0.98 with a 95% confidence interval of 0.93 and 1.04. The result is an overall downward trend in both the long- and short- term. Juvenile data were also recently examined. Both upward and downward trends were apparent (Good et al. 2005b). According to the NMFS 2016 status review, the available data for winter-run populations— predominately in the North Coastal, North-Central Coastal, and Central Coastal strata— indicate that all populations are well below viability targets, most being between 5% and 13% of these goals. Data from Van Arsdale Station likewise suggests that, although the long-term trend has been negative, run sizes of natural-origin steelhead have stabilized or are increasing (Spence 2016). Thus, we have no strong evidence to indicate conditions

for winter-run populations in the DPS have worsened appreciably since the last status review (NMFS 2011). Summer-run populations continue to be of significant concern because of how few populations currently exist. The Middle Fork Eel River population has remained remarkably stable for nearly five decades and is closer to its viability target than any other population in the DPS (Spence 2016). Reduction of summer-run steelhead populations has significantly reduced current DPS diversity compared to historic conditions. Of the 10 summer-run steelhead populations, only four are extant. Of these, only the Middle Fork Eel River population is at moderate risk of extinction, the remaining three are at high risk (Spence et al. 2008a). Hatchery influence has likely been limited.

Genetic Diversity / Distribution. Artificial propagation was identified as negatively affecting wild stocks of salmonids through interactions with non-native fish, introductions of disease, genetic changes, competition for space and food resources, straying and mating with native populations, loss of local genetic adaptations, mortality associated with capture for broodstock and palliating the destruction of habitat and concealing problems facing wild stocks.

Designated Critical Habitat. NMFS designated critical habitat for NC steelhead on September 2, 2005 (70 FR 52488). PBFs considered essential for the conservation of Steelhead, Northern California DPS are described in Appendix B.

The current condition of critical habitat designated for the NC steelhead is moderately degraded. Nevertheless, it does provide some conservation value necessary for species recovery. Within portions of its range, especially the interior Eel River, rearing PBF quality is affected by elevated temperatures by removal of riparian vegetation. Spawning PBF attributes such as the quality of substrate supporting spawning, incubation, and larval development have been generally degraded throughout designated critical habitat by silt and sediment fines in the spawning gravel. Bridges and culverts further restrict access to tributaries in many watersheds, especially in watersheds with forest road construction, thereby reducing the function of adult migration PBF.
Recovery Goals. See the 2016 recovery plan for the Northern California steelhead DPS for complete down-listing/delisting criteria for recovery goals for the species (NMFS 2016d).

6.2.21 Steelhead, Puget Sound DPS

Table 120. Steelhead, Puget Sound DPS; overview table

Species	Common Name	DPS	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus mykiss	Steelhead Trout	Puget Sound	Threatened	2022	2007 72 FR 26722	2019	2016 81 FR 9251

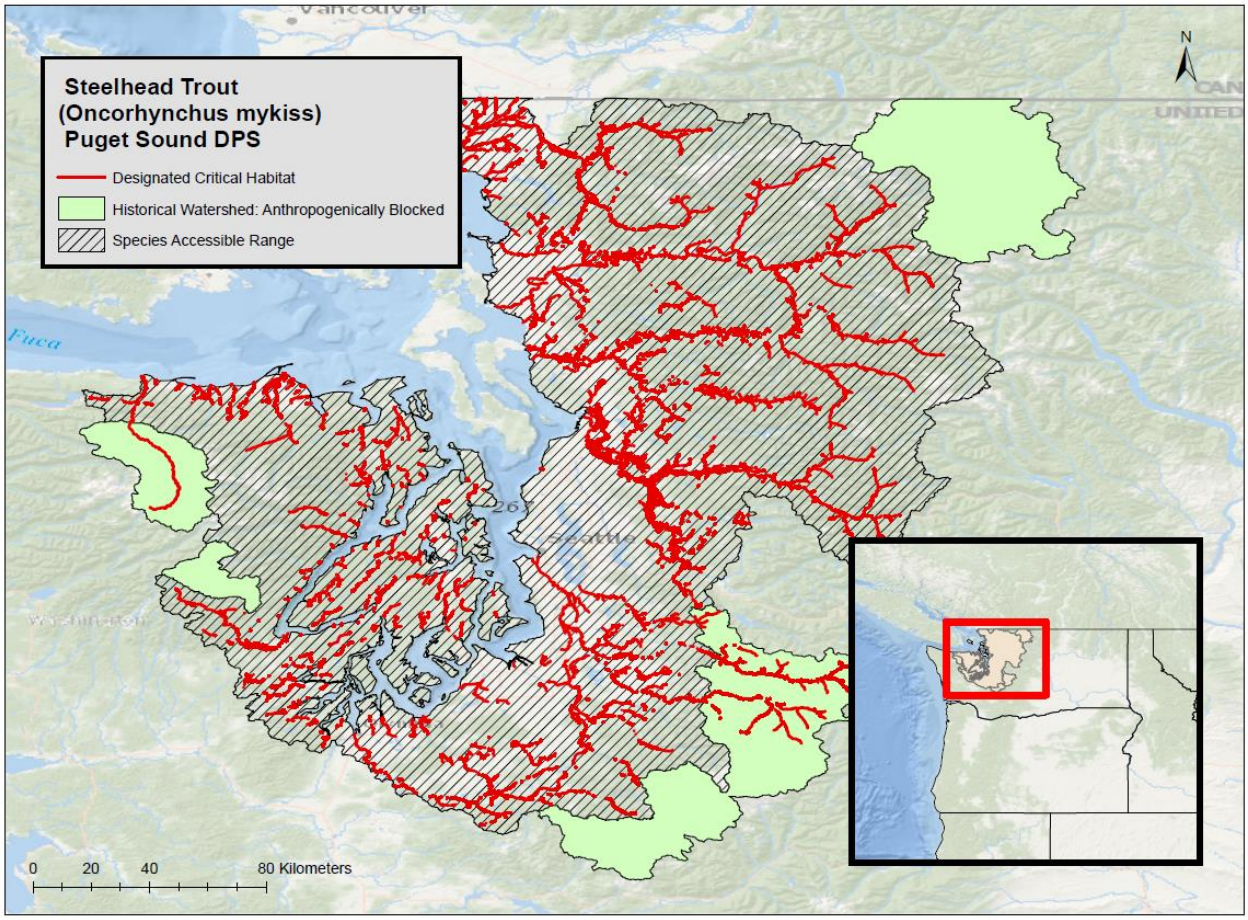


Figure 24. Steelhead, Puget Sound DPS range and designated critical habitat

Species Description. Steelhead are dark-olive in color, shading to silvery-white on the underside with a speckled body and a pink-red stripe along their sides. Those migrating to the ocean develop a slimmer profile, becoming silvery in color, and typically growing larger than rainbow trout that remain in fresh water. Steelhead trout grow to 55 pounds (25 kg) in weight and 45 inches (120 cm) in length, though the average size is much smaller. On June 11, 2007 NMFS listed the Puget Sound (PS) DPS of steelhead as threatened (72 FR 26722). This DPS includes naturally spawned anadromous O. mykiss (steelhead) originating below natural and manmade impassable barriers from rivers flowing into Puget Sound from the Elwha River (inclusive) eastward, including rivers in Hood Canal, South Sound, North Sound and the Strait of Georgia. Also, steelhead from six artificial propagation programs are included in this DPS.

Status. Puget Sound steelhead DPS status has not substantively changed since the listing in 2007, or since the 2011 status review. Furthermore, the PS steelhead Technical Recovery Team (TRT) recently concluded that the DPS was at very low viability, as were all three of its constituent MPGs, and many of its 32 DIPs (Hard et al. 2015). Recent analyses indicate that the viability of the Puget Sound steelhead DPS has improved somewhat since the PSTRT concluded that the DPS was at very low viability, as were all three of its constituent MPGs, and many of its 32 DIPs (Hard et al. 2015). Increases in spawner abundance were observed in a number of populations over the last five years. These improvements were disproportionately found within the Central & South Puget Sound and the Hood Canal & Strait of Juan de Fuca MPGs, primarily among smaller populations. The apparent reversal of strongly negative trends among winter-run populations in the White, Nisqually, and Skokomish Rivers abated somewhat the demographic risks facing those populations. Certainly, improvement in the status of the Elwha River steelhead (both winter- and summer-run) following the removal of the Elwha dams reduced the demographic and diversity risk for the DIP and the MPG. Improvements in abundance were not as widely observed in the Northern Cascades MPG. Foremost among the declines were summer- and winter-run populations in the Snohomish River basin. These populations figure prominently as sources of abundance for the MPG and DPS. Additionally, the decline in the Tolt River summer-run steelhead population was especially of concern given that it is the only population for which we have abundance estimates. The demographic and diversity risks to the Tolt River summer-run DIP are very high. In fact, all summer-run steelhead populations in the Northern Cascades MPG are likely at a very high demographic risk. In spite of improvements in some areas, most populations are still at relatively low abundance levels, with about a third of the DIPs unmonitored and presumably at very low levels.

Life History. The Puget Sound steelhead DPS contains both winter-run and summer-run steelhead. Adult winter-run steelhead generally return to Puget Sound tributaries from December to April (NMFS 2005b). Spawning occurs from January to mid-June, with peak spawning occurring from mid-April through May. Prior to spawning, maturing adults hold in pools or in side channels to avoid high winter flows. Less information exists for summer-run steelhead as their smaller run size and higher altitude headwater holding areas have not been conducive for monitoring. Based on information from four streams, adult run time occur from mid-April to October with a higher concentration from July through September (NMFS 2005b).
The majority of juveniles reside in the river system for two years with a minority migrating to the ocean as one or 3-year olds. Smoltification and seaward migration occur from April to mid-May. The ocean growth period for Puget Sound steelhead ranges from one to three years in the ocean (Busby et al. 1996). Juveniles or adults may spend considerable time in the protected marine environment of the fjord-like Puget Sound during migration to the high seas.

Table 121. Temporal distribution of Steelhead, Puget Sound DPS in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)	Present											
Spawning		Present										
Incubation (eggs)		Present										
Emergence (alevin to fry phases)				Present								
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance. In the 1996 and 2005 status reviews, the Skagit and Snohomish Rivers (North Puget Sound) winter-run steelhead were found to produce the largest escapements (Busby et al. 1996, NMFS 2005b). The two rivers still produce the largest wild escapement with the 2005 to 2008 4-year geometric mean of 5,468 for the Skagit River and an average 2,944 steelhead in Snohomish River for the two years 2005 and 2006 (Washington Department of Fish and Wildlife (WDFW) 2009).

The Hood Canal and Strait of Juan de Fuca MPG populations experienced an increase in abundance during the 2015–19 period. The 5-year geomean for the Elwha River DIP increased to 1,241 winter-run steelhead, an 82% increase over the 2010–14 period. Productivity estimates for recent broodyears have also been strongly positive. In addition, summer-run steelhead have been observed in the upper Elwha River, with recent counts in the low hundreds of returning adults (Pess et al. 2020). Rather than a recolonization, these fish appear to be reanadromized *O. mykiss* from summer-run steelhead originally isolated behind the Elwha and Glines Canyon Dams.

Within the Northern Cascades MPG over the last five years, there has been considerable variability in the performance of individual basins. The winter-run populations in the Samish River and Bellingham Bay tributaries exhibited a 74% increase in the 5-year geometric mean abundance, with an average 1,305 natural-origin spawners for the present review period. Additionally, this estimate is an underestimate as it does not include tributaries to Bellingham Bay. Winter-run DIPs in the Nooksack and Skagit River basins exhibited slight increases in their average 5-year abundances, although within the 2015–19 period a negative trend in abundances is evident in the Skagit River populations with a geomean of 7,181. The Stillaguamish River winter-run DIP exhibited a moderate increase in its 5-year geomean abundance of 26%, although the longer-term trend for this population from abundance levels in the 1980s is strongly downward. DIPs in the Snohomish River basin were stable or negative. This MPG represents the majority of the abundance for the entire Puget Sound steelhead DPS, with a total abundance (based on 5-year geomeans) of over 10,000 natural spawners. Several populations have abundances over 1,000, and others over 250; however, over a third of the populations are not sufficiently monitored to develop population abundance estimates and likely have very low numbers of spawners. Except for the Samish River/Bellingham Bay Tributaries DIP and perhaps the Nooksack and Skagit Rivers, productivity for most populations was negative (in contrast to the 5-year geomean trends), suggesting a downward trend into the near future.

Steelhead populations in the Central and South Puget Sound MPG exhibited strongly positive increases in their 5-year abundances. Four populations represent the major basins in this MPG: Green River, Puyallup River, White River, and Nisqually River winter-run DIPs exhibited 94–187% increases in 5-year abundances. Long-term (15-year) trends for three of these populations—White, Puyallup, and Nisqually—were positive, with annual growth rates of 6–8%, while the Green River DIP long-term trend remained stable at 0%. Abundances for the White and Puyallup River winter-run DIPs remain in the low hundreds and continue to be at some demographic risk, although estimates include counts from only portions of the DIPs. Further, abundances for the Puyallup/Carbon River DIP include data series for the Puyallup and Carbon Rivers that could not be combined due to differences in survey protocols. Recent productivity for these four populations has

been predominately positive. Two DIPs in the Lake Washington watershed, North Lake Washington Tributaries and Cedar River, had adult abundances near zero.
Productivity / Population Growth Rate. Long-term trends (1980 to 2004) for the Puget Sound steelhead natural escapement have declined significantly for most populations, especially in southern Puget Sound, and in some populations in northern Puget Sound (Stillaguamish winter-run), Canal (Skokomish winter-run), and along the Strait of Juan de Fuca (Dungeness winter-run) (NMFS 2005b). Positive trends were observed in the Samish winter-run (northern Puget Sound) and the Hamma Hamma winter-run (Hood Canal) populations. The increasing trend on the Hamma Hamma River may be due to a captive rearing program rather than to natural escapement (NMFS 2005b).

The negative trends in escapement of naturally produced fish resulted from peaks in natural escapement in the early 1980s. Still, the period 1995 through 2004 (short-term) showed strong negative trends for several populations. This is especially evident in southern Puget Sound (Green, Lake Washington, Nisqually, and Puyallup winter-run), Hood Canal (Skokomish winter-run), and the Strait of Juan de Fuca (Dungeness winter-run) (NMFS 2005b). As with the long-term trends, positive trends were evident in short-term natural escapement for the Samish and Hamma Hamma winter-run populations, and also in the Snohomish winter-run populations.
Median population growth rates (λ) using 4-year running sums is less than one, indicating declining population growth, for nearly all populations in the DPS (NMFS 2005b). However, some of the populations with declining recent population growth show only slight declines, (*e.g.*, Samish and Skagit winter-run in northern Puget Sound, and Quilcene and Tahuya winter-run in Hood Canal).

The long-term abundance of adult steelhead returning to many Puget Sound rivers has fallen substantially since estimates began for many populations in the late 1970s and early 1980s; however, in the nearer term, there has been a relative improvement in abundance and productivity. Of the 20 datasets analyzed, abundance trends were available for seven of the 8 winter-run DIPs in the Hood Canal & Strait of Juan de Fuca MPG; for five of the 8 winter-run DIPs in the Central & South Puget Sound MPG; and for seven of the 11 winter-run DIPs, but only one of the five summer-run DIPs, in the Northern Cascades MPG (Table 54). One-third of the populations lack monitoring and abundance data; in most cases it is likely that abundances are very low. The data submitted only included natural-origin spawners, therefore statistical analyses for natural spawners and total spawners were identical.

Genetic Diversity. Only two hatchery stocks genetically represent native local populations (Hamma Hamma and Green River natural winter-run). The remaining programs, which account for the vast preponderance of production, are either out-of-DPS derived stocks or were within-DPS stocks that have diverged substantially from local populations. The WDFW estimated that 31 of the 53 stocks were of native origin and predominantly natural production (Washington Department of Fish and Wildlife (WDFW) 1993).

Distribution. NMFS listed Puget Sound steelhead as threatened on May 11, 2007 (72 FR 26722). Fifty-three populations of steelhead have been identified in this DPS, of which 37 are winter-run. Summer-run populations are distributed throughout the DPS but are concentrated in northern Puget Sound and Hood Canal; only the Elwha River and Canyon Creek support summer-run steelhead in the rest of the DPS. The Elwha River run, however, is descended from the introduced Skamania

Hatchery summer-run steelhead. Historical summer-run steelhead in the Green River and Elwha River were likely extirpated in the early 1900s.

Designated Critical Habitat. NMFS designated critical habitat for Puget Sound steelhead on February 2, 2016 (81 FR 9251). PBFs considered essential for the conservation of Steelhead, Puget Sound DPS are described in Appendix B.

Recovery Goals. See the 2019 Recovery Plan (NMFS 2019) for a complete description of recovery goals and criteria. The overarching viability criteria for this DPS is that "all three of the species MPGs (the Central and South Puget Sound MPG, Hood Canal and Strait of Juan de Fuca MPG, and North Cascades MPG) need to be viable for the DPS to be removed from the ESA's threatened and endangered species list." Currently, all three MPGs remain at low viability.

6.2.22 Steelhead, Snake River Basin

Table 122. Steelhead, Snake River Basin DPS; overview table

Species	Common Name	DPS	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus mykiss	Steelhead Trout	Snake River Basin	Threatened	2022	2006 71 FR 834	2017	2005 70 FR 52630

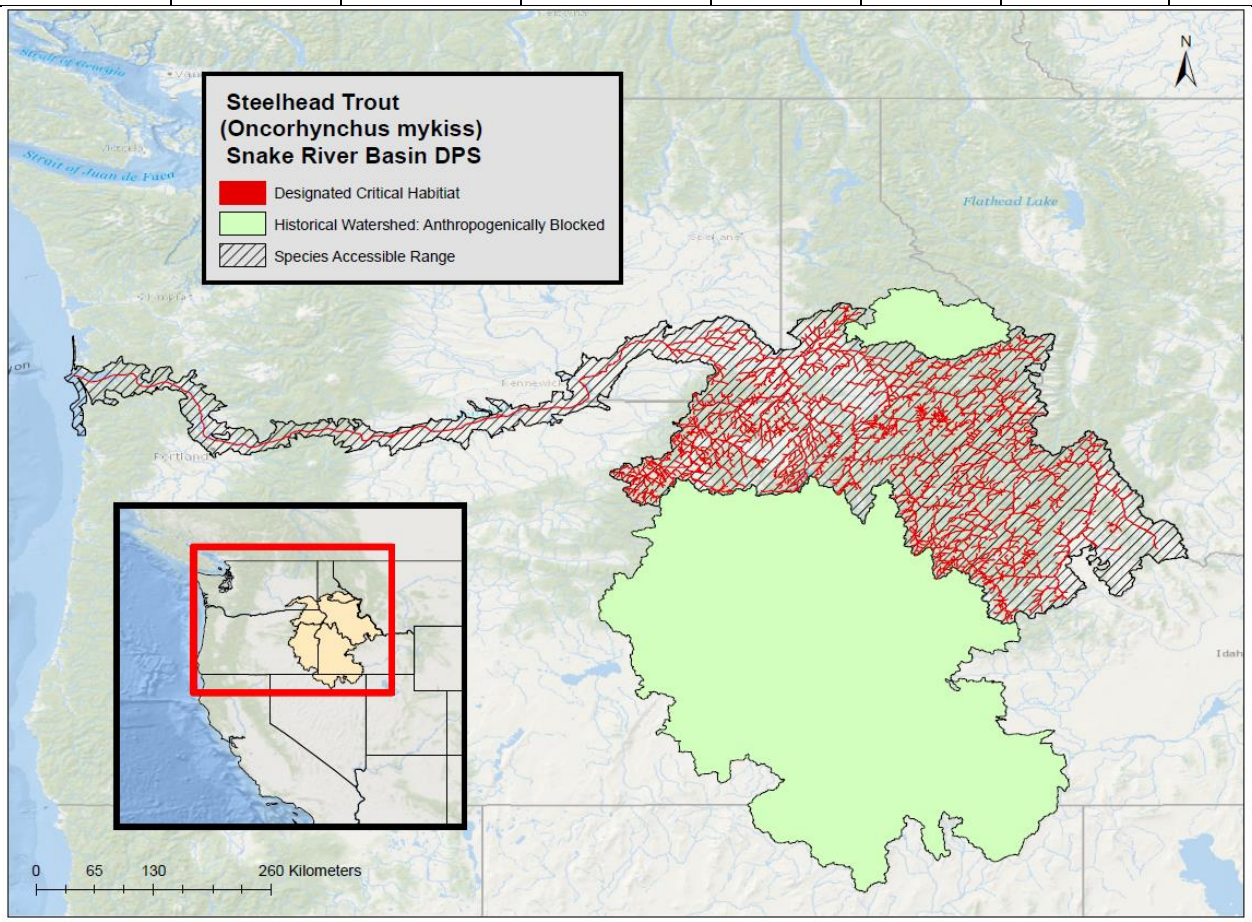


Figure 25. Steelhead, Snake River Basin DPS range and designated critical habitat

Species Description. Steelhead are dark-olive in color, shading to silvery-white on the underside with a speckled body and a pink-red stripe along their sides. Those migrating to the ocean develop a slimmer profile, becoming silvery in color, and typically growing larger than rainbow trout that remain in fresh water. Steelhead trout grow to 55 pounds (25 kg) in weight and 45 inches (120 cm) in length, though the average size is much smaller. On August 18, 1997 NMFS listed the Snake River Basin (SRB) DPS of steelhead as threatened (62 FR 43937) and reaffirmed the DPS's status as threatened on January 5, 2006 (71 FR 834). The 2022 Status Update found no new information that would justify a change in the delineation of the SRB steelhead DPS (Ford 2022).This DPS includes naturally spawned anadromous O. mykiss (steelhead) originating below natural and manmade impassable barriers from the Snake River basin, and also steelhead from six artificial propagation programs. The 2022 status review updated the SRB DPS listing to reflect the following

six changes made by NMFS to hatchery programs (85 FR 81822): (1) added the Salmon River B-run Program because the existing release is now classified as a separate and distinct program; (2) added the South Fork Clearwater (Clearwater Hatchery) B-run program because the existing release is now classified as a separate and distinct program; (3) changed the name of the East Fork Salmon River Program to the East Fork Salmon River Natural Program; (4) removed the Lolo Creek Program because it is now considered part of the listed Dworshak National Fish Hatchery Program; (5) removed the North Fork Clearwater Program because it is now considered part of the listed Dworshak National Fish Hatchery Program, and; (6) changed the name of the Little Sheep Creek/Imnaha River Hatchery Program to the Little Sheep Creek/Imnaha Program.

Status. Based on the updated viability information available for this review, all five MPGs are not meeting the specific objectives in the draft recovery plan, and the viability of many individual populations remains uncertain (NWFSC 2015c). The Grande Ronde MPG is tentatively rated as viable; more specific data on spawning abundance and the relative contribution of hatchery spawners for the Lower Grande Ronde and Wallowa populations would improve future assessments. 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. Overall, the information analyzed for this viability review indicates that the Snake River Basin steelhead DPS remains at "moderate" risk of extinction, with viability largely unchanged from the prior review. Of particular note, the updated, population-level abundance estimates have made very clear the recent (last five years) sharp declines that are extremely worrisome, were they to continue.

Life History. SR basin steelhead are generally classified as summer-run fish. They enter the Columbia River from late June to October. After remaining in the river through the winter, SR basin steelhead spawn the following spring (March to May). Managers recognize two life history patterns within this DPS primarily based on ocean age and adult size upon return: A-run and B-run. A-run steelhead are typically smaller, have a shorter freshwater and ocean residence (generally one year in the ocean), and begin their up-river migration earlier in the year. B-run steelhead are larger, spend more time in fresh water and the ocean (generally two years in ocean), and appear to start their upstream migration later in the year. SR basin steelhead usually smolt after two or three years.

Table 123. Temporal distribution of Steelhead, Snake River Basin DPS in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)					Present							
Spawning			Present									
Incubation (eggs)			Present									
Emergence (alevin to fry phases)				Present								
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance / Productivity.

There is uncertainty for wild populations given limited data for adult spawners in individual populations. Regarding population growth rate, there are mixed long- and short-term trends in abundance and productivity. Overall, the abundances remain well below interim recovery criteria. The 5-year geometric mean abundance estimates for the populations in this DPS all show significant declines in the recent past. Each of the populations decreased by roughly 50% in the past 5-year period, resulting in a near-zero population change in the past 15 years for the three

populations with sufficiently long data time series. Hatchery-origin spawner estimates for these populations continued to be low.

Populations in the Snake River Basin steelhead DPS exhibited similar temporal patterns in broodyear returns per spawner, oscillating with a rough period of 10 years. Return rates for broodyears 1995−99 generally exceeded replacement (1:1). Spawner-to-spawner ratios for broodyears 2001−03 were generally well below replacement for many populations, cycling above replacement during 2005–10, and strongly below replacement since 2010. Broodyear return rates reflect the combined impacts of year-to-year patterns in marine life-history stages, upstream and downstream passage survivals, as well as density-dependent effects resulting from capacity or survival limitations on tributary spawning or juvenile rearing habitats.

Genetic Diversity. The ICTRT identified 24 extant populations within this DPS, organized into five major population groups (ICTRT 2003). They also identified a number of potential historical populations associated with tributary habitat above the Hells Canyon Dam complex on the mainstem Snake River, a barrier to anadromous migration. The five MPGs with extant populations are Lower Snake River (2 populations), Clearwater River (5 extant populations, one extirpated), Grande Ronde River (4 populations), Imnaha River (1 population), and Salmon River (12 populations). In addition, the ICTRT concluded that small tributaries entering the mainstem Snake River below Hells Canyon Dam may have historically been part of a larger population with a core area currently cut off from anadromous access. That population would have been part of one of the historical upstream MPGs.

Distribution. The ICTRT (ICTRT 2003) identified 23 populations. SR basin steelhead remain spatially well distributed in each of the six major geographic areas in the Snake River basin (Good et al. 2005b). The SR basin steelhead B- run populations remain particularly depressed. Designated Critical Habitat. Critical habitat was designated for this species on September 2, 2005 (70 FR 52630). PBFs considered essential for the conservation of Steelhead, Snake River Basin DPS are described in Appendix B.

The current condition of critical habitat designated for SR basin steelhead is moderately degraded. Critical habitat is affected by reduced quality of juvenile rearing and migration PBFs within many watersheds. Contaminants from agriculture affect both water quality and food production in several watersheds and in the mainstem Columbia River. Loss of riparian vegetation to grazing has resulted in high water temperatures in the John Day basin. These factors have substantially reduced the rearing PBFs contribution to the conservation value necessary for species recovery. Several dams affect adult migration PBF by obstructing the migration corridor.

Recovery Goals. See the 2017 Recovery Plan (NMFS 2017d)for a complete list of recovery goals and criteria. The recovery plan outlines a variety of different scenarios that may lead to a viable DPS, however, the overall criteria for the DPS is that all extant MPGs and any extirpated MPGs critical for proper functioning of the DPS should be at low risk.

6.2.23 Steelhead, South-Central California Coast DPS

Table 124. Steelhead, South-Central California Coast DPS; overview table

Species	Common Name	DPS	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus mykiss	Steelhead Trout	South-Central California Coast	Threatened	2023	2006 71 FR 834	2013	2005 70 FR 52488

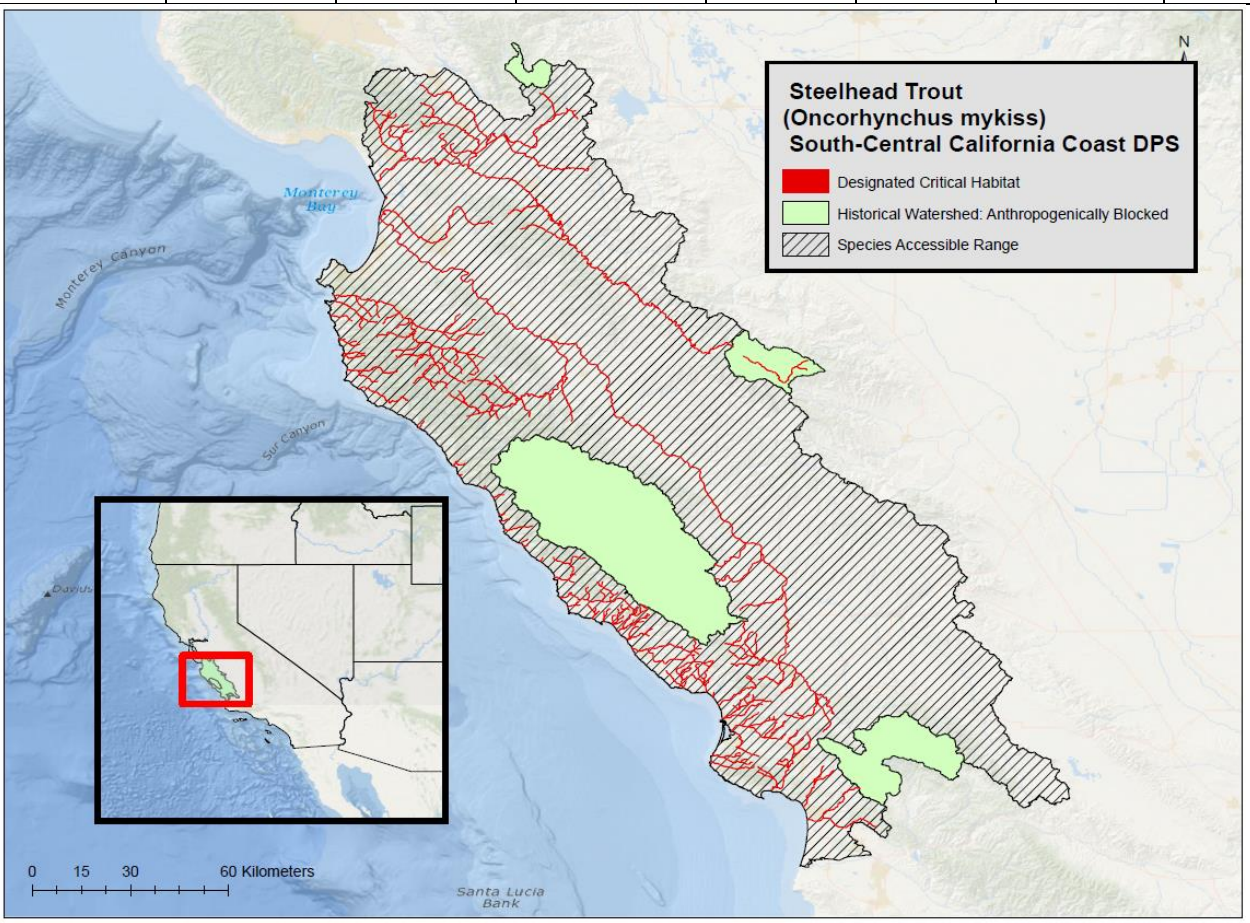


Figure 26. Steelhead, South-Central California Coast DPS range and designated critical habitat

Species Description. Steelhead are dark-olive in color, shading to silvery-white on the underside with a speckled body and a pink-red stripe along their sides. Those migrating to the ocean develop a slimmer profile, becoming silvery in color, and typically growing larger than rainbow trout that remain in fresh water. Steelhead trout grow to 55 pounds (25 kg) in weight and 45 inches (120 cm) in length, though the average size is much smaller. On August 18, 1997 NMFS listed the South-Central California Coast (SCCC) DPS of steelhead as threatened (62 FR 43937) and reaffirmed the DPS's status as threatened on January 5, 2006 (71 FR 5248). This DPS includes naturally spawned anadromous O. mykiss (steelhead) originating below natural and manmade impassable barriers from the Pajaro River to (but not including) the Santa Maria River.

Status. Following the dramatic rise in South-Central California's human population after World War II and the associated land and water development within coastal drainages (particularly major dams and water diversions), steelhead abundance rapidly declined, leading to the extirpation of populations in many watersheds and leaving only sporadic and remnant populations in the remaining, more highly modified watersheds such as the Salinas River and Arroyo Grande Creek watersheds (Good et al. 2005b, Boughton et al. 2007). As conditions in South-Central California coastal rivers and streams continued to deteriorate, put-and-take trout stocking became more focused on suitable man made reservoirs. Since the listing of the SCCC DPS as threatened in 1997, the California Department of Fish and Wildlife has ceased stocking hatchery reared fish in the anadromous waters of South-Central California (California Department of Fish and Wildlife and U.S. Fish and Wildlife Service 2010). A substantial portion of the upper watersheds, which contain the majority of historical spawning and rearing habitats for anadromous *O. mykiss*, remain intact (though inaccessible to anadromous fish) and protected from intensive development as a result of their inclusion in the Los Padres National Forest (Blakley and Barnette 1985).

Life History. Only Winter run steelhead are found in this DPS. Migration and spawn timing are similar to adjacent steelhead populations. There is limited life history information for steelhead in this DPS.

Table 125. Temporal distribution of Steelhead, South-Central California Coast DPS in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)	Present											
Spawning		Present										
Incubation (eggs)		Present										
Emergence (alevin to fry phases)				Present								
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance / Productivity. The data summarized in this status review indicate small (generally <10 adult spawners) but surprisingly persistent annual runs of anadromous O. mykiss are currently being monitored across a limited but diverse set of basins within the range of this DPS, but interrupted in years when the mouth of the coastal estuaries fail to open to the ocean due to low flows (Williams et al. 2011, Williams et al. 2016).

Genetic Diversity / Distribution. South-Central California Coast (SCCC) steelhead include all naturally spawned steelhead populations below natural and manmade impassable barriers in streams from the Pajaro River (inclusive) to, but not including the Santa Maria River, California. No artificially propagated steelhead populations that reside within the historical geographic range of this DPS are included in this designation. The two largest basins overlapping within the range of this DPS include the inland basins of the Pajaro River and the Salinas River.

Designated Critical Habitat. Critical habitat was designated for this species on September 2, 2005 (70 FR 52488). PBFs considered essential for the conservation of Steelhead, South-Central California Coast DPS are described in Appendix B.

Migration and rearing PBFs are degraded throughout critical habitat by elevated stream temperatures and contaminants from urban and agricultural areas. Estuarine PBF is impacted by most estuaries being breached, removal of structures, and contaminants.

Recovery Goals. See the 2013 recovery plan (NMFS 2013c) for the South-Central California Coast steelhead DPS for complete down-listing/delisting criteria for recovery goals for the species.

6.2.24 Steelhead, Southern California DPS

Table 126. Steelhead, Southern California DPS; overview table

Species	Common Name	DPS	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus mykiss	Steelhead Trout	Southern California Coast	Endangered	2016	2006 71 FR 834	2012	2005 70 FR 52488

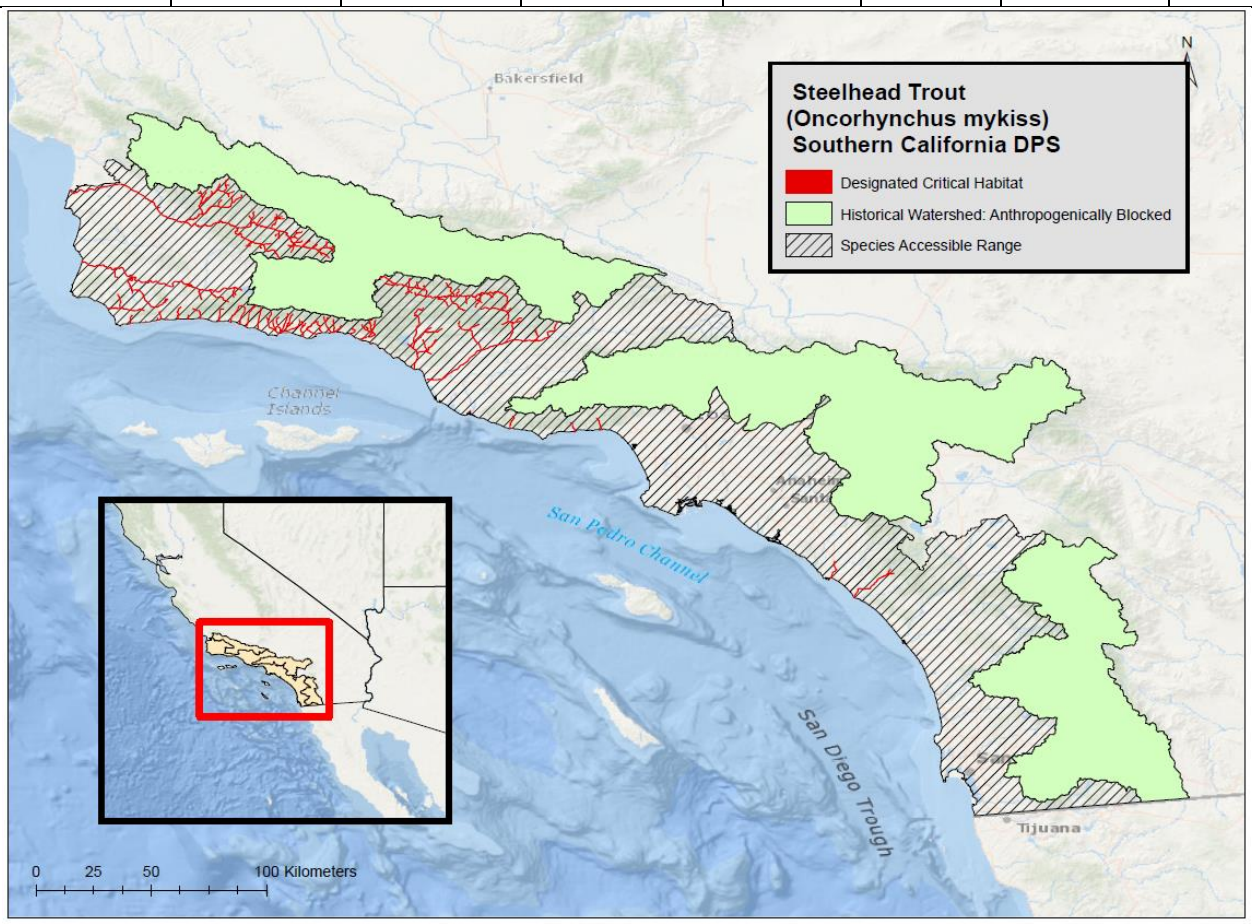


Figure 27. Steelhead, Southern California DPS range and designated critical habitat

Species Description. Steelhead are dark-olive in color, shading to silvery-white on the underside with a speckled body and a pink-red stripe along their sides. Those migrating to the ocean develop a slimmer profile, becoming silvery in color, and typically growing larger than rainbow trout that remain in fresh water. Steelhead trout grow to 55 pounds (25 kg) in weight and 45 inches (120 cm) in length, though the average size is much smaller. On August 18, 1997 NMFS listed the Southern California (SC) DPS of steelhead as endangered (62 FR 43937) and reaffirmed the DPS's status as endangered on January 5, 2006 (71 FR 5248). This DPS includes naturally spawned anadromous *O. mykiss* (steelhead) originating below natural and manmade impassable barriers from the Santa Maria River to the U.S.-Mexico Border.

Status. There is little new evidence to indicate that the status of the Southern California Coast Steelhead DPS has changed appreciably in either direction since the last status review (Williams et al. 2011). The extended drought and the recent genetic data documenting the high level of introgression and extirpation of native *O. mykiss* stocks in the southern portion of the DPS has elevated the threats level to the already endangered populations; the drought, and the lack of comprehensive monitoring, has also limited the ability to fully assess the status of individual populations and the DPS as a whole. The systemic anthropogenic threats identified at the time of the initial listing have remained essentially unchanged over the past five years, though there has been significant progress in removing fish passage barriers in a number of the smaller and mid-sized watersheds. Threats to the Southern California Steelhead DPS posed by environmental variability resulting from projected climate change are likely to exacerbate the factors affecting the continued existence of the DPS.

Life History. There is limited life history information for SC steelhead. In general, migration and life history patterns of SC steelhead populations are dependent on rainfall and streamflow (Moore 1980). Steelhead within this DPS can withstand higher temperatures compared to populations to the north. The relatively warm and productive waters of the Ventura River have resulted in more rapid growth of juvenile steelhead compared to the more northerly populations (Moore 1980).

Table 127. Temporal distribution of Steelhead, Southern California DPS in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)		Present										
Spawning				Present								
Incubation (eggs)				Present								
Emergence (alevin to fry phases)						Present						
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance / Productivity. Limited information exists on SC steelhead runs. Based on combined estimates for the Santa Ynez, Ventura, and Santa Clara rivers, and Malibu Creek, an estimated 32,000 to 46,000 adult steelhead occupied this DPS historically. In contrast, less than 500 adults are estimated to occupy the same four waterways presently. The last estimated run size for steelhead in the Ventura River, which has its headwaters in Los Padres National Forest, is 200 adults (Busby et al. 1996).

Genetic Diversity / Distribution. Limited information is available regarding the structural and genetic diversity of the Southern California steelhead.

Designated Critical Habitat. Critical habitat was designated for this species on September 2, 2005 (70 FR 52630). PBFs considered essential for the conservation of Steelhead, Southern California DPS are described in Appendix B.

All PBFs have been affected by degraded water quality by pollutants from densely populated areas and agriculture within the DPS. Elevated water temperatures impact rearing and juvenile migration

PBFs in all river basins and estuaries. Rearing and spawning PBFs have also been affected throughout the DPS by management or reduction in water quantity. The spawning PBF has also been affected by the combination of erosive geology and land management activities that have resulted in an excessive amount of fines in the spawning gravel of most rivers.

Recovery Goals. See the 2012 recovery plan (NMFS 2012b) for the California Central Valley steelhead DPS for complete down-listing/delisting criteria for recovery goals for the species.

6.2.25 Steelhead, Upper Columbia River DPS

Table 128. Steelhead, Upper Columbia River DPS; overview table

Species	Common Name	DPS	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus mykiss	Steelhead Trout	Upper Columbia River	Threatened	2022	2009 74 FR 42605	2007	2005 70 FR 52630

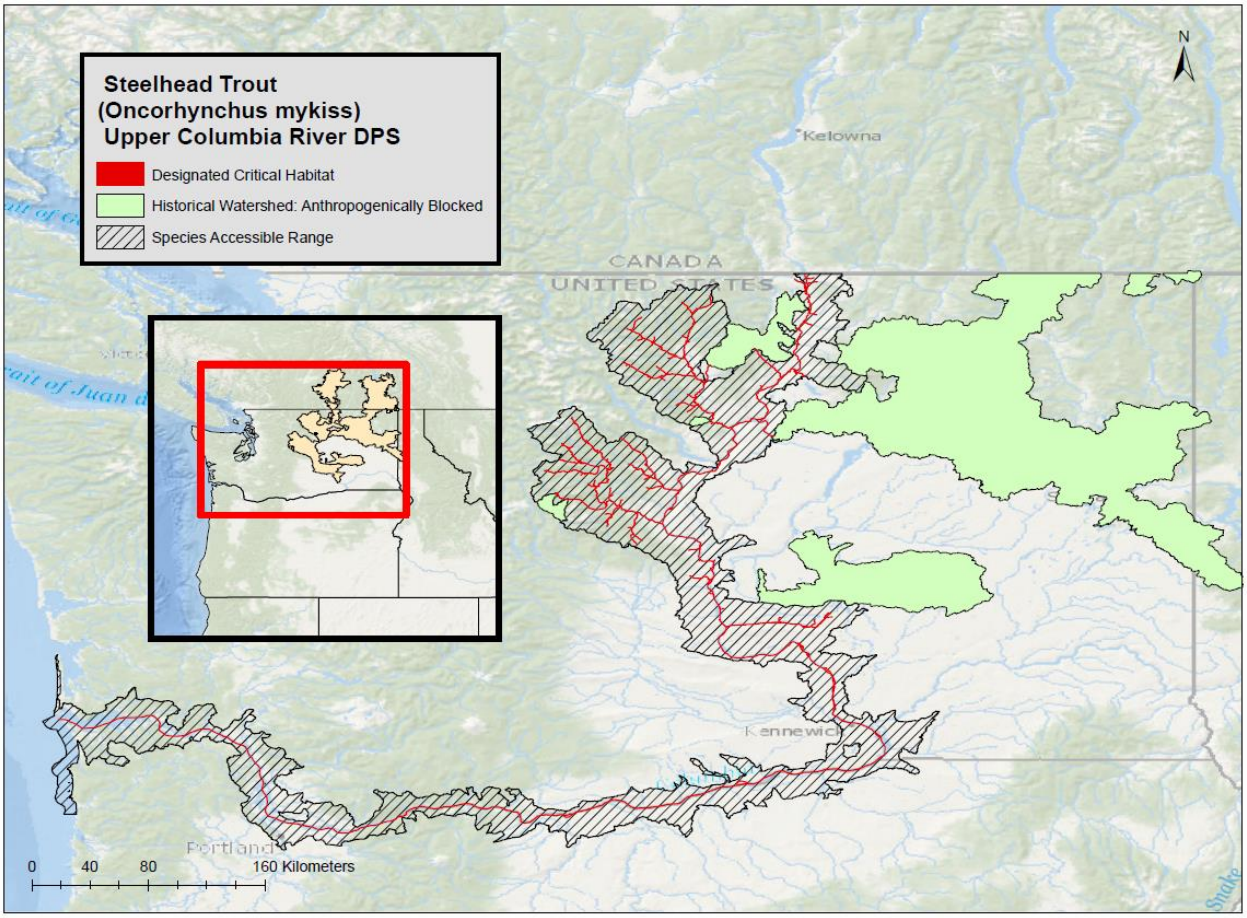


Figure 28. Steelhead, Upper Columbia River DPS range and designated critical habitat

Species Description. Steelhead are dark-olive in color, shading to silvery-white on the underside with a speckled body and a pink-red stripe along their sides. Those migrating to the ocean develop a slimmer profile, becoming silvery in color, and typically growing larger than rainbow trout that remain in fresh water. Steelhead trout grow to 55 pounds (25 kg) in weight and 45 inches (120 cm) in length, though the average size is much smaller. On August 18, 1997 NMFS listed the Upper Columbia River (UCR) DPS of steelhead as endangered (62 FR 43937) and reclassified the DPS's status as threatened on January 5, 2006 (71 FR 833) and this was reaffirmed on August 24, 2009 (74 FR 42605); updated April 14, 2014 (79 FR 20802). The 2022 Status Update found no new information that would justify a change in the delineation of the UCR steelhead DPS (Ford 2022). This DPS includes naturally spawned anadromous *O. mykiss* (steelhead) originating below natural

and manmade impassable barriers from the Columbia River and its tributaries upstream of the Yakima River to the U.S.-Canada border. Also, steelhead from six artificial propagation programs.

Status. The most recent estimates (5-year geometric mean) of total and natural-origin spawner abundance have declined dramatically, erasing gains observed over the past two decades for all four populations (Wenatchee, Entiat, Methow and Okanogan Rivers). Recent declines are persistent and large enough to result in small, but negative, 15-year trends in abundance for all four populations. The abundance and productivity viability rating for the Wenatchee River exceeds the minimum threshold for 5% extinction risk. The overall Upper Columbia River steelhead DPS viability remains largely unchanged from the prior review, and the DPS is at high risk driven by low abundance and productivity relative to viability objectives and diversity concerns. The Northwest Fisheries Science Center's review of updated information (Ford 2022) does not indicate a change in the biological risk category for this species since the time of the last 5-year review (NWFSC 2015). Analysis of the ESA section 4(a)(1) factors indicates that the collective risk to the UCR Steelhead's persistence has not changed significantly since our previous 5-year review for the UCR Steelhead DPS.

Life History. All UCR steelhead are summer-run steelhead. Adults return in the late summer and early fall, with most migrating relatively quickly to their natal tributaries. A portion of the returning adult steelhead overwinters in mainstem reservoirs, passing over upper-mid-Columbia dams in April and May of the following year. Spawning occurs in the late spring of the year following river entry. Juvenile steelhead spend one to seven years rearing in fresh water before migrating to sea. Smolt outmigrations are predominantly year class two and three (juveniles), although some of the oldest smolts are reported from this DPS at seven years. Most adult steelhead return to fresh water after one or two years at sea.

Table 129. Temporal distribution of Steelhead, Upper Columbia River DPS in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)	Present											
Spawning			Present									
Incubation (eggs)			Present									
Emergence (alevin to fry phases					Present							
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance. The average 1997 to 2001 return counted through the Priest Rapids fish ladder was approximately 12,900 returning adults. The average for the previous five years (1992 to 1996) was 7,800 returning adult fish. Abundance estimates of returning naturally produced UCR steelhead were based on extrapolations from mainstem dam counts and associated sampling information (Good et al. 2005b). The natural component of the annual steelhead run over Priest Rapids Dam increased from an average of 1,040 (1992-1996), representing about 10% of the total adult count, to 2,200 (1997-2001), representing about 17% of the adult count during this period of time (ICTRT 2003). Adult abundances for the Wenatchee and Entiat aggregate population and the Methow

population were low with a 5-year geometric mean (1997 to 2001) of approximately 900 naturally produced steelhead returned to the Wenatchee and Entiat Rivers (combined).

The most recent estimates (5-year geometric mean) of total and natural-origin spawner abundance have declined dramatically, erasing gains observed over the past two decades for all four populations. Naturally produced spawner 5-year geomean were estimated at 554, 92, 595, and 223 for the Wenatchee, Entiat, Methow, and Okanogan Rivers, respectively. Recent declines are persistent and large enough to result in small, but negative, 15-year trends in abundance for all four populations. Updated spawner estimation methods show a strong concordance with existing methods, which is extremely encouraging as the estimation process based on detecting tags from a run-at-large tagging program is a very robust approach to monitoring across the DPS.

Hatchery-origin returns continue to constitute a high fraction of total spawners in natural spawning areas for this DPS. The estimated proportion of natural-origin spawners has increased consistently since the late 1990s for all four populations. Natural-origin proportions were highest in the Wenatchee River (58%). Although increasing, natural-origin proportions in the Methow and Okanogan Rivers remained at low levels.

Productivity / Population Growth Rate. Annual brood-year R/S estimates have been well below replacement in recent years for all four populations. The R/S estimates summarized in Figure 14 are ratios of the estimated natural-origin returns produced from spawners in each brood year, under the assumption that both hatchery- and natural-origin fish contribute to production as parent spawners. All populations are consistently exhibiting natural production rates well below replacement, and natural production has also declined consistently, resulting in an increasing fraction of hatchery fish on the spawning grounds each year.

Genetic Diversity. It was initially determined that all UCR steelhead populations have reduced genetic diversity from homogenization of populations that occurred during the Grand Coulee Fish Maintenance project from 1939-1943, from 1960, and 1981 (Chapman et al. 1994). Genetics samples taken in the 1980s indicate little differentiation within populations in the Upper Columbia River steelhead DPS. More recent studies within the Wenatchee River basin have found differences between samples from the Peshastin River, believed to be relatively isolated from hatchery spawning, and those from other reaches in the basin. This suggests that there may have been a higher level of within- and among-population diversity prior to the advent of major hatchery releases (Seamons et al. 2012).

Distribution. The UCR steelhead consisted of four historical independent populations: the Wenatchee, Entiat, Methow, and Okanogan. All populations are extant. The UCR steelhead must navigate over several dams to access spawning areas. The construction of Grand Coulee Dam in 1939 blocked access to over 50% of the river miles formerly available to UCR steelhead (ICTRT 2003). With the exception of the Okanogan population, the upper Columbia River steelhead populations were rated as low-risk for spatial structure. The high-risk ratings for diversity are largely driven by high levels of hatchery spawners within natural spawning areas, and lack of genetic diversity among the populations. The basic major life-history patterns (summer A-run type, tributary and mainstem spawning/rearing patterns, and the presence of resident populations and

subpopulations) appear to be present. All of the populations were rated at high risk for current genetic characteristics by the ICTRT.

Designated Critical Habitat. Critical habitat was designated for this species on September 2, 2005 (70 FR 52630). PBFs considered essential for the conservation of Steelhead, Upper Columbia River DPS are described in Appendix B.

The current condition of critical habitat designated for the UCR steelhead is moderately degraded. Habitat quality in tributary streams varies from excellent in wilderness and roadless areas to poor in areas subject to heavy agricultural and urban development. Critical habitat is affected by reduced quality of juvenile rearing and migration PBFs within many watersheds; contaminants from agriculture affect both water quality and food production in several watersheds and in the mainstem Columbia River. Several dams affect adult migration PBF by obstructing the migration corridor.

Recovery Goals. See the 2007 recovery plan (Upper Columbia Salmon Recovery Board 2007) for the Upper Columbia River steelhead DPS for complete down-listing/delisting criteria for recovery goals for the species.

6.2.26 Steelhead, Upper Willamette River DPS

Table 130. Steelhead, Upper Willamette River DPS; overview table

Species	Common Name	DPS	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Oncorhynchus mykiss	Steelhead Trout	California Central Valley	Threatened	2022	2006 71 FR 834	2011	70 FR 52630

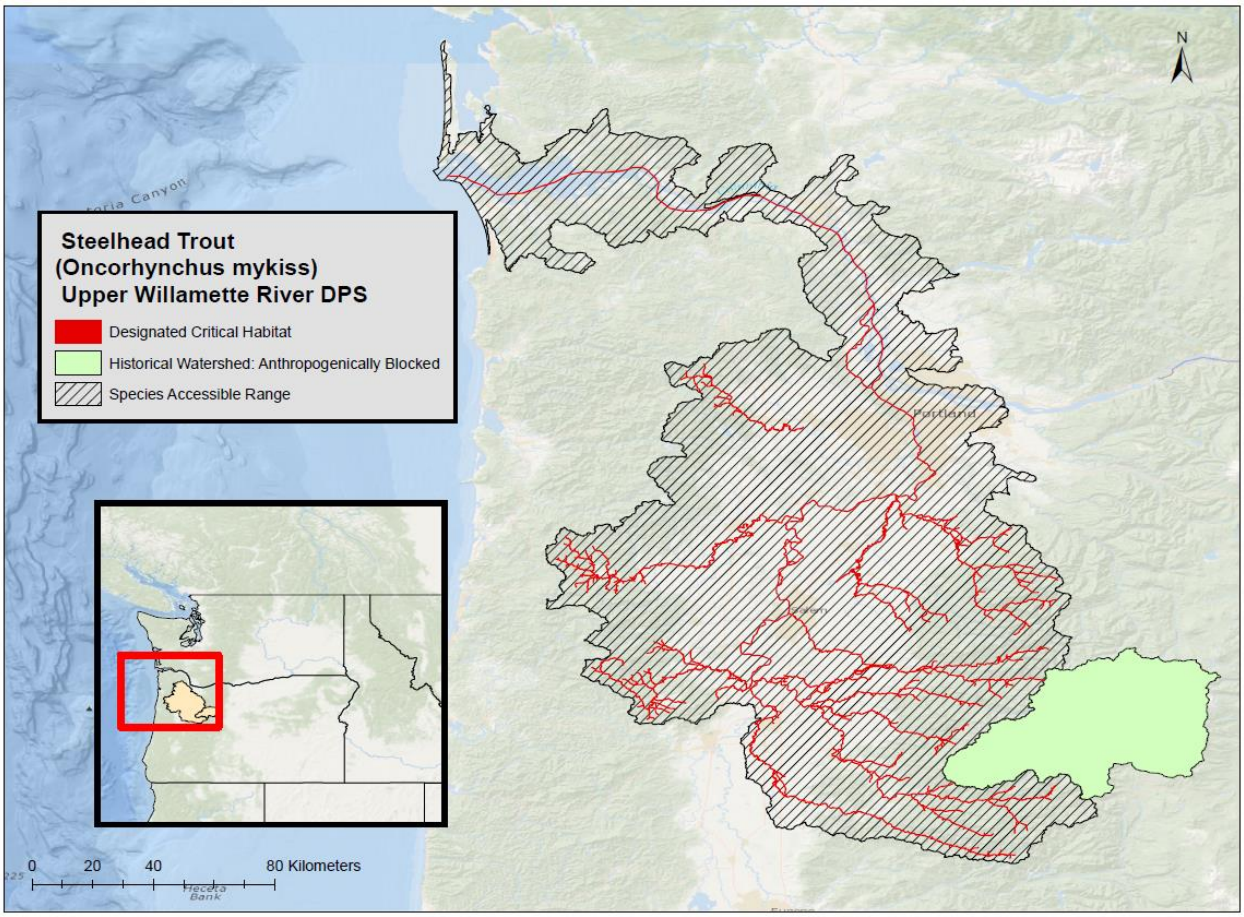


Figure 29. Steelhead, Upper Willamette River DPS range and designated critical habitat

Species Description. Steelhead are dark-olive in color, shading to silvery-white on the underside with a speckled body and a pink-red stripe along their sides. Those migrating to the ocean develop a slimmer profile, becoming silvery in color, and typically growing larger than rainbow trout that remain in fresh water. Steelhead trout grow to 55 pounds (25 kg) in weight and 45 inches (120 cm) in length, though the average size is much smaller. On March 25, 1999 NMFS listed the Upper Willamette River (UWR) DPS of steelhead as threatened (64 FR 14517) and reaffirmed the DPS's status as threatened on January 5, 2006 (71 FR 834). This DPS includes naturally spawned anadromous winter-run *O. mykiss* (steelhead) originating below natural and manmade impassable barriers from the Willamette River and its tributaries upstream of Willamette Falls to and including the Calapooia River.

Status. Four basins on the east side of the Willamette River historically supported independent populations for the UWR steelhead, all of which remain extant. Data reported in McElhaney et al. (2007) indicate that currently the two largest populations within the DPS are the Santiam River populations. Mean spawner abundance in both the North and South Santiam River is about 2,100 native winter-run steelhead. However, about 30% of all habitat has been lost due to human activities (McElhany et al. 2007a). The North Santiam population has been substantially affected by the loss of access to the upper North Santiam basin. The South Santiam subbasin has lost habitat behind non-passable dams in the Quartzville Creek watershed. Notwithstanding the lost spawning habitat, the DPS continues to be spatially well distributed, occupying each of the four major subbasins.

Overall, the Upper Willamette River steelhead DPS continued to decline in abundance. Although the most recent counts at Willamette Falls and the Bennett Dams in 2019 and 2020 suggest a rebound from the record 2017 lows, it should be noted that current "highs" are equivalent to past lows. Uncertainty in adult counts at Willamette Falls are a concern, given that the counts represent an upper bound on DPS abundance. Radio-tagging studies suggest that a considerable proportion of "winter" steelhead ascending Willamette Falls do not enter the tributaries that are considered part of this DPS; these fish may be non-native early-winter steelhead that appear to have colonized the western tributaries, misidentified summer steelhead, late-winter steelhead that have colonized tributaries not historically part of the DPS, or hybrids between native and non-native steelhead. More definitive genetic monitoring of steelhead ascending Willamette Falls, in tandem with radio tagging work, needs to be undertaken to estimate the total abundance of the DPS.

Life History. Native steelhead in the Upper Willamette are a late-migrating winter group that enters fresh water in January and February (Howell et al. 1985). UWR steelhead do not ascend to their spawning areas until late March or April, which is late compared to other West Coast winter steelhead. Spawning occurs from April to June 1. The unusual run timing may be an adaptation for ascending the Willamette Falls, which may have facilitated reproductive isolation of the stock. The smolt migration past Willamette Falls also begins in early April and proceeds into early June, peaking in early- to mid-May (Howell et al. 1985). Smolts generally migrate through the Columbia via the Multnomah Channel rather than the mouth of the Willamette River. As with other coastal steelhead, the majority of juveniles smolt and outmigrate after two years; adults return to their natal rivers to spawn after spending two years in the ocean. Repeat spawners are predominantly female and generally account for less than 10% of the total run size (Busby et al. 1996).

Table 131. Temporal distribution of Steelhead, Upper Willamette River DPS in freshwater habitats

Life History phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Entering Fresh Water (adults/jacks)	Present											
Spawning				Present								
Incubation (eggs)						Present						
Emergence (alevin to fry phases)							Present					
Rearing and migration (juveniles)	Present											

Population Dynamics

Abundance. UWR steelhead are moderately depressed from historical levels (McElhany et al. 2007a). Average number of late-fall steelhead passing Willamette Falls decreased during the 1990s to less than 5,000 spawners. The number again increased to over 10,000 spawners in 2001 and 2002. The geometric and arithmetic mean number of late-run steelhead passing Willamette Falls for the period 1998 to 2001 were 5,819 and 6,795, respectively.

Winter steelhead counts at Willamette Falls provide a complete count of fish returning to the DPS. In the last five years, counts of steelhead at Willamette Falls experienced a marked decrease, with a record low count in 2017 of 822. During the 2016–17 return year, pinniped predation at Willamette Falls became a concern. Increases in the pinniped population at the falls, in conjunction with low steelhead return, resulted in an estimated 25% predation rate on winter steelhead (Steingass et al. 2019). With the initiation of pinniped control measures in 2019 and improvements in the steelhead run size, predation levels fell to an estimated 8% in 2019 (Steingass et al. 2019). Overall, there was a 59% decrease in the geometric average for 2015–19 relative to 2010–14. Abundances at Willamette Falls appear to have recovered since the 2017 low, with a recent (unofficial) count of 5,510 winter-run steelhead.

Productivity / Population Growth Rate. Population information for individual basins exist as redds per (river) mile. These redd counts show a declining long-term trend for all populations (Good et al. 2005b). One population, the Calapooia, had a positive short-term trend during the years from 1990 to 2001. McElhany *et al.* (2007a). While the viability of the ESU appears to be declining, the recent uptick in abundance may provide a short-term demographic buffer. Furthermore, increased monitoring is necessary to provide quantitative verification of sustainability for most of the populations. In the absence of substantial changes in accessibility to high-quality habitat, the DPS will remain at "moderate-to-high" risk. Overall, the Upper Willamette River steelhead DPS is therefore at "moderate-to-high" risk, with a declining viability trend.

Genetic Diversity. Introgression by non-native summer-run steelhead continues to be a concern. Genetic analysis suggests that there is introgression among native late-winter steelhead and summer-run steelhead (Van Doornik et al. 2015, Johnson et al. 2018, 2021).
Distribution. The UWR steelhead DPS includes all naturally spawned winter-run steelhead populations in the Willamette River and its tributaries upstream from Willamette Falls to the Calapooia River (inclusive). The North Santiam and South Santiam rivers are thought to have been major production areas (McElhany et al. 2003) and these populations were designated as "core" and "genetic legacy". The four "east-side" subbasin populations are part of one stratum, the Cascade Tributaries Stratum, for UWR winter steelhead. Accessibility to historical spawning habitat is still limited, especially in the North Santiam River. Efforts to provide juvenile downstream passage at Detroit Dam are well behind the proscribed timetable (NMFS 2008), and passage at Green Peter Dam has not yet entered the planning stage. Much of the accessible habitat in the Molalla, Calapooia, and the lower reaches of the North and South Santiam Rivers is degraded and under continued development pressure. Although habitat restoration efforts are underway, the time scale for restoring functional habitat is considerable. There are no hatchery programs supporting this DPS (Myers et al. 2006). The hatchery summer-run steelhead that are produced and released in the subbasins are from an out-of-basin stock and not considered part of the DPS. Accessibility to historical spawning habitat is still limited, especially in the North Santiam River. Much of the accessible habitat in the Molalla, Calapooia, and lower reaches of North and South Santiam rivers is

degraded and under continued development pressure. Although habitat restoration efforts are underway, the time scale for restoring functional habitat is considerable (NWFSC 2015c).

Designated Critical Habitat. NMFS designated critical habitat for this species on September 2, 2005 (70 FR 52488). PBFs considered essential for the conservation of Steelhead, Upper Willamette River DPS are described in Appendix B.

The current condition of critical habitat designated for the UWR steelhead is degraded, and provides a reduced conservation value necessary for species recovery. Critical habitat is affected by reduced quality of juvenile rearing and migration PBFs within many watersheds; contaminants from agriculture affect both water quality and food production in several watersheds and in the mainstem Columbia River. Several dams affect adult migration PBF by obstructing the migration corridor.

Recovery Goals. See the 2011 recovery plan (NMFS 2011c) for the Upper Willamette River steelhead DPS for complete down-listing/delisting criteria for recovery goals for the species.

6.2.27 Eulachon, Southern DPS

Table 132. Eulachon. Southern DPS; overview table

Species	Common Name	DPS	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Thaleichthys pacificus	Eulachon	Southern	Threatened	2022	2010 75 FR 13012	2017	2011 76 FR 65323

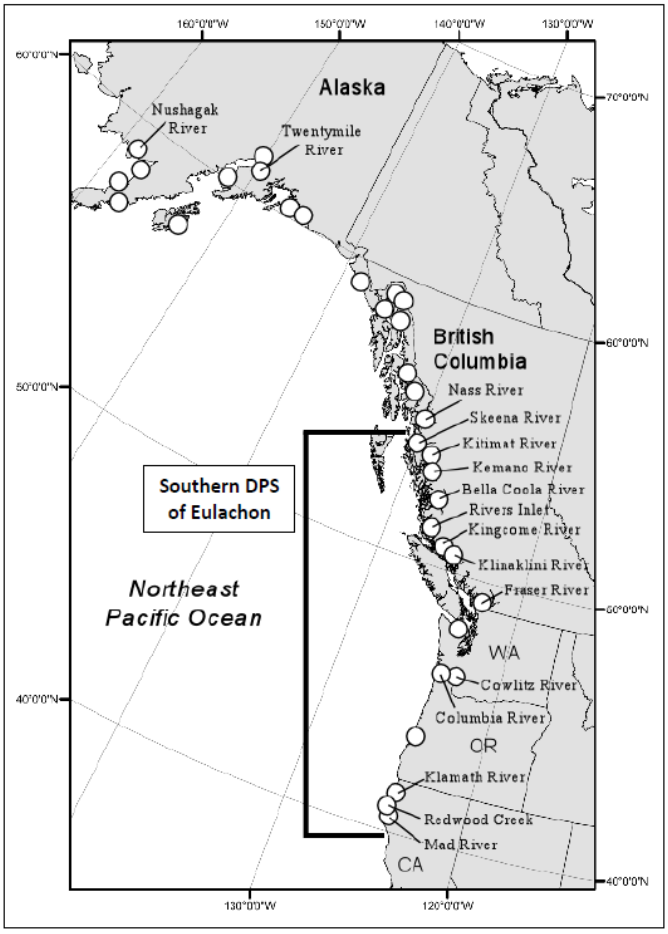


Figure 30. Eulachon, Southern DPS range. From the NMFS 2016 5-Year Review (NMFS 2016).

Species Description. The eulachon is a small, cold-water species of anadromous fish, occupying the eastern Pacific Ocean in nearshore waters to depths of about 1,000 ft (300 m) from California to the Bering Sea. Eulachon will return to their natal river spawn. Southern DPS eulachon are those that spawn in rivers south of the Nass River in British Columbia to the Mad River in California (NMFS 2016b).

Status. Eulachon formerly experienced widespread, abundant runs and have been a staple of Native American diets for centuries along the northwest coast. However, such runs that were formerly present in several California rivers as late as the 1960s and 1970s (i.e., Klamath River, Mad River and Redwood Creek) no longer occur (Larson and Belchik 2000). This decline likely began in the

1970s and continued until, in 1988 and 1989, the last reported sizeable run occurred in the Klamath River and no fish were found in 1996, although a moderate run was noted in 1999 (Larson and Belchik 2000, Moyle 2002b). Eulachon have not been identified in the Mad River and Redwood Creek since the mid-1990s (Moyle 2002b). The species is considered to be at moderate risk of extinction throughout its range because of a variety of factors, including ocean conditions, predation, commercial and recreational fishing pressure (directed and bycatch), water quality, and loss of habitat. Warmer water temperatures associated with climate change could alter the timing of spawning, and the availability of prey for larval and juvenile eulachon (NMFS 2016b). Further population decline is anticipated to continue as a result of climate change and bycatch in commercial fisheries. However, because of their fecundity, eulachon are assumed to have the ability to recover quickly if given the opportunity associated with favorable ocean conditions (Bailey and Houde 1989).

Ocean Conditions. From late 2013 to mid-2017 the California Current Ecosystem (CCE) experienced both a severe marine heat wave (MHW) in the form of the "Blob" (2013–16) and a strong El Niño event (2015– 16). The impact of the "Blob" on eulachon abundance is likely reflected in the 2018 Columbia River SSB estimate of slightly more than four million fish, the lowest since 2010. Eulachon returning to the Columbia River in 2018 were mostly from the broodyears 2015 or 2016, which would have entered the CCE in spring to summer of those years, when both the "Blob" and the strong El Niño of 2015–16 were active. In 2015 and 2016, the biological spring transition never occurred, as northern copepods were absent from surveys along the Newport Hydrographic Line during both years. Euphausiids (commonly called krill), the primary prey of juvenile/adult eulachon, experienced very low densities during 2015–2016, which likely had negative impacts on eulachon growth and survival. Additional MHWs developed in May 2019, and again in 2020 and 2021, although the latter two MHWs mostly stayed offshore and had low impact on the CCE.

The near-term outlook for eulachon productivity in the CCE is positive, based on the presence of good ocean conditions. The current abundance of northern copepods and depressed numbers of southern copepods in the CCE would be expected to result in increased eulachon survival. The return of good ocean conditions and the likelihood that these conditions will persist into the near future suggests that population stabilization or increases may be widespread in the upcoming return years. The productivity potential as indicated by life history characteristics such as low age-at maturity, small body size, planktonic larvae, and perhaps their high fecundity, confers eulachon with some resilience to environmental perturbations, as they retain the ability to quickly respond to favorable ocean conditions.

Montgomery (2020) used a multivariate analyses to look at ocean ecosystem indicators in years when ocean residency is correlated with eulachon abundance in the Columbia River. Large-scale and bottom-up indicators such as the status of the Pacific Decadal Oscillation and prey abundance describe much of the variation in eulachon abundance. The time series analysis also indicates eulachon abundance correlates strongly with ocean conditions in the two and three years prior to their return, suggesting dominant life histories of 2- and 3-year ocean types.

Total fleetwide bycatch in U.S. West Coast groundfish and ocean shrimp trawl fisheries continue to affect productivity of Eulachon. However in recent years the numbers caught in these fisheries have been in decline.

2022 Updated Risk Summary

California
Although the Yurok Tribal Fisheries Program has not conducted any official eulachon surveys since 2014, eulachon have been observed in small numbers (no more than two per night) at the mouth of the Klamath River every year since then (Gustafson et al. 2022).

Oregon/Washington
Since the 2016 5-year status review, annual monitoring of eulachon spawning stock biomass (SSB) has continued in the Columbia (2011–2021) River; and expanded to the Grays (2011–2013, 2015–2016), Cowlitz (2015–2018), Naselle (2015–2017), and Chehalis (2015–2018) Rivers (Gustafson et al. 2022). In 2018, eulachon were 2.4 times more abundant in the Fraser River than in the Columbia River. Although the cause of the decline in Columbia River SSB in 2017–2018 is unknown, it is possibly related to the 2013–2016 MHW, known as the "Blob," that reduced productivity of northern copepods and euphausiids, critical prey for eulachon in the CCE. The Lower Elwha S'klallam Tribe has sampled eulachon adults and/or larvae in the Elwha, Dungeness, and Lyre Rivers on the Olympic Peninsula of Washington.

Columbia River Basin
In the Columbia River, eulachon abundance decreased markedly since the 2016 status review. The decrease in abundance reflects both changes in biological status and changes in ocean conditions. For the years 2011 through 2015, the 5-year SSB mean was 97.9 million spawners. For the years 2016 through 2021, the 6-year SSB mean was 40.2 million spawners. However, the 2021 estimate (96.4 million spawners) was nearly equivalent to the 2011-2015 mean.

Canada
No new information on the status of Klinaklini River eulachon has been located since the 2016 status review (Gustafson et al. 2022); however, there were anecdotal reports that large numbers of eulachon were observed in Kingcome River during 2015–17. Wuikinuxv Nation conducts an annual eulachon monitoring survey on the Wannock, Kilbella and Chckwalla Rivers in Rivers Inlet; however, results have not been released. Anecdotal information indicates that eulachon began to return to the Bella Coola River in 2012 and the run has been slowly building in numbers, such that multiple schools of eulachon were observed in 2018; however, the run was not large enough to support a fishery.

Life History. Eulachon spend 95–98% of their lives at sea (Hay and McCarter 2000) and return to freshwater to spawn. In the portion of the species' range that lies south of the U.S.–Canada border, most eulachon production originates in the Columbia River Basin, including the Columbia River, the Cowlitz River the Grays River, the Kalama River, the Lewis River, and the Sandy River (Gustafson et al. 2010). Spawning usually occurs between ages two and 5. Spawning is strongly influenced by water temperatures and tides, and the timing of migration typically occurs between December and June during high tides, when water temperatures are between 0°C and 10°C

(Gustafson 2016). In the Columbia River and further south, spawning occurs from late January to March (Hay and McCarter 2000). Further north, the peak of eulachon runs in Washington State is from February through March (Hay and McCarter 2000). Females lay between 7,000 and 60,000 eggs over sand, course gravel or detritial substrate. Eggs attach to gravel or sand and incubate for 30 to 40 days after which larvae drift to estuaries and coastal marine waters. Larvae and young juveniles become widely distributed in coastal waters, mostly at depths up to 15 m (Hay and McCarter 2000) but sometimes as deep as 182 m (Barraclough 1964, as cited in Willson et al. 2006). Adult eulachon are found in coastal and offshore marine habitats. With the exception of some individuals in Alaska, eulachon generally die after spawning (Gustafson 2016). The maximum known lifespan is nine years of age, but 20 to 30% of individuals live to four years and most individuals survive to three years of age, although spawning has been noted as early as two years of age. Larval and post larval eulachon prey upon phytoplankton, copepods, copepod eggs, mysids, barnacle larvae, worm larvae, and other eulachon larvae until they reach adult size (WDFW and ODFW 2001). The primary prey of adult eulachon are copepods and euphausiids, malacostracans and cumaceans.

Population Dynamics

Abundance. There are no reliable fishery-independent, historical abundance estimates for eulachon. Spawning stock biomass estimations of eulachon in the Columbia River for the years 2000 through 2017 have ranged from a low of 783,400 fish in 2005 to a high of 185,965,200 fish in 2013, with an estimated 18,307,100 fish in 2017. Spawning stock biomass estimations of eulachon in the Fraser River for the years 1995 through 2017 have ranged from a low of 109,129 to 146,606 fish in 2010 to a high of 41,709,035 to 56,033,332 fish in 1996, with an estimated 763,330 to 1,026,251 fish in 2017.

Productivity / Population Growth Rate. There is no population growth rate available for Southern DPS eulachon, although some indices show an increasing temporal trend. (Gustafson 2016).

Genetic Diversity. Southern DPS eulachon are genetically distinct from eulachon in the northern parts of its range (i.e., Alaska). Recent genetic analysis indicates that the Southern DPS exhibits a regional population structure, with a 3-population southern Columbia-Fraser group, coming from the Cowlitz, Columbia, and Fraser rivers (Candy et al. 2015, Gustafson 2016). Sutherland et al. (2021) developed an improved genetic baseline of 521 variant single nucleotide polymorphism (SNP) loci, genotyped in 1,989 individuals from 14 populations ranging from southcentral Alaska (Twentymile River) to northern California (Klamath River). Three main groupings were evident: southern rivers (Klamath, Columbia, Cowlitz, Sandy, and Fraser), northern rivers (Kingcome, Klinaklini, Wannock, Bella Coola, Kemano, Skeena, Nass, and Unuk), and the Gulf of Alaska (Twentymile River). These results were similar to those of Candy et al. (2015), and "the general trend of the data was similar between the SNP and microsatellite results, with a large divide between the populations to the south of the Fraser River, inclusive, and the populations to the north of the Fraser River, with Twentymile River as an outgroup" (Sutherland et al. 2021, p. 84–85). Separation of the southern rivers group from northern rivers "had high bootstrap support (>99.99%)" in dendrograms (Sutherland et al. 2021, p. 82). Within the southern grouping, there was some clustering of Columbia River populations together, but the Cowlitz River population grouped into a cluster with Klamath River, and more broadly with the Fraser River rather than with the other

Columbia River populations (Columbia River, Sandy River). Cowlitz River and Klamath River are grouped closely together, and in 87% of trees Cowlitz and Klamath rivers group together without the Fraser River. In general these populations were very similar (e.g., Fraser River versus Columbia River: Fst = 0.0079 Fraser River versus Klamath River: FST = 0.0021, and Klamath River versus Columbia River: Fst = 0.0091 [Sutherland et al. 2021, p. 82].

Within the northern grouping, the Kingcome, Klinaklini, and Bella Coola Rivers "had high genetic similarity with each other (mean Fst = 0.0021)," as did the Kemano and Wannock Rivers (Fst = 0.0043) (Sutherland et al. 2021, p. 82). The Skeena and Nass Rivers "were nearly indistinguishable Fst = 0.0009" and the "Unuk River clustered outside of the north coast and central coast groupings, but still within the larger northern grouping" (Sutherland et al. 2021, p. 82). In the future, this improved genetic baseline will be applied to mixed stock analysis of at-sea sampled eulachon to improve estimates of where eulachon from specific rivers are distributed and which rivers are most impacted from at-sea bycatch risk (Sutherland et al. 2021).

Distribution. Adult and juvenile Southern DPS eulachon can be found in the Pacific Ocean, along the continental shelf, in waters from 50 to 200 m deep (Gustafson 2016). In the portion of the species' range that lies south of the U.S.–Canada border, most eulachon production originates in the Columbia River Basin, including the Columbia River, the Cowlitz River the Grays River, the Kalama River, the Lewis River, and the Sandy River (Gustafson et al. 2010) and sometimes in the Klamath River, California.

Designated Critical Habitat. On October 20, 2011, NMFS designated critical habitat for Southern DPS eulachon (76 FR 65324). Sixteen areas were designated in the states of Washington, Oregon, and California. These areas include: the Mad River, CA, Redwood Creek, CA, Klamath River, CA, Umpqua River/Winchester Bay, OR, Tenmile Creek, OR, Sandy River, OR, Lower Columbia River, OR and WA, Grays River, WA, Skamokawa Creek, WA, Elochoman River, WA, Cowlitz River, WA, Toutle River, WA, Kalama River, WA, Lewis River, WA, Quinault River, WA, and the Elwha River, WA. The designated areas are a combination of freshwater creeks and rivers and their associated estuaries, comprising approximately 539 km (335 mi) of habitat. The physical or biological features essential to the conservation of the DPS include:

- Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation, and with migratory access for adults and juveniles.
- Freshwater and estuarine migration corridors associated with spawning and incubation sites that are free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted.
- Nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival.

Recovery Goals. See the 2017 Recovery Plan (NMFS 2017e)for the Southern DPS eulachon, for complete down listing/delisting criteria for each of their respective recovery goals. The Eulachon Recovery Team identified four recovery objectives: 1) ensure subpopulation viability, 2) conserve spatial structure and temporal distribution patterns, 3) conserve existing genetic and life history

diversity and provide opportunities for interchange of genetic material between and within subpopulations and, 4) eliminate or sufficiently reduce the severity of threats.

6.2.28 Green Sturgeon, Southern DPS

Table 133. Green Sturgeon, Southern DPS; overview table

Species	Common Name	DPS	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Acipenser medirostris	Green Sturgeon	Southern	Threatened	2021	2006 71 FR 17757	2018	2009 74 FR 52299

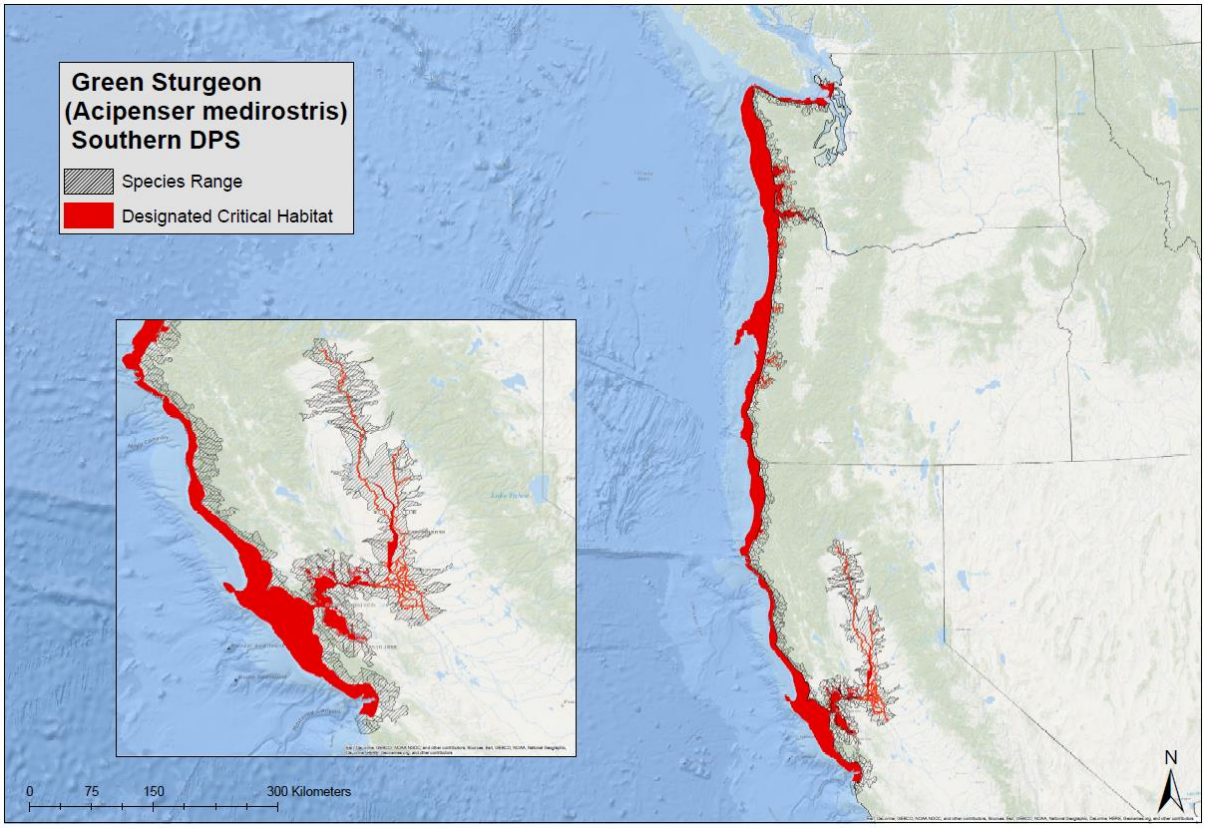


Figure 31. Green Sturgeon, Southern DPS range (within the contiguous US) and designated critical habitat

Species Description. The North American green sturgeon, *Acipenser medirostris*, is an anadromous fish that occurs in the nearshore Eastern Pacific Ocean from Alaska to Mexico (Moyle 2002a). Green sturgeon are long-lived, late-maturing, iteroparous, anadromous species that spawn infrequently in natal streams, and spend substantial portions of their lives in marine waters. Although they are members of the class of bony fishes, the skeleton of sturgeons is composed mostly of cartilage. Sturgeon have five rows of characteristic bony plates on their body (called scutes). Green sturgeon have an olive green to dark green back, a yellowish green-white belly, and a white stripe beneath the lateral scutes (Adams et al. 2002). NMFS has identified two DPS of green sturgeon; northern and southern (Israel et al. 2009). In 2006, NMFS determined that the southern DPS green sturgeon warranted listing as a threatened species under the ESA (71 FR 17757). Green sturgeon have been observed in large concentrations in the summer and autumn within coastal bays and estuaries along the west coast of the US, including the Columbia River estuary, Willapa Bay, Grays Harbor, San Francisco bay and Monterey bay.

Status. Attempts to evaluate the status of southern DPS green sturgeon have been met with limited success due to the lack of reliable long term data, however based on available scientific data (Adams et al. 2007) and ongoing conservation efforts, NMFS concluded in the final rule designating this species that southern DPS green sturgeon were likely to become endangered in the foreseeable future throughout all of its range. The final rule listing Southern DPS green sturgeon indicates that the principle factor for the decline in the DPS is the reduction of spawning to a limited area in the Sacramento River (71 FR 17757). In general, the primary threats to southern DPS green sturgeon are the reduction of potential spawning habitat (most notably by impoundments), water temperature and flow, and commercial and recreational bycatch. Climate change has the potential to impact Southern DPS green sturgeon in the future, but it is unclear how changing oceanic, nearshore and river conditions will affect the Southern DPS overall (NMFS 2015d).

Life History. Green sturgeon reach sexual maturity at approximately 15 years of age (Van Eenennaam et al. 2006), and may spawn every 3-5 years throughout their long lives (Tracy 1990). Southern DPS green sturgeon spawn in cool (14-17ºC), deep, turbulent areas with clean, hard substrates. Spawning occurs primarily in the Sacramento River (Brown 2007, Poytress et al. 2015, Mora et al. 2018). Since 2015, spawning has also been documented in the Feather and Yuba rivers, which are tributaries to the Sacramento River (Seesholtz et al. 2015, Beccio 2018, 2019). Adult Southern DPS green sturgeon enter San Francisco Bay in late winter through early spring, migrate upstream, and spawn from April through early July, with peaks of activity influenced by factors including water flow and temperature (Heublein et al. 2009, Poytress et al. 2015, Miller et al. 2020). Post-spawn fish typically congregate and hold for several months in a few deep pools in the upper mainstem Sacramento River near spawning sites and migrate back downstream when river flows increase in fall. They re-enter the ocean during the winter months (November through January) and begin their marine migration north along the coast (California Fish Tracking Consortium database).

Green sturgeon eggs primarily adhere to gravel or cobble substrates, or settle into crevices (Van Eenennaam et al. 2001, Poytress et al. 2011). Larvae disperse at approximately 12 days post hatch (dph) in the laboratory (Kynard et al. 2005), and are suspected to remain near spawning habitats. It is unknown how long juveniles remain in upriver rearing habitats after metamorphosis. Based on length distribution data from salvage and recent upstream surveys, juveniles typically enter the Delta as sub-yearlings or yearlings to rear prior to ocean entry. The San Francisco Bay Delta Estuary provides year-round rearing habitat for juveniles, as well as foraging habitat for non-spawning adults and subadults in the summer months (NMFS 2009c).
Once at sea, subadults and adults occupy coastal waters to a depth of 110 m from Baja California, Mexico to the Bering Sea, Alaska (Hightower 2007). Seasonal migrations are known to occur. Fish congregate in coastal bays and estuaries of Washington, Oregon, and California during summer and fall. In winter and spring, similar aggregations can be found from Vancouver Island to Hecate Strait, British Columbia, Canada (Lindley et al. 2008)

Green sturgeon are opportunistic feeders that consume a variety of prey items such as insect larvae, oligochaetes, and decapods (NMFS 2009a). In the San Francisco Bay Delta Estuary, juvenile green sturgeon feed on shrimp, amphipods, isopods, clams, annelid worms, and an assortment of crabs and fish (Ganssle 1966; Radtke 1966). Post-spawn adult green sturgeon in freshwater likely feed on benthic prey species (e.g., lamprey ammocoetes, crayfish). In coastal bays and estuaries, adult and

subadult green sturgeon feed on shrimp, clams, crabs, and benthic fish (Moyle et al. 1995; Dumbauld et al. 2008). Nearshore marine prey resources likely include species similar to those of coastal bays and estuaries.

Population Dynamics

Abundance. Mora et al. (2018) estimated the Southern DPS total population size to be 17,548 individuals (95% confidence interval [CI] = 12,614-22,482). The SWFSC recently updated the total population estimate to 17,723 (Dudley 2021).These surveys estimate the abundance of Southern DPS adults at 2,106 individuals (95% CI = 1,246-2,966) (Mora 2016, Mora et al. 2018). A conceptual demographic structure applied to the adult population estimate resulted in a Southern DPS subadult population estimate of 11,055 (95% CI = 6,540-15,571) and juvenile population estimate of 4,387 (95% CI = 2,595-6,179) (Mora et al. 2018).

Productivity / Population Growth Rate. Attempts to evaluate the status of southern DPS green sturgeon have been met with limited success due to the lack of reliable long term data. No estimate of λ is available for southern DPS green sturgeon.

Genetic Diversity. The available genetic data do not change the status of the species or the imminence or magnitude of any threat; data only confirm the DPS structure and add detail to the DPS composition in different estuaries during the sampling periods (NMFS 2015d). Green sturgeon stocks from the DPSs have been found to be genetically differentiated (Israel et al. 2004, Israel et al. 2009).

Distribution. In general, subadult (from the age of ocean entry to age of first spawning) and adult North American green sturgeon occur from Graves Harbor, Alaska to Monterey Bay, California (Moser and Lindley 2007; Lindley et al. 2008, 2011; Schreier et al. 2016). Within this range, green sturgeon have been observed in large concentrations in the summer and autumn within coastal bays and estuaries along the west coast of the US, including the Columbia River estuary, Willapa Bay, Grays Harbor, San Francisco bay and Monterey bay (Moser and Lindley 2007, Lindley et al. 2008, Lindley et al. 2011, Huff et al. 2012).

Designated Critical Habitat. Critical habitat was designated for Southern DPS green sturgeon on October 9, 2009, and includes marine, coastal bay, estuarine, and freshwater areas (74 FR 52300). PBFs considered essential for the conservation of Green Sturgeon, Southern DPS are:

Freshwater areas

- *Food resources.* Abundant prey items for larval, juvenile, subadult, and adult life stages.
- Substrate type or size (i.e., structural features of substrates)
- Water flow. A flow regime (i.e., the magnitude, frequency, duration, seasonality, and rate-of-change of fresh water discharge over time) necessary for normal behavior, growth, and survival of all life stages.
- Water quality. Water quality, including temperature, salinity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages.

- Migratory corridor. A migratory pathway necessary for the safe and timely passage of Southern DPS fish within riverine habitats and between riverine and estuarine habitats (e.g., an unobstructed river or dammed river that still allows for safe and timely passage).
- Water depth. Deep (≥5 m) holding pools for both upstream and downstream holding of adult or subadult fish, with adequate water quality and flow to maintain the physiological needs of the holding adult or subadult fish.
- Sediment quality. Sediment quality (i.e., chemical characteristics) necessary for normal behavior, growth, and viability of all life stages.

Estuarine areas

- Food resources. Abundant prey items within estuarine habitats and substrates for juvenile, subadult, and adult life stages.
- Water flow. Within bays and estuaries adjacent to the Sacramento River (*i.e.*, the Sacramento-San Joaquin Delta and the Suisun, San Pablo, and San Francisco bays), sufficient flow into the bay and estuary to allow adults to successfully orient to the incoming flow and migrate upstream to spawning grounds.
- *Water quality.* Water quality, including temperature, salinity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages.
- Migratory corridor. A migratory pathway necessary for the safe and timely passage of Southern DPS fish within estuarine habitats and between estuarine and riverine or marine habitats.
- Water depth. A diversity of depths necessary for shelter, foraging, and migration of juvenile, subadult, and adult life stages.
- Sediment quality. Sediment quality (i.e., chemical characteristics) necessary for normal behavior, growth, and viability of all life stages. This includes sediments free of elevated levels of contaminants

Coastal Marine Areas

- Migratory corridor. A migratory pathway necessary for the safe and timely passage of Southern DPS fish within marine and between estuarine and marine habitats.
- Water quality. Coastal marine waters with adequate dissolved oxygen levels and acceptably low levels of contaminants (e.g., pesticides, PAHs, heavy metals that may disrupt the normal behavior, growth, and viability of subadult and adult green sturgeon).
- Food resources. Abundant prey items for subadults and adults, which may include benthic invertebrates and fish.

Recovery Goals See the 2018 Recovery Plan (NMFS 2018) for a complete description of recovery goals, objectives and criteria. The five demographic recovery criteria are as follows:

- The adults DPS green sturgeon census population remains at or above 3,000 for three generations. In addition, the effective population size must be at least 500 individuals in any given year and each annual spawning run must be comprised of a combined total, from all spawning locations, of at least 500 adult fish in any given year.
- Southern DPS green sturgeon spawn successfully in at least two rivers within their historical range. Successful spawning will be determined by the annual presence of larvae for at least 20 years.

- A net positive trend in juvenile and subadult abundance is observed over the course of at least 20 years.
- The population is characterized by a broad distribution of size classes representing multiple cohorts that are stable over the long term (20 years or more).
- There is no net loss of DPS green sturgeon diversity from current levels.

6.2.29 Black Abalone

Table 134. Black Abalone; overview table

Species	Common Name	DPS	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Haliotis cracherodii	Abalone, Black	N/A	Endangered	2009	2009 74 FR 1 937	2020	2011 76 FR 66806

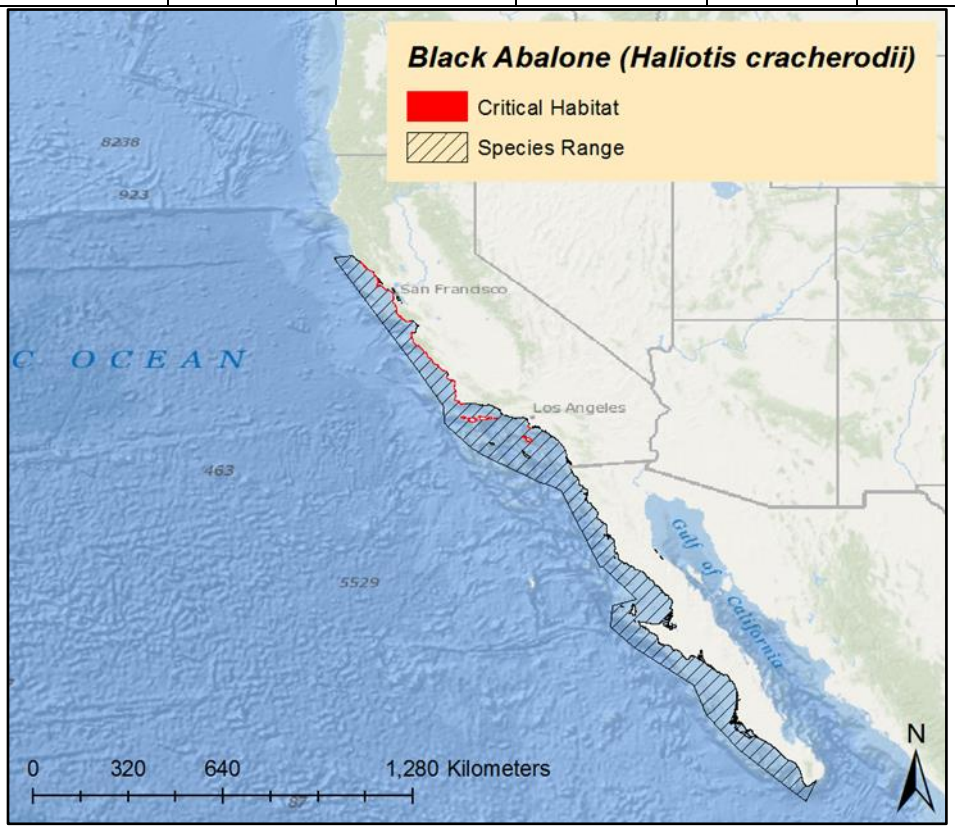


Figure 32. Black Abalone range and designated critical habitat

Species Description. Black abalone is a large marine gastropod mollusk belonging to the taxonomic family of Haliotidae, a group of sea snails with convex spiral structured shells. The majority of experts concur that the present range of black abalone extends from Point Arena (Mendocino County, California) to Northern Baja California. The black abalone is a moderately large aquatic gastropod mollusk found along rocky shorelines and coastal habitats. The majority of experts concur that the present range of black abalone extends from Point Arena (Mendocino County, California) to Northern Baja California. Black abalone are uncommon north of San Francisco (Morris et al. 1980a) and south of Punta Eugenia (P.Raimondi, pers. comm. as cited in Butler et al. 2009) Black abalone, as with all abalone are benthic, occurring on hard substrata, relatively stationary, and are for the most part herbivorous, feeding on attached or floating algal material (Geiger 1999). The mollusk possesses a shell that is smooth, circular, and black to slate blue in colors (Leach 1814 as cited in Butler et al. 2009). There are 5-9 open respiratory pores, known as tremata, that are level with the shell's outer surface. Normally the shell's interior is white

(Haaker et al. 1986), with ill-defined or no muscle scar (Howorth 1978). The muscular foot of the black abalone permits the animal to firmly fasten itself to rocky surfaces without being displaced by wave action. A rolling motion of the foot completes movement for the species as a column of muscle attaches the body to the shell. The epipodium, a sensory structure and extension of the foot which holds lobed tentacles of the same color (Cox 1962), circles the foot and extends beyond the shell of a healthy black abalone. The internal organs are arranged around the foot and under the shell.

Status. Black abalone has experienced substantial decline, which is reflected by the decrease in commercial catches until 1993, when commercial harvests were halted. Historic levels approached 2,200 tons in California in 1879 and declined to around 1,000 tons in the 1970's. Commercial landings then decreased to 19.1 tons in the last year of harvests, when mortality from withering syndrome devastated remaining black abalone stocks throughout southern California (Haaker 1994). Over 20 years, densities of more than 100 individuals per cubic yard disappeared from most of their former range south of Point Conception (Davis 1993). A similar mass mortality was reported at Palos Verdes Peninsula in the late 1950's, where average density decreased from more than 2.8 individuals per square yard from 1975 to 1979 down to about 0.03 individuals per square yard from 1987 to 1991 (Cox 1962). Island habitats experienced more severe trends; 99% of black abalone vanished from Anacapa, Santa Barbara, and Santa Rosa Islands in less than five years (Haaker et al. 1989, Richards and Davis 1993).

Black abalone have also experienced severe declines due to a temperature-related disease called withering syndrome. This bacteria-based disease prevents assimilation of nutrients in the digestive system and results in abalone that “wither” as individuals consume body tissues. The disease was first identified west of Santa Cruz and Anacapa islands in 1985 and 1986 before spreading to Santa Rosa Island and Santa Barbara Island by 1988. The disease made its appearance along the mainland in 1988 in San Luis Obispo county, where 85% of the resident black abalone died in Diablo Cove. This die-off was attributed to the presence of warm-water effluent from a nuclear power facility. From 1988 to the early 1990’s, withering syndrome continued to spread throughout the Channel islands to 2000, when it was estimated that only 1% of the original population remained (Richards 2000).

However, as previously expressed, signs of possible recovery can be seen in recent Channel Island surveys that have demonstrated growth in juvenile abundance (Eckdahl 2015). Nonetheless, issues stemming from previous declines are very much ostensible on several mainland and island sites from Point Conception to San Diego, which show density estimates to be well below the minimum needed for successful recruitment of the species to occur. Densities at island sites ranged from 0.06-0.64/m^2 and mainland sites ranged from 0-0.01/m^2 whereas the estimated minimum density needed is between 0.75-1.1/m^2 (Eckdahl 2015).

Life History. Black abalone have separate sexes and are broadcast spawners. As spawning occurs, gametes are dispersed from the gonads of both parents into the sea and fertilization is entirely external. The embryos and larvae that result from this process are small and unprotected, obtain no parental care or safeguard of any kind, and are exposed to a wide range of physical and biological sources of mortality. The average life expectancy for an abalone that reaches adulthood is 30 years. Adults attain a maximum shell length of approximately 200 mm (indexed by linear measure of the

maximum diameter of the elliptical shell). Female black abalone become sexually mature at a length of about 50 mm, and males at about 40 mm (Ault 1985). Ault (1985) projected that sexually mature female black abalone may discharge over two million unfertilized eggs per spawning episode and are capable of undergoing multiple episodes each spawning season. Black abalone spawning season is between April and September with peak times occurring during the late summer and early autumn (Leighton 2005 as cited in Butler et al. 2009). Black abalone are most commonly observed in the mid to low intertidal, in complex habitats with deep crevices that provide shelter for juvenile recruitment and adult survival.

Population Dynamics

Abundance. Using landings data obtained from the height of the black abalone commercial and recreational fisheries era (1972-1981), Rogers-Bennett et al. (2002) estimated baseline abundance of the species to be approximately 3.54 million animals. Due to significant declines throughout the 20th century as a result of overfishing, habitat loss, and disease (most notably withering syndrome), the abundance of black abalone currently stands as small fraction of historical numbers. Through the analysis of both fishery and fishery-independent long-term monitoring data, identification of substantial declines of black abalone throughout central and southern California have been made. Neuman et al. (2010) states that overall rates of decline exceed 95% for populations of black abalone south of Monterrey County, CA. Recent NOAA surveys off the shores of the South Farallon Islands (coastal islands located 30 miles west of San Francisco) show no current presence of black abalone (Roletto 2015). However, recent surveys on the Channel Islands have shown an increase in juvenile abundance, which may deem positive for recruitment (Eckdahl 2015). Nevertheless, in a recent 2015 survey that explored several mainland and island sites from Point Conception to San Diego, density estimates were well below the minimum density needed for successful recruitment of the species to occur.

Productivity / Population Growth Rate. As stated, population growth rates for black abalone have experienced steep declines since the late 1970s. Butler et al. (2009) states due to the large declines of the species south of Monterrey County, CA it is doubtful that black abalone populations will be able to recover naturally to their former abundance levels, at least in the near future. Furthermore, due the persistent decline of most populations and the continued northward expansion of withering syndrome as a result of warming events (Raimondi et al. 2002), it seems likely that black abalone populations will continue to decline on a large scale.

Genetic Diversity. Neuman et al. (2010) states that black abalone populations exhibit a heterogeneous genetic structure among populations and it is possible that localized genetic diversity has been lost in areas where populations have declined to extremely low abundance levels, rendering extant populations less capable of dealing with both long- and short- term environmental or anthropogenic challenges.

Distribution. As stated in the description of the species, black abalone is found off the Western Coast of the U.S. from Point Arena (Mendocino County, California) to Northern Baja California. Inside this broad geographic range, black abalone mostly inhabits coastal and offshore island intertidal habitats on uncovered rough shores where bedrock offers profound, protective crevice shelter (Leighton 2005 as cited in Butler et al. 2009). Compared to other native species of abalone

found along California and its coastal islands, black abalone bathymetrically inhabits shallower locations situated predominantly in rocky intertidal environments (Morris et al. 1980a). Bathymetry distribution for black abalone ranges from the high intertidal zone (i.e., shoreline) to six m depth, with most animals found in middle and lower intertidal

Designated Critical Habitat. On October 27, 2011, the NMFS designated critical habitat for black abalone. This includes rocky areas from mean high water to six m water depth in the Farallon, Channel, and Año Nuevo islands, as well as the California coastline from Del Mar Ecological Reserve south to Government Point (excluding some stretches, such as in Monterey Bay and between Cayucos and Montaña de Oros State Park) in northern and central California and between the Palos Verdes and Torrance border south to Los Angeles Harbor. PBFs considered essential for the conservation of black abalone are:

- Rocky substrate: Rocky benches, crevices, large boulders
- Food resources: Bacterial and diatom films, algae
- Juvenile settlement habitat: Rocky habitat with coralline algae and/or crevices, cryptic biogenic structures
- Suitable water quality
- Suitable nearshore circulation patterns

Recovery Goals. See the 2020 Recovery Plan (NMFS 2020) for complete details on recovery goals and criteria. The following are the two general recovery objectives: 1) Increase the abundance, productivity, spatial structure, and diversity of black abalone populations to levels that support the species' long-term survival, viability, and resilience to threats; and 2) Sufficiently address the threats of concern.

6.2.30 Sunflower Sea Star

Table 135 Sunflower Sea Star; overview table

Species	Common Name	DPS	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Pycnopodia helianthoides	Sunflower Sea Star	All	Proposed Threatened	2023	2023 88 FR 16212 (Proposed)	NA	NA



Figure 33. Six potentially significant portions of the range of the Sunflower Sea Star identified in the 2022 Status Review Report (Lowry et al. 2022).

Species Description Potentially significant portions of the range of the Sunflower Sea Star are shown in Figure 33. The sunflower sea star, or *Pycnopodia helianthoides,* is an Echinoderm and is among the largest sea stars in the world, reaching over one m in total diameter from ray tip to ray tip across the central disk. *P. helianthoides* is characterized by having 15-24 rays. Its closest relative, *Lysastrosoma anthosticta*, has only five rays and reaches a much smaller maximum size. Very young *P. helianthoides* generally have less than a dozen rays, and additional rays are added by budding in symmetrical pairs as the individual grows.

Other sea stars in the northern Pacific Ocean with many rays include several sun stars of the genera *Solaster*, *Crossaster*, and *Rathbunaster*, but these species generally have 8–17 rays, as opposed to

the 20 or more rays commonly found in *P. helianthoides*, and all of the sun stars are considerably smaller and less massive than *Pycnopodia*. In describing *P. helianthoides*, (Fisher 1928) said: "When under "full sail," with its thousands of tube-feet lashing back and forth, it is an impressive animal, and its numerous cushions of tenacious pedicellariae and the wide expanse of its flexible body make it a formidable engine of destruction." Based on long-standing taxonomic analysis, and lacking any evidence to the contrary, the 2022 Status Review Report (Lowry 2022), had determined that *Pycnopodia helianthoides* represents a unique species as defined by Section three of the ESA.

Status. In 2020, the International Union for Conservation of Nature (IUCN) conducted the first ever status assessment for the sunflower sea star throughout its range (Gravem et al. 2021, Lowry 2022, Lowry et al. 2022). Estimates of population size were based on mean density in various regions and the availability of habitat. Data sources included a variety of stand-alone ecosystem monitoring efforts that regularly encounter sunflower sea stars, many of them SCUBA-based, with several geographic regions having sparse spatiotemporal coverage. The IUCN assessment concluded that the status of the sunflower sea star on a range-wide basis was critically endangered, citing a > 90% loss in overall abundance since 2013, largely as a direct consequence of the sea star wasting syndrome (SSWS) pandemic (Gravem et al. 2021). Additionally, Hamilton et al.(2021) used logistic models (general linear model with binomial errors and logit links) and presence-absence data to estimate the timing and extent of the decline in occurrence among the 12 regions used in the IUSC assessment. Range-wide occurrence declined by 52.3%, with more severe declines of 92.2% in occurrence from Oregon southward to Mexico. Where density data were available, Hamilton et al. (2021) also used zero-inflated generalized linear models (with Poisson errors and log-link) to estimate the change in density among regions and between phases (pre- and post-SSWS). Density declined by 99.2% from Baja California to the Washington coast, while declines were slightly lower (but greater than 87.8%) in regions from British Columbia through the Aleutian Islands.

Prior to 2013, the global abundance of sunflower sea stars was estimated at several billion animals, but from 2013-17 SSWS reached pandemic levels, killing an estimated 90%+ of the population. Impacts varied by region across the range of the species and generally progressed from south to north, though a notable delay occurred off Oregon for unknown reasons. By 2017, the sunflower sea star was rare south of Cape Flattery, WA, in areas where it had long been a conspicuous and ecologically important component of benthic marine ecosystems. Declines in coastal British Columbia and the Aleutian Islands were less pronounced, but still exceeded at least 60%, and more likely 80%. While the root cause of SSWS has not yet been identified, dozens of independent monitoring efforts using SCUBA, benthic trawls, and shellfish pots have documented similar declines in abundance, and sometimes in their spatial distribution, without subsequent recovery. Environmental factors such as temperature and dissolved oxygen likely contributed to the pandemic, and continue to interact with the disease agent to suppress recovery, but studies have failed to document conclusive linkages that apply on broad scales. Complex interactions among stressors, some of which have become more intense as a consequence of anthropogenic climate change, affect both the persistence of individuals and local populations.

Life-History. Little is known about several fundamental biological aspects of the life history and demography of the sunflower sea star. Parameters such as age/size at first maturity, fecundity, longevity, reproductive life span, and individual growth rate have not been validated. Furthermore,

variation in these parameters over time and space, including any systematic differences among regions or habitats, have not been described. While regional asynchrony in SSWS impacts was observed during the pandemic, the degree to which this pattern aligns with population-level differences in genetics, population growth rate, disease susceptibility, and other factors is unknown. Any such relationship is also confounded by the fact that occurrence and abundance data have been collected independently using an array of methods over different timespans and seasons, resulting in a patchwork of information that is incomplete and not intended to provide information on these parameters.

Typically, sea stars with planktotrophic larval development from the temperate nearshore Northwest Pacific Ocean spawn in late winter or early spring, which serves to provide the best growing conditions for their offspring by synchronizing the presence of their obligate plankton-feeding larvae with the peak of the spring phytoplankton bloom (Menge 1975, Strathmann 1987). The spawning seasons of several other asteriid sea stars with planktotrophic larval development in the Pacific Northwest and on the U.S. West Coast, including *Pisaster ochraceus* (Brandt), *Pisaster brevispinus* (Stimpson), *Pisaster giganteus* (Stimpson), *Evasterias troschelii* (Stimpson), and *Orthasterias koehleri* (deLoriol), occurs between March and August ((Mortensen and Mortensen 1921, Farmanfarmaian et al. 1958, Mauzey 1966, Fraser et al. 1981, Pearse and Eernisse 1982, Strathmann 1987, Pearse et al. 1988, Sanford and Menge 2007). Planktotrophic larvae of the sunflower sea star developing during winter (November to February) in the Northeast Pacific Ocean would be at a distinct disadvantage due to the scarcity of planktonic algae at that time of year. Sea stars may modify their behavior during spawning in ways that improve the chances of egg fertilization, including aggregating, modifying their positions and postures, and spawning synchronously (Strathmann 1987, Chia 1991, Dams et al. 2018). However, it is uncertain whether the sunflower sea star does so. Kjerskog-Agersborg (1918) studied sunflower sea star in Puget Sound at Bremerton, Washington, and suggested that individuals migrated to shallower waters during the spawning season and were present in large aggregations at this time of year.(Kjerskog-Agersborg 1918) Kjerskog-Agersborg (1918, p. 246–247) stated:

> Temperature together with the impulse to breed are still other causes for migration…. That *Pycnopodia* should move up to shallow water during the spawning season seems reasonable, for the temperature in deeper waters is undoubtedly lower than at the surface even during the spring. …*Pycnopodia* was found in large numbers on a certain side of a bay, during spring, while it was totally absent from these grounds later on, during the summer. As a matter of fact, during the spring of 1915, on the … [east side of Port Washington Narrows near Bremerton] more than 100 specimens were counted, while in July of the same year not a single specimen was seen in the same area.

A number of other sea stars move into shallow water during the spawning season, supporting that movement into shallow water may be an adaptive behavior that promotes fertilization in some way (Babcock et al. 2000). Greer (1962) reported that time from fertilization to metamorphosis for larvae from the San Juan Islands, Washington, ranged from 60-70 days when reared at 10-12°C. After fertilization, the embryos quickly develop into swimming, bilateral larvae that progress through the typical echinoderm larval phases of prism, bipinnaria, and pluteus larvae (Morris et al. 1980b).

Larvae of sea stars are capable of regenerating lost body parts much like adults (Vickery and McClintock 2000, Vickery et al. 2002, Allen et al. 2018a) and may also reproduce asexually through the process of larval cloning—budding off of tissue fragments that regenerate into complete larvae (Bosch et al. 1989, Jaeckle 1994, Knott et al. 2003). Recently, Hodin et al. (2021) reported that larvae of the sunflower sea star also have the capability to clone in a laboratory setting, describing cloning as "commonplace" in all larval cultures. The degree to which larval sunflower sea stars clone in nature may have profound implications for life history (*e.g.,* fecundity, dispersal distance), population dynamics, and population genetic structure (Knott et al. 2003, Balser 2004, Rogers-Bennett and Rogers 2008, Allen et al. 2018a, Allen et al. 2019).

Sunflower sea stars are voracious predators, consuming a wide array of benthic species, and can influence ecosystem structure by virtue of their predatory habits. They prey especially on sea urchins, which consume kelp and other marine vegetation that provide habitat for many nearshore species, sometimes during crucial life stages. Kelp forests have also disappeared from parts of California where the sunflower sea star has severely declined.

Population Dynamics

To understand the population dynamics of *P. helianthoides* on a range-wide basis it is crucial to develop an understanding of larval longevity and capacity for dispersal. Time from egg fertilization to metamorphosis for *P. helianthoides* under various conditions has been described as 49-77 days (Hodin et al. 2021), 60-70 days (Greer 1962), and 90-146 days (Strathmann 1978). As noted by Gravem et al. (2021), broadcast spawning with a long pelagic larval duration has the potential for broad larval dispersal, especially in open coastal areas with few geographic barriers. Along more heterogeneous, complex shorelines like those found inside the Salish Sea or Southeast Alaska, complex flow patterns may result in localized entrainment of larval and reduce dispersal capacity.

Abundance As part of the IUCN status assessment process, Gravem et al. (2021) contacted a broad array of government, non-government, academic, and private data holders engaged in both direct and indirect monitoring of *P. helianthoides* occurrence, abundance, density, and habitat use throughout the range of the species. After careful evaluation of the temporal span, accuracy, taxonomic resolution, and verifiability of this suite of data sources, they identified 31 data sets that met minimum criteria for use in describing abundance trends over time (Table 136).

Table 136. Summarized estimates of population growth rate, annual rate of change, percent decline since 2013 for the West Coast region from four models (2022 Status Review Report (Lowry et al. 2022).

Region	Model	U1	Pre-2013 annual %	U2	Post-2013 annual %	% decline since 2013
Alaska	Best-fit w/NA	-0.210	-19.0	-2.475	-91.6	100.0
	Best-fit w/min	-0.069	-6.6	-1.447	-76.5	100.0
	AK only w/NA	0.207	23.0	-0.182	-16.7	80.6
	AK only w/min	0.374	45.3	-1.017	-63.8	100.0
BC & SS	Best-fit w/NA	0.090	9.4	-0.151	-14.1	74.4
	Best-fit w/min	0.129	13.8	-0.384	-31.9	96.8
	BC only w/NA	0.005	0.5	-0.142	-13.2	72.0
	BC only w/min	-0.017	-1.7	-0.271	-23.7	91.3
West Coast	Best-fit w/NA	0.017	1.7	-0.299	-25.8	93.2
	Best-fit w/min	-0.021	-2.1	-0.246	-21.8	89.1
	WC w/NA	0.056	5.8	-0.465	-37.2	98.5
	WC w/min	0.013	1.3	-0.260	-22.9	90.3

*The best-fit modes included data for the entire range with zeros replaced either by NAs or by minimum values (see Appendix A of the **2022 Status Review Report**). Regional-only models contain only data for that region. Best-fit w/NA is the top model from the primary model comparison. U1 = pre-2013 growth rate, U2 = post-2013 growth rate.*

Productivity / Population Growth Rate / Genetic Diversity. Little is known about the natural productivity of the sunflower sea star on both an individual and population basis. Lack of information about growth rate, longevity, age at maturity, fecundity, natural mortality, the influence of larval cloning, and other fundamental biological attributes require that broad assumptions be applied and proxy species used to inform estimates on both regional and range-wide bases. Regardless of the values of nearly all of these parameters, the loss of ~90% of the global population of sunflower sea stars from 2013-17 is likely to have had profound impacts on population-level productivity. The standing crop of individuals capable of generating new recruits has been decreased, possibly to levels where productivity will be compromised on a regional or global basis. The combined factors of spatial distribution of individuals across the seascape and ocean conditions are crucial to dictating whether productivity is sufficient to allow population rebound. Broadly dispersed individuals may lack the ability to find mates, further reducing realized productivity despite abundance being high enough to theoretically result in population persistence.

Species-level impacts from SSWS, both during the 2013-17 pandemic and on an ongoing basis, were identified as the major threat affecting the long-term persistence of sunflower sea stars on a global basis. SSWS directly affects abundance, distribution, productivity, and spatial connectivity at a scale that places the sunflower sea star at a moderate risk of extinction throughout its range. Productivity, population growth rate, and phenotypic and genetic diversity may also be affected, but data were not available to directly assess these impacts. Impacts from anthropogenic climate change were also identified as a substantial threat to species persistence, but all other threats were determined to likely have minimal effects on species viability over the next 30 years on a range-wide basis.

Distribution. Sunflower sea stars are native to marine waters along the Pacific Coast, from northern Baja California to the central Aleutian Islands (Figure 33). Although they can live in waters ranging from a few feet deep to greater than 1,400 ft deep, these sea stars are generally encountered in waters shallower than 120 ft in depth. This species has no clear associations with specific habitats and is considered a habitat generalist (Gravem et al. 2021). The large geographic and depth range of the sunflower sea star indicates this species is well adapted for a wide variety of environmental conditions and habitat types. They are found along the outer coasts and inside waters, which have complex geophysical features including glacial fjords, sounds, embayments, and tidewater glaciers. Preferring temperate waters, they inhabit kelp forests and rocky intertidal shoals (Hodin et al. 2021), but are regularly found in eelgrass meadows as well (Dean and Jewett 2001, Gravem et al. 2021). Sunflower sea stars occupy a wide range of benthic substrates including mud, sand, shell, gravel, and rocky bottoms while roaming in search of prey (Lambert 2000, Konar et al. 2019). They dwell in the low intertidal and subtidal zones to a depth of 435 m (1,427 ft) but are most common at depths less than 25 m (82 ft) and rare in waters deeper than 120 m (394 ft) (Fisher 1928, Lambert 2000, Gravem et al. 2021).

Designated Critical Habitat. None designated.

Recovery Goals. A Recovery Plan has not been developed.

7 ENVIRONMENTAL BASELINE

Environmental baseline refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. 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. The impacts to listed species or designated critical habitat from Federal agency activities or existing Federal agency facilities that are not within the agency's discretion to modify are part of the environmental baseline. (50 C.F.R. §402.02)

The BLM manages over two-hundred million acres in the western U.S. and Alaska. Public lands represent from less than 0.1% of the total land area in some western states to over 67% of lands in Nevada. Approximately 164 million acres of public lands are upland rangeland, of which approximately 161 million acres are open to livestock grazing. Other public uses on rangeland include recreation, and oil, gas, and mineral development. Another 55 million acres are forestland and woodland. Forestlands and woodlands are a source of timber and other forest products, and are used for livestock grazing, recreational, and cultural purposes. Wetland and riparian areas total about 23 million acres and are primarily used for recreation and grazing. The remaining 19 million acres consist of barren mountains, mountaintops, glaciers, sand dunes, and playas.

Because our action area and the environmental baseline encompass a very broad spatial scale with many distinct ecosystems, wherever possible we have focused on common indicators of the biological, chemical, and physical health of the nation's aquatic environments. The environmental baseline for this consultation provides the backdrop for evaluating the effects of the action on listed resources under NMFS's jurisdiction.

7.1 Salmonid Habitat

Baseline Habitat Condition.

The BLM administers approximately 12.8 million acres of wetlands. Of these, approximately 12.6 million acres are found in Alaska (USDI BLM 2006d). Riparian and wetland areas comprise approximately 9% of public lands (USDI BLM 2006c). The benefits of these vital areas, however, far exceed their relatively small acreage. The functions of wetland and riparian areas include water purification, stream shading, flood attenuation, shoreline stabilization, groundwater recharge, and habitat for aquatic, semiaquatic, and terrestrial plants and animals (USEPA 2001b). The BLM also administers lands directly affecting almost 155,000 miles of fish-bearing streams and four million acres of reservoirs and natural lakes (USDI BLM 2006d). These habitats range from isolated desert springs of the Southwest to large interior rivers and their numerous tributaries.

As noted in the status of the species section, the riparian zones for many of the ESUs/ DPSs are degraded. Riparian zones are the areas of land adjacent to rivers and streams. These systems serve as the interface between the aquatic and terrestrial environments. Riparian vegetation is

characterized by emergent aquatic plants and species that thrive in close proximity to water, such as willows. This vegetation maintains a healthy river system by reducing erosion, stabilizing main channels, and providing shade. Leaf litter that enters the river becomes an important source of nutrients for invertebrates (Bisson and Bilby 2001). Riparian zones are also the major source of large woody debris (LWD). When trees fall and enter the water, they become an important part of the ecosystem. The LWD alters the flow, creating the pools of slower moving water preferred by salmon (Bilby et al. 2001). While not necessary for pool formation, LWD is associated with around 80% of pools in northern California, Washington, and the Idaho pan-handle (Bilby and Bisson 2001).

Bilby and Bisson (2001) discuss several studies that associate increased LWD with increased pools, and both pools and LWD with salmonid productivity. Their review also includes documented decreases in salmonid productivity following the removal of LWD. Other benefits of LWD include deeper pools, increased sediment retention, and channel stabilization.

Floodplains are relatively flat areas adjacent to streams and rivers that stretch from the banks of the channel to the base of the enclosing valley walls. They allow for the lateral movement of the main channel and provide storage for floodwaters during periods of high flow. The floodplain includes the floodway, which consists of the stream channel, and adjacent areas that actively carry flood flows downstream; and the flood fringe, which are areas that are inundated, but which do not experience a strong current. Water stored in the floodplain is later released during periods of low flow. This process ensures adequate flows for salmonids during the summer months, and reduces the possibility of high-energy flood events destroying salmonid redds (Smith 2005).

Periodic flooding of these areas creates habitat used by salmonids. Thus, floodplain areas vary in depth and widths and may be intermittent or seasonal. Storms also wash sediment and LWD into the main stem river, often resulting in blockages. These blockages may force the water to take an alternate path and result in the formation of side channels and sloughs (Benda et al. 2001), which are important spawning and rearing habitat for salmonids. The degree to which these off-channel habitats are linked to the main channel via surface water connections is referred to as connectivity (PNERC 2002). As river height increases with heavier flows, more side channels form and connectivity increases. Juvenile salmonids migrate to and rear in these channels for a certain period of time before swimming out to the open sea.

Healthy riparian habitat and floodplain connectivity are vital for supporting a salmonid population. Chinook salmon and steelhead have life history strategies that rely on floodplains during their juvenile life stages. Chum salmon use adjacent floodplain areas for spawning. Soon after their emergence, chum salmon use the riverine system to rapidly reach the estuary where they mature, rear, and migrate to the ocean. Coho salmon use the floodplain landscape extensively for rearing. Estuarine floodplains can provide value to juveniles of all species once they reach the salt water interface.

Once floodplain areas have been disturbed, it can take decades for their recovery (Smith 2005). Consequently, most land use practices cause some degree of impairment. Development leads to

construction of levees and dikes, which isolate the mainstem river from the floodplain. Agricultural development and grazing in riparian areas also significantly change the landscape. Riparian areas managed for logging, or logged in the past, are often impaired by a change in species composition. Most areas in the Pacific Northwest were historically dominated by conifers. Logging results in recruitment of deciduous trees, decreasing the quality of LWD in the rivers. Deciduous trees have smaller diameters than conifers; they decompose faster and are more likely to be displaced (Smith 2005).

Without a properly functioning riparian zone, salmonids contend with a number of limiting factors. They face reductions in quantity and quality of both off-channel and pool habitats. Also, when seasonal flows are not moderated, both higher and lower flow conditions exist. Higher flows can displace fish and destroy redds, while lower flows cut off access to parts of their habitat. Finally, decreased vegetation limits the available shade and cover, exposing individuals to higher temperatures and increased predation.

Parasites and/or Disease. Most young fish are highly susceptible to disease during the first two months of life. The cumulative mortality in young animals can reach 90 to 95%. Although fish disease organisms occur naturally in the water, native fish have co-evolved with them. Fish can carry these diseases at less than lethal levels (Kier Associates 1991, Walker and Foott 1993, Foott et al. 2003). However, disease outbreaks may occur when water quality is diminished and fish are stressed from crowding and diminished flows (Spence et al. 1996, Guillen 2003). Young coho salmon or other salmonid species may become stressed and lose their resistance in higher temperatures (Spence et al. 1996). Consequently, diseased fish become more susceptible to predation and are less able to perform essential functions, such as feeding, swimming, and defending territories (McCullough 1999). Examples of parasites and disease for salmonids include whirling disease, infectious hematopoietic necrosis (IHN), sea-lice (e.g., *Lepeophtheirus salmonis*, various *Caligus* species *Henneguya salminicola*, or Ich (*Ichthyopthirius multifiliis)* and Columnaris *(Flavobacterium columnare*)).

Whirling disease is a parasitic infection caused by the microscopic parasite *Myxobolus cerebrali*. Infected fish continually swim in circular motions and eventually expire from exhaustion. The disease occurs in the wild and in hatcheries and results in losses to fry and fingerling salmonids, especially rainbow trout. The disease is transmitted by infected fish, fish parts and birds.

IHN is a viral disease in many wild and farmed salmonid stocks in the Pacific Northwest. Infection results in a variety of conditions including anemia, abnormal behavior, and hemorrhages, often resulting in death. This disease affects rainbow/steelhead trout, cutthroat trout (*Salmo clarki*), brown trout (*Salmo trutta*), Atlantic salmon (*Salmo salar*), and Pacific salmon including Chinook, sockeye, chum, and coho salmon. The virus is triggered by low water temperatures and is shed in the feces, urine, sexual fluids, and external mucus of salmonids. Transmission is mainly from fish to fish, primarily by direct contact and through the water.

Sea lice is a marine ectoparasite found in coastal waters that can also cause deadly infestations of farm-grown salmon and may affect wild salmon. *Henneguya salminicola*, a protozoan parasite, is

commonly found in the flesh of salmonids, particularly in British Columbia. The fish responds by walling off the parasitic infection into a number of cysts that contain milky fluid. This fluid is an accumulation of a large number of parasites. Fish with the longest freshwater residence time as juveniles have the most noticeable infection. The order of prevalence for infection is coho followed by sockeye, Chinook, chum, and pink salmon. The *Henneguya* infestation does not appear to cause disease in the host salmon – even heavily infected fish tend to return to spawn successfully. Additionally, ich (a protozoan) and *Columnaris* (a bacterium) are two common fish diseases that were implicated in the massive kill of adult salmon in the Lower Klamath River in September 2002 (Guillen 2003, Belchik 2004).

Wildland Fire.

The BLM, a leader in wildland fire management, conducts a broad range of actions to protect the public, natural landscapes, wildlife habitat, recreational areas, and other values and resources. The agency's national fire and aviation program, BLM Fire, which focuses on public safety as its top priority, consists of fire suppression, preparedness, predictive services, vegetative fuels management, community assistance and protection, and fire prevention through education. To meet its wildland fire-related challenges, the BLM fields highly trained professional firefighters and managers who are committed to managing fire in the most effective and efficient manner.

As the largest and most complex fire program within the Department of the Interior, BLM Fire is directly responsible for fire management on more than two-hundred million acres. This land is commonly intermixed with other federal, state, and local jurisdictions, making partnerships and collaborative efforts crucial to the mission of safety and fire management. Overall, BLM Fire implements fire protection on approximately 650 million acres of public land with other fire management agencies.

Wildland fires that are allowed to burn naturally in riparian or upland areas may benefit or harm aquatic species, depending on the degree of departure from natural fire regimes. Although most fires are small in size, large size fires increase the chances of adverse effects on aquatic species. Large fires that burn near the shores of streams and rivers can have biologically significant short-term effects. They include increased water temperatures, ash, nutrients, pH, sediment, toxic chemicals, and loss of LWD (Buchwalter et al. 2004, Rinne 2004). Nevertheless, fire is also one of the dominant habitat-forming processes in mountain streams (Bisson et al. 2003). As a result, many large fires burning near streams can result in fish kills with the survivors actively moving downstream to avoid poor water quality conditions (Greswell 1999, Rinne 2004). The patchy, mosaic pattern burned by fires provides a refuge for those fish and invertebrates that leave a burning area or simply spares some fish that were in a different location at the time of the fire (USFS 2000). Small fires or fires that burn entirely in upland areas also cause ash to enter rivers and increase smoke in the atmosphere, contributing to ammonia concentrations in rivers as the smoke adsorbs into the water (Greswell 1999).

The presence of ash also has indirect effects on aquatic species depending on the amount of ash entry into the water. All ESA-listed salmonids rely on macroinvertebrates as a food source for at

least a portion of their life histories. When small amounts of ash enter the water, there are usually no noticeable changes to the macroinvertebrate community or the water quality (Bowman and Minshall 2000). When significant amounts of ash are deposited into rivers, the macroinvertebrate community density and composition may be moderately to drastically reduced for a full year with long-term effects lasting 10 years or more (Minshall et al. 2001, Buchwalter et al. 2003, Buchwalter et al. 2004). Larger fires can also indirectly affect fish by altering water quality. Ash and smoke contribute to elevated ammonium, nitrate, phosphorous, potassium, and pH, which can remain elevated for up to four months after forest fires (Buchwalter et al. 2003).

7.2 Pacific Northwest and Alaska Region

The Pacific Northwest includes all of Washington and parts of California, Idaho, Montana, Nevada, Oregon, Utah, and Wyoming. This region totals roughly 700,000 km^2 of which about 600,000 km^2 is classified as undeveloped, 30,000 km^2 is classified as developed and about 70,000 km^2 is classified as agriculture (Figure 34.)

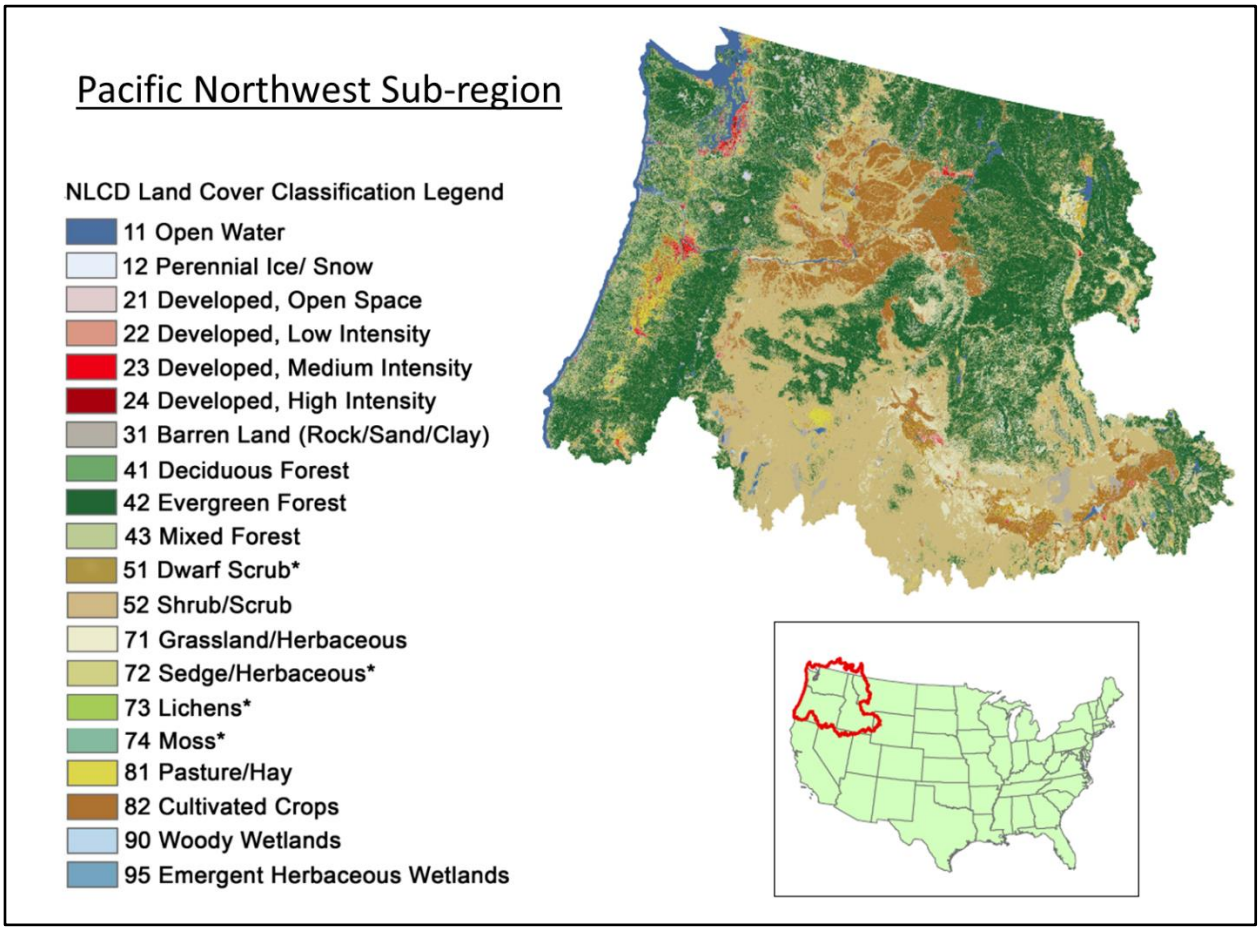


Figure 34. Land use in the Pacific Northwest region. Data from the NLCD (www.mrlc.gov). Twenty-four of the 59 species addressed in the conference and biological opinion occur in this region. They are: bocaccio rockfish, yelloweye rockfish, green sturgeon Southern DPS, chinook salmon (ESUs: Snake River spring/summer-run, Snake River fall-run, Puget Sound, Upper Columbia River spring-run, Lower Columbia River, and Upper Willamette River), chum salmon (ESUs: Columbia River,

and Hood Canal summer-run), coho salmon (ESUs: Oregon coast, Southern Oregon/Northern California coast, Lower Columbia River), sockeye salmon (ESUs: Ozette Lake, and Snake River), steelhead (DPSs: Upper Columbia River, Upper Willamette River, Middle Columbia River, Lower Columbia River, Snake River basin, Puget Sound), southern DPS eulachon, and southern resident killer whale.

In Oregon and Washington, the BLM manages a diverse array of aquatic habitats that support a wide variety of fish and wildlife species. BLM manages unique habitats ranging from temperate rainforests west of the Cascade Mountains to shrub/sage steppe of the high deserts in Eastern Oregon and Washington. These habitats support a wide variety of fish and wildlife species. The diverse fish species range from the iconic salmon and steelhead, to prized rainbow and cutthroat trout.

In Alaska, BLM manages about 72 million acres of federal public lands – including 127,000 miles of stream habitats and three million acres of lake habitats – about 20% of Alaska's streams and 24% of its lakes. At least 33 species of fish live in these waters. BLM's fisheries staffers study these fish habitats and the fisheries reactions to different uses of these lands. Their studies help with managing lands for multiple-use.

BLM fisheries biologists and hydrologists work on restoration projects that address legacy watershed impacts from past land management practices. These practices included removing large wood and boulders from streams, installing culverts that caused barriers to fish migration, or removing all trees down to the water's edge. These practices resulted in unintended negative consequences to fish populations and their habitat. Today, streams and riparian areas are well protected, and these impacts no longer occur on federally managed lands. To correct those legacy impacts, BLM staff routinely add logs, wood, or boulders to strategically slow the river water. Sometimes this requires heavy equipment like excavators, cable yarders, and large helicopters. These structures provide complex habitat where juvenile fish live and thrive. They also trap and store gravels that are important for fish spawning and insect production. BLM has also replaced hundreds of fish-barrier culverts with more "fish friendly" designs to allow all life stages of fish and other aquatic animals to pass freely. BLM aquatic habitat restoration also comes in various other forms. Streamside areas may be revegetated or thinned, or invasive plant species and noxious weeds may be removed. Riparian fences can also be installed to better manage livestock grazing or actions may be taken to reduce sediment impacts from forest roads.

The rivers, streams, wetlands, ponds and lakes on public lands managed by the Bureau of Land Management in Idaho are home to a diverse array of fish. The majority of Idaho is part of the Columbia River basin, with the extreme southeast corner of the state lying within the Bear River watershed which drains into the Great Salt Lake. Elevations within Idaho range from a high of 12,662 ft at the summit of Borah Peak to a low of 710 ft along the Snake River near Lewiston. A significant portion of BLM managed lands are located in the arid landscapes of southern Idaho.

Idaho may be best known for the anadromous fish found in the Snake River and its tributaries. Fall Chinook spawn and rear in the Snake River below Hells Canyon Dam, spring/summer Chinook and

steelhead spawn and rear in rivers and streams in the Salmon River and Clearwater River subbasins. Sockeye salmon migrate through the lower Snake and Salmon Rivers on their way to and from Redfish Lake. The 425-mile Salmon River is the largest tributary of the Snake River and the longest free-flowing river in the lower 48 states.

7.2.1 Water Quality

Impaired baseline water temperature, DO, nutrients, BOD, COD, toxics and other 303(d) impairments (CWA) are significant detriments to the health, diversity, and distribution of aquatic life affecting the survival of native listed species within the action area. Figure 35 and Table 137 depict waterbodies that exceed 303(d) standards and give us insights into which ESUs and DPSs are affected within the Pacific Northwest region.

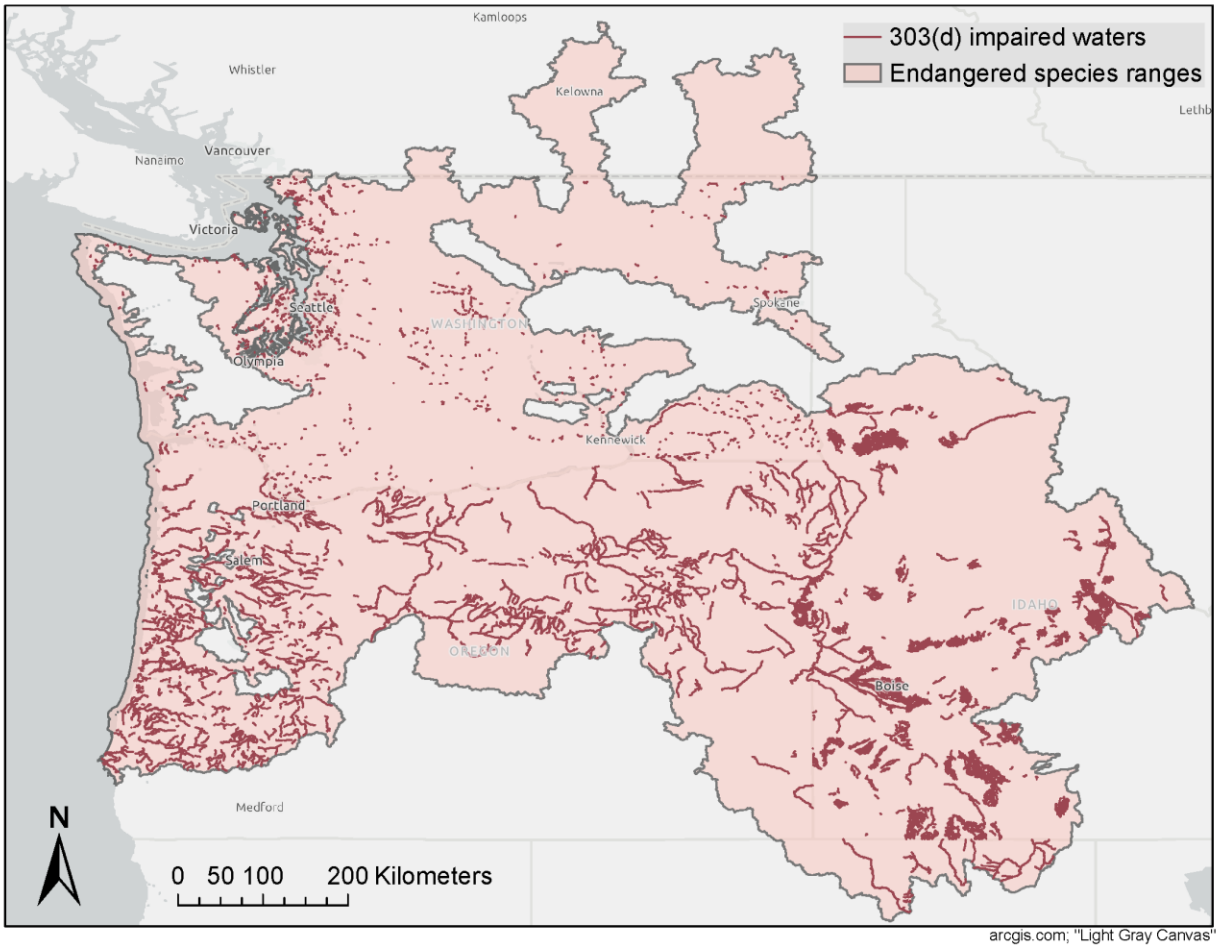


Figure 35. 303(d) impairments within the combined species ranges for the Pacific Northwest region. Data downloaded from USEPA ATTAINS website in September 2022.

Of the total number of km of impaired waterbodies in the Pacific Northwest region, 2.9% were due to background pesticides and 59.5% were due to elevated temperature (Table 137). The background pesticides reported in this region (found via the "Detailed Cause" associated with a "Parent Cause" as defined by USEPA's ATTAINS database) include: 4, 4'-DDD/DDE/DDT, aldrin, alpha-BHC,

chlordane, chlorpyrifos, DDE/DDT, diazinon, dieldrin, endosulfan, guthion (azinphos-methyl), heptachlor, heptachlor epoxide, malathion, and methyl parathion.

Table 137. Number of km of river, stream and estuaries included in ATTAINS 303(d) lists that are located within species ranges in the Pacific Northwest region, along with the percent of impaired waters[1] that each group[2] represents. Data were taken from USEPA ATTAINS website in September 2022.

Group [2]	Parent Causes - as described by 303(d)	Sum of impaired waters (km)	Percent of total km impaired waters [1]
All reasons	NA	24,887.0	NA
Organics	TOTAL	2,351.6	9.4
	Toxic Organics	60.4	0.2
	PCBs	145.3	0.6
	Dioxins	28.5	0.1
	Oil and Grease	560.5	2.3
	Organic Enrichment/Oxygen Depletion	1,556.9	6.3
Inorganics/Metals	TOTAL	2,713.5	10.9
	Toxic Inorganics	8.7	> 0
	Mercury	925.1	3.7
	Metals (other than mercury)	1,779.6	7.2
Nutrients/pathogens/algal growth	TOTAL	6,255.2	25.1
	Ammonia	584.0	2.3
	Nutrients	1,229.8	4.9
	Pathogens	4,168.8	16.8
	Algal Growth	272.6	1.1
	Biotoxins	0.0	0.0
Sediment/Turbidity	TOTAL	5,254.8	21.1
	Turbidity	1,105.4	4.4
	Sediment	4,149.4	16.7
Pesticides	TOTAL	722.8	2.9
	Pesticides	722.8	2.9
Water Quality	TOTAL	831.7	3.3
	Ph/Acidity/Caustic	725.4	2.9
	Salinity/Total Dissolved Solids/Chlorides/ Sulfates	103.7	0.4
	Chlorine	2.7	> 0

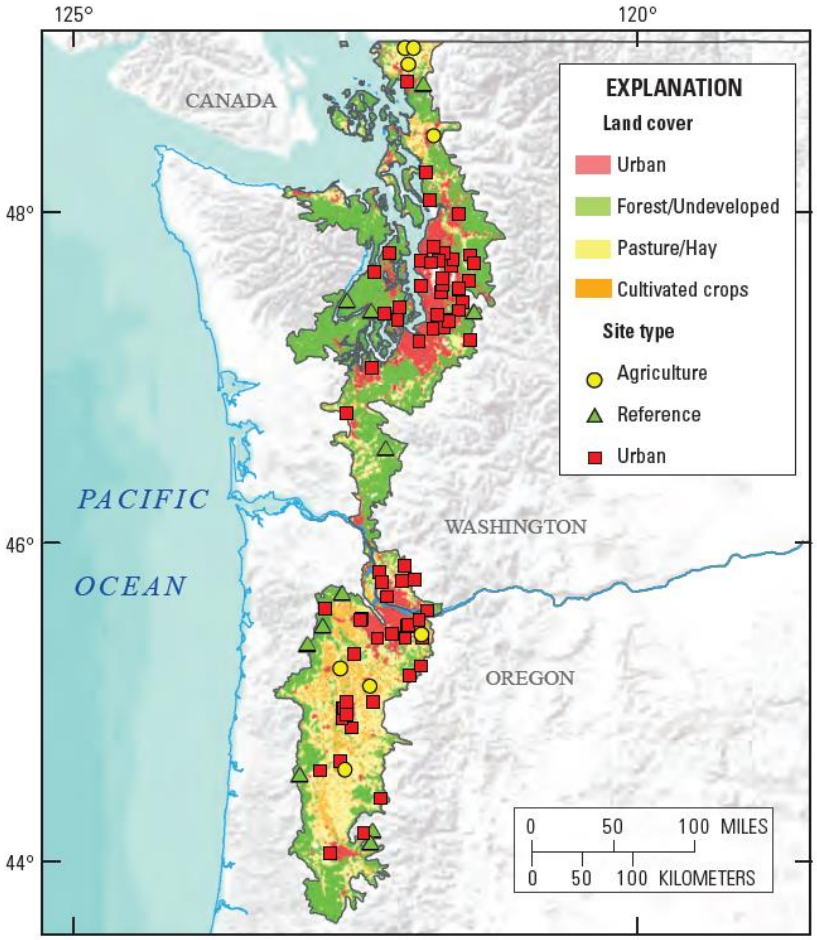
Temperature	TOTAL	14,819.9	59.5
	Temperature	14,819.9	59.5
Other	TOTAL	4,302.5	17.3
	Other Cause	85.3	0.3
	Cause Unknown	846.4	3.4
	Cause Unknown - Impaired Biota	3,365.9	13.5
	Total Toxics	4.9	> 0

1 The percentages may not add up to 100%, because certain water bodies have more than one 303(d) impairment and therefore are accounted for more than once on occasion (i.e., in different "Parent Causes")
2 "Parent Causes", as described by 303(d), were grouped into nine categories and the group totals are shown in bold.

7.2.1.1 USGS NAWQA Regional Stream Quality Assessment

Analysis of surface and ground water contaminants were conducted for a number of basins within the Pacific Northwest Region by the NAWQA program. The USGS has a number of fixed water quality sampling sites throughout various tributaries of the Columbia River. Many of the water quality sampling sites have been in place for decades. Water volumes, crop rotation patterns, crop type, and basin location are some of the variables that influence the distribution and frequency of pesticides within a tributary. Detection frequencies for a particular pesticide can vary widely. In addition to current use-chemicals, legacy chemicals continue to pose a serious problem to water quality and fish communities despite their ban in the 1970s and 1980s (Hinck et al. 2004).

In 2015, the USGS sampled 88 sites as part of the Pacific Northwest Stream Quality Assessment (Figure 36). Water samples were analyzed for about 230 dissolved pesticides and pesticide degradates. Results from the 2015 water quality assessment were considered and are available at https://webapps.usgs.gov/rsqa/#!/region/PNSQA.



Base-map image is the intellectual property of Esri and isused herein under license. Copyright © 2014 Esri and its licensors. All rights reserved. Base modified from Esri digital data, 1:70,000 (Esri, 2009) Land cover from National Land Cover Database, 2006, Web Mercator Projection, World Geodetic System of 1984 (WGS 84)

Figure 36. The Pacific Northwest Stream Quality Assessment study area. Taken from Van Metre et al. (2015): Figure 1: "Study area boundary is based on the Willamette Valley and Puget Lowlands level three ecological regions (ecoregions) of the U.S.."

7.2.2 Habitat Modification

This section briefly describes how anthropogenic land use has altered aquatic habitat conditions for salmonids in the Pacific Northwest Region. Basin wide, critical ecological connectivity (mainstem to tributaries and riparian floodplains) has been disconnected by dams and associated activities such as floodplain deforestation and urbanization. Dams have flooded historical spawning and rearing habitat with the creation of massive water storage reservoirs. More than 55% of the Columbia River Basin that was accessible to salmon and steelhead before 1939 has been blocked by large dams (NWPPC 1986). Construction of the Grand Coulee Dam blocked 1,000 miles (1,609 km) of habitat from migrating salmon and steelhead (Wydoski and Whitney 1979). Similarly, over one third (2,000 km) of coho salmon habitat is no longer accessible (Good et al. 2005b). The mainstem habitats of the lower Columbia and Willamette rivers have been reduced primarily to a single channel. As a result, floodplain area is reduced, off-channel habitat features have been eliminated or disconnected from the main channel, and the amount of LWD in the mainstem has been reduced.

Remaining areas are affected by flow fluctuations associated with reservoir management for power generation, flood control, and irrigation. Overbank flow events, important to habitat diversity, have become rare as a result of controlling peak flows and associated revetments. Portions of the basin are also subject to impacts from cattle grazing and irrigation withdrawals. Consequently, estuary dynamics have changed substantially.

Habitat loss has fragmented habitat and human density increase has created additional loads of pollutants and contaminants within the Columbia River Estuary (Anderson et al. 2007). About 77% of swamps, 57% of marshes, and over 20% of tree cover have been lost to development and industry. Twenty-four threatened and endangered species occur in the estuary, some of which are recovering while others (i.e., Chinook salmon) are not.

Stream habitat degradation in the Columbia Central Plateau is relatively high (Williamson et al. 1998). In the most recent NAWQA survey, a total of 16 sites were evaluated - all of which showed signs of degradation (Williamson et al. 1998). Streams in this area have an average of 20% canopy cover and 70% bank erosion. These factors have severely affected the quality of habitat available to salmonids. The Palouse subunit of the Lower Snake River exceeds temperature levels for the protection of aquatic life (Williamson et al. 1998).

The Willamette Basin Valley has been dramatically changed by modern settlement. The complexity of the mainstem river and extent of riparian forest have both been reduced by 80% (PNERC 2002). About 75% of what was formerly prairie and 60% of what was wetland have been converted to agricultural purposes. These actions, combined with urban development, extensive (96 miles) bank stabilization, and in-river and nearshore gravel mining, have resulted in a loss of floodplain connectivity and off-channel habitat (PNERC 2002).

Much of the estuarine wetlands in Puget Sound 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 also experience increasing effects from industrial and urban causes. By 1980, an estimated 27,180 acres of intertidal or shore wetlands had been lost at 11 deltas in Puget Sound (Bortleson et al. 1980). Tidal wetlands in Puget Sound amount to roughly 18% of their historical extent (Collins and Sheikh 2005). Coastal marshes close to seaports and population centers have been especially vulnerable to conversion with losses of 50 - 90%. By 1980, an estimated 27,180 acres of intertidal or shore wetlands had been lost at 11 deltas in Puget Sound (Bortleson et al. 1980). As of 2005, tidal wetlands in Puget Sound amount to about 17 - 19% of their historical extent (Collins and Sheikh 2005). Coastal marshes close to seaports and population centers have been especially vulnerable to conversion with losses of 50 - 90% common for individual estuaries. Salmon use freshwater and estuarine wetlands for physiological transition to and from salt-water and rearing habitat. The land conversions and losses of Pacific Northwest wetlands constitute a major impact. Salmon use marine nearshore areas for rearing and migration, with juveniles using shallow shoreline habitats (Brennan et al. 2004).

About 800 miles of Puget Sound's shorelines are hardened or dredged (PSAT 2004, 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% of the shoreline has been altered, mostly from shoreline armoring associated with the Burlington Northern Railroad tracks (Ruckelshaus and McClure 2007). 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.

Urbanization has caused direct loss of riparian vegetation and soils and has significantly altered hydrologic and erosion rates. Watershed development and associated urbanization throughout the Puget Sound, Hood Canal, and Strait of Juan de Fuca regions have increased sedimentation, raised water temperatures, decreased LWD recruitment, decreased gravel recruitment, reduced river pools and spawning areas, and dredged and filled estuarine rearing areas (Bishop and Morgan 1996 in (NMFS 2008f)). Large areas of the lower rivers have been channelized and diked for flood control and to protect agricultural, industrial, and residential development.

The principal factor for decline of Puget Sound steelhead is the destruction, modification, and curtailment of its habitat and range. Barriers to fish passage and adverse effects on water quality and quantity resulting from dams, the loss of wetland and riparian habitats, and agricultural and urban development activities have contributed and continue to contribute to the loss and degradation of steelhead habitats in Puget Sound (NMFS 2008f).

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. According to the State of the Sound Report (PSAT 2007), in 2004 more than 1,400 fresh and marine waters in the region were listed as "impaired." Almost two-thirds of these water bodies were listed as impaired due to contaminants, such as toxics, pathogens, and low dissolved oxygen or high temperatures, and less than one-third had established cleanup plans. More than 5,000 acres of submerged lands (primarily in urban areas; 1% of the study area) are contaminated with high levels of toxic substances, including polybrominated diphenyl ethers (PBDEs; flame retardants), and roughly one-third (180,000 acres) of submerged lands within Puget Sound are considered moderately contaminated.

While much of the coastal region is forested, it has still been impacted by land use practices. As of 2000, less than 3% of the Oregon coastal forest was old growth conifers (Gregory 2000). The lack of mature conifers indicates high levels of habitat modification. As such, overall salmonid habitat quality is poor, though it varies by watershed. The amount of remaining high quality habitat ranges from 0% in the Sixes River to 74% in the Siltcoos River (ODFW 2005). Approximately 14% of freshwater winter habitat available to juvenile coho is of high quality. Much of the winter habitat is unsuitable due to high temperatures. For example, 77% of coho salmon habitat in the Umpqua basin exceeds temperature standards.

Reduction in stream complexity is the most significant limiting factor in the Oregon coastal region. An analysis of the Oregon coastal range determined the primary and secondary life cycle

bottlenecks for the 21 populations of coastal coho salmon (Nicholas et al. 2005). Nicholas et al. (2005) determined that stream complexity is either the primary (13) or secondary (7) bottleneck for every population. Stream complexity has been reduced through past practices such as splash damming, removing riparian vegetation, removing LWD, diking tidelands, filling floodplains, and channelizing rivers.

The only listed salmonid population in coastal Washington is the Ozette Lake sockeye. The range of this ESU is small, including only one lake (31 km^2) and 71 km of stream. Like the Oregon Coastal drainages, the Ozette Lake area has been heavily managed for logging. Logging resulted in road building and the removal of LWD, which affected the nearshore ecosystem (NMFS Salmon Recovery Division 2008). LWD along the shore offered both shelter from predators and a barrier to encroaching vegetation (NMFS Salmon Recovery Division 2008). Aerial photograph analysis shows near-shore vegetation has increased significantly over the past 50 years (Ritchie 2005). Further, there is strong evidence that water levels in Ozette Lake have dropped between 1.5 and 3.3 ft from historic levels [Herrera 2005 *in* (NMFS Salmon Recovery Division 2008)]. The impact of this water level drop is unknown. Possible effects include increased desiccation of sockeye redds and loss of spawning habitat. Loss of LWD has also contributed to an increase in silt deposition, which impairs the quality and quantity of spawning habitat. Very little is known about the relative health of the Ozette Lake tributaries and their impact on the sockeye salmon population.

7.3 California Region

7.3.1 Land Use

The California region includes parts of California, Nevada, and Oregon. The region totals roughly 430,000 km^2 of which about 320,000 km^2 is classified as undeveloped, 50,000 km^2 is classified as developed and about 50,000 km^2 is classified as agriculture (Figure 37).

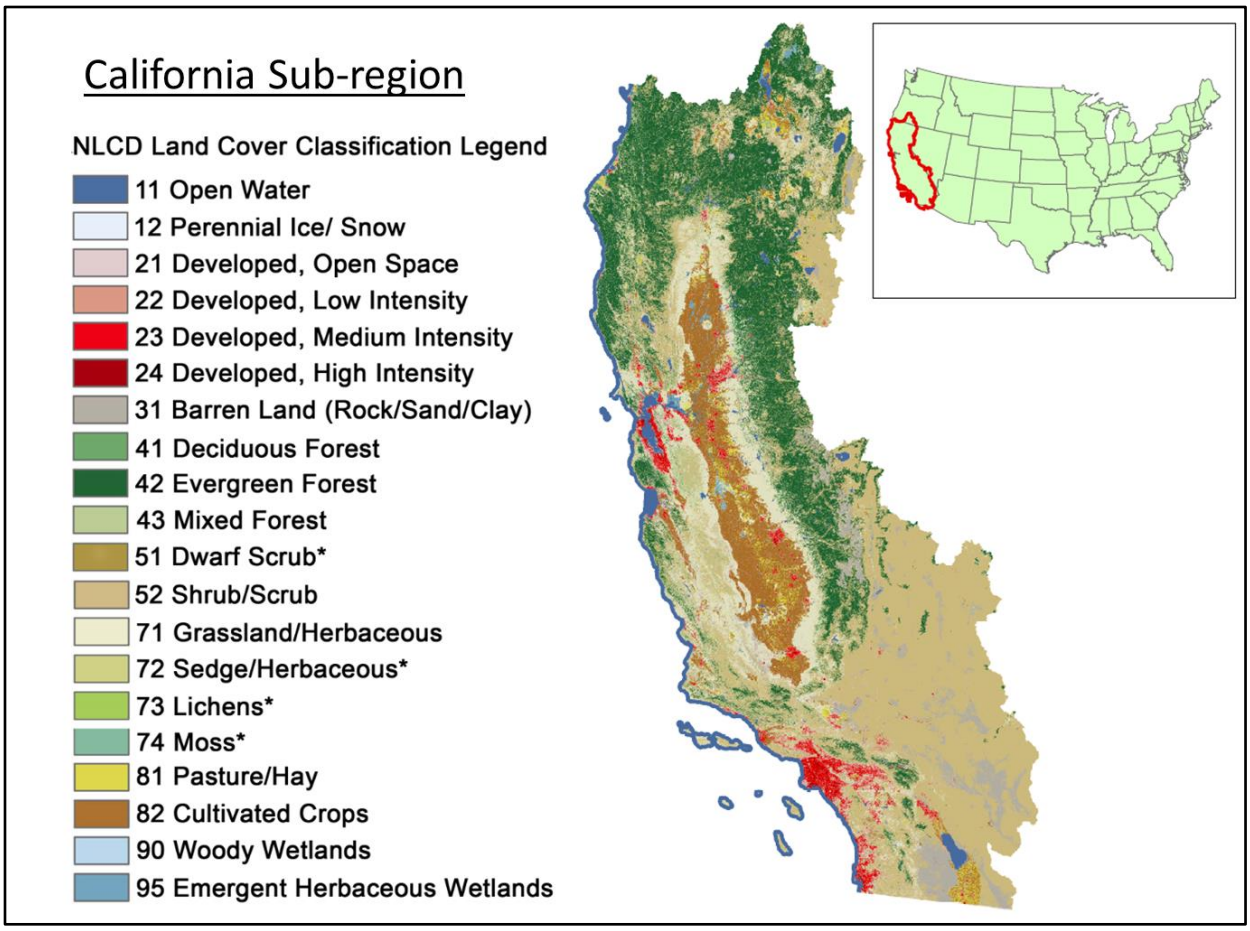


Figure 37. Land use in the California region. Data from the NLCD (www.mrlc.gov).

Fifteen of the 61 species addressed in the opinion occur in this region. They are: Chinook salmon (ESUs: Central Valley spring-run, California coastal, Sacramento River winter-run), coho salmon (ESUs: southern Oregon/northern California coastal, central California coast), steelhead salmon (DPSs: northern California, south-central California coast, central California coast, California Central Valley, southern California), southern DPS eulachon, southern DPS green sturgeon, southern resident killer whale, and black abalone.

In California, BLM's Aquatic Resources Program conserves and restores aquatic resources on BLM-managed lands and ensures that water is available for a combination of balanced and diverse uses. Healthy riparian-wetland areas, fisheries, watersheds, riverscapes, and water supplies provide the resource values and ecosystem services that the BLM needs to achieve the agency's multiple use and sustained yield mandate. BLM's current priorities are to: conserve, restore, and connect riparian, fisheries, and water resources; protect water supplies and uses; prevent the establishment and spread of aquatic invasive species; and foster a watershed approach to improve water quality.

7.3.2 Water Quality

Impaired baseline water temperature, DO, nutrients, BOD, COD, toxics and other 303(d) impairments are significant detriments to the health, diversity, and distribution of aquatic life

affecting the survival of native listed species within the action area. Figure 38 and Table 138 depict water bodies that exceed 303(d) standards and give us insights into which ESUs and DPSs are affected within California.

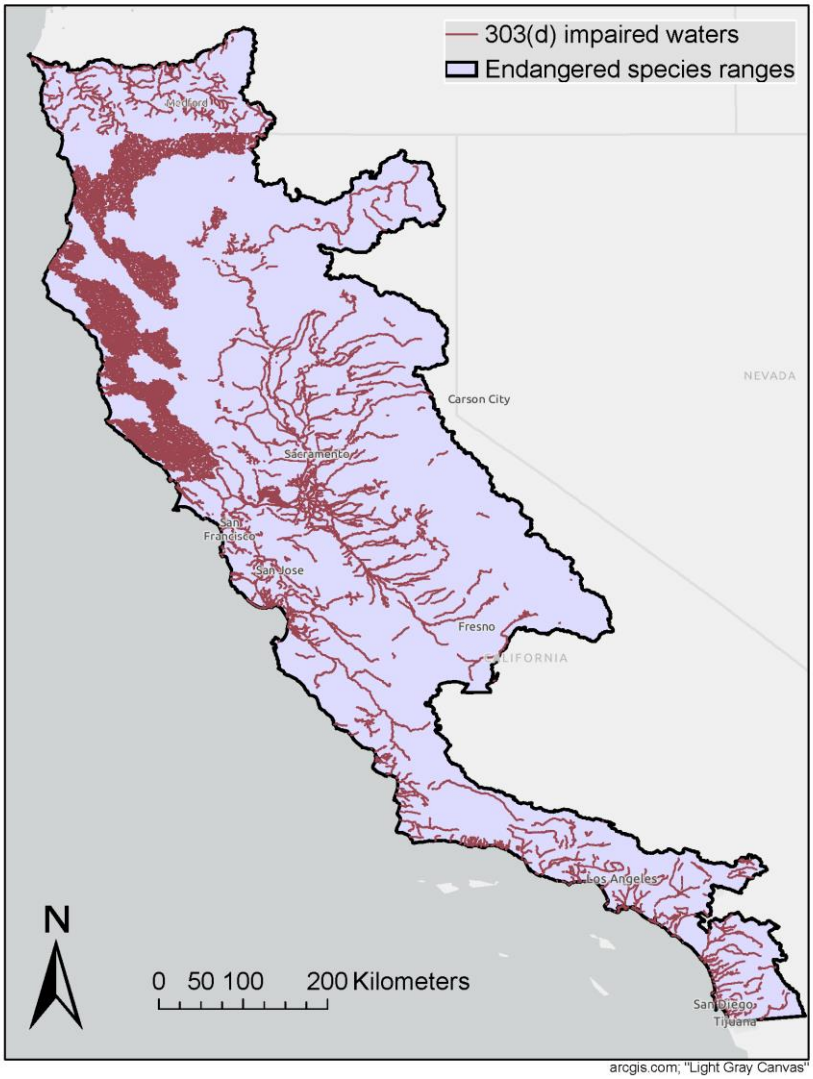


Figure 38. 303(d) impairments within the combined species ranges for the California region. Data downloaded from USEPA ATTAINS website in September 2022.

Of the total number of km of impaired waterbodies in the California region, 41.7% were due to background pesticides and 25.1% were due to elevated temperature (Table 138). The background pesticides found in this region (found via the "Detailed Cause" associated with a "Parent Cause" as defined by USEPA's ATTAINS database) include: 2-methylnaphthalene, aldicarb, alpha-BHS, bifenthrin, carbofuran, chlordane (which also appears in tissue and sediment), chlorpyrifos, DDT, DDE, DDT (which also appears in tissue and sediment), diazinon, dichlorvos, dieldrin (which also appears in tissue and sediment), dimethoate, disulfotron, diuron, endrin, group A pesticides (generally), guthion (azinphos-methyl), heptachlor epoxide, hexachlorobenzene, lindane, malathion,

organophosphorus pesticides (generally), oxyfluorfen, permethrin, pyrethroids, simazine, toxaphene, and trifluralin.

Table 138. Number of km of river, stream and estuaries included in ATTAINS 303(d) lists that are located within species ranges in the California region, along with the percent of impaired waters[1] that each group[2] represents. Data were taken from USEPA ATTAINS website in September 2022.

Group[2]	Parent Causes - as described by 303(d)	Sum of impaired waters (km)	Percent of total km impaired waters [1]
All reasons	**NA**	**35,073.2**	**NA**
Organics	**TOTAL**	**45,017.3**	**128.4**
	Toxic Organics	430.9	1.2
	PCBs	2,709.0	7.7
	Dioxins	1,460.6	4.2
	Oil and Grease	37.6	0.1
	Organic Enrichment/Oxygen Depletion	40,379.2	115.1
Inorganics/Metals	**TOTAL**	**19,822.6**	**56.5**
	Toxic Inorganics	2,826.1	8.1
	Mercury	7,640.6	21.8
	Metals (other than mercury)	9,355.9	26.7
Nutrients/pathogens/algal growth	**TOTAL**	**82,140.2**	**234.2**
	Ammonia	750.6	2.1
	Nutrients	36,055.4	102.8
	Pathogens	16,139.5	46.0
	Algal Growth	3,507.1	10.0
	Biotoxins	25,687.5	73.2
Sediment/Turbidity	**TOTAL**	**76,812.6**	**219.0**
	Turbidity	1,918.6	5.5
	Sediment	74,894.0	213.5
Pesticides	**TOTAL**	**14,635.2**	**41.7**
	Pesticides	14,635.2	41.7
Water Quality	**TOTAL**	**16,644.8**	**47.5**
	Ph/Acidity/Caustic	4,156.6	11.9
	Salinity/Total Dissolved Solids/Chlorides/ Sulfates	12,488.2	35.6
Temperature	**TOTAL**	**88,056.5**	**251.1**

	Temperature	88,056.5	251.1
Habitat/Flow Alterations	**TOTAL**	**117.1**	**0.3**
	Habitat Alterations	43.3	0.1
	Flow Alterations	73.8	0.2
Other	**TOTAL**	**13,062.7**	**37.2**
	Other Cause	55.7	0.2
	Taste, Color, Odor	141.6	0.4
	Nuisance Exotic Species	1,915.4	5.5
	Trash	1,520.2	4.3
	Cause Unknown - Impaired Biota	250.7	0.7
	Cause Unknown - Fish Kills	0.6	> 0
	Total Toxics	9,171.2	26.1
	Fish Consumption Advisory	7.4	> 0

1 The percentages may not add up to 100%, because certain water bodies have more than one 303(d) impairment and therefore are accounted for more than once on occasion (i.e., in different "Parent Causes").

2 "Parent Causes", as described by 303(d), were grouped into nine categories and the group totals are shown in bold .

7.3.2.1 USGS NAWQA Regional Stream Quality Assessment

In 2017, the USGA sampled 85 sites as part of the California Stream Quality Assessment (Figure 39). Water samples were analyzed for about 230 dissolved pesticides and pesticide degradates. Results from the 2017 water quality assessment were considered and are available at https://www.usgs.gov/programs/national-water-quality-program/national-water-quality-assessment-project-nawqa.

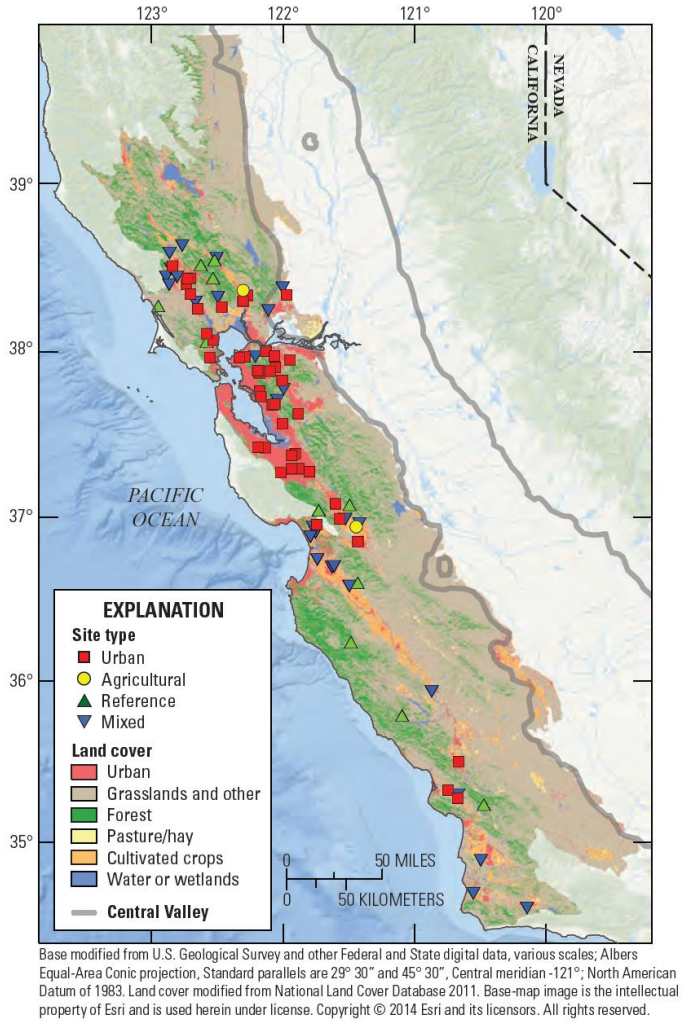


Figure 39. The California Stream Quality Assessment study area. Taken from Van Metre et al. 2017: Figure 1: "California Stream Quality Assessment study area and provisionally selected sampling sites; the boundary is based on the U.S. Environmental Protection Agency level III ecoregions of the U.S."

7.3.3 Habitat Modification

Salmon habitat in California has experienced anthropogenic stressors for nearly 200 years (Munsch et al. 2022) The Central Valley area, including San Francisco Bay and the Sacramento and San Joaquin River Basins, has been drastically changed by development. Salmonid habitat has been reduced to 300 miles from historic estimates of 6,000 miles (CDFG 1993). In the San Joaquin Basin alone, the historic floodplain covered 1.5 million acres with two million acres of riparian vegetation (CDFG 1993). Roughly 5% of the Sacramento River Basin's riparian forests remain. Impacts of development include loss of LWD, increased bank erosion and bed scour, changes in sediment loadings, elevated stream temperature, and decreased base flow. Thus, lower quantity and quality of LWD and modified hydrology reduce and degrade salmonid rearing habitat.

The Klamath Basin in Northern California has been heavily modified as well. Water diversions have reduced spring flows to 10% of historical rates in the Shasta River, and dams block access to 22% of historical salmonid habitat. The Scott and Trinity Rivers have similar histories. Agricultural development has reduced riparian cover and diverted water for irrigation (NRC 2003). Riparian habitat has decreased due to extensive logging and grazing. Dams and water diversions are also common. These physical changes resulted in water temperatures too high to sustain salmonid populations. The Salmon River, however, is comparatively pristine; some reaches are designated as Wild and Scenic Rivers. The causes of riparian loss in the Salmon River basin includes wild fires (NRC 2003).

7.4 General Factors

7.4.1 Climate Variability and Climate Change

Freshwater habitats, resources, and species are declining at unprecedented rates. Chief among the drivers are water development and climate change. Dams, diversions, and groundwater extraction disconnect and degrade riparian and fisheries habitat and deplete water supplies. Climate change affects all aspects of the hydrologic cycle. Hydrologic stress resulting from climate change alters the timing, frequency, duration, and magnitude of events such as drought, floods, and wildfire; alters the thermal regime of freshwater habitats; exacerbates resource use impacts; and threatens to undermine restoration actions. Drought and wildfire exacerbated by climate change have the potential to adversely impact multiple BLM programs by reducing the availability of water and vegetation. Interacting with these threats are challenges related to invasive species, pollution, and current and past permitted and legacy uses on public lands.

There is a large and growing body of literature on past, present, and future impacts of global climate change, exacerbated and accelerated by human activities. Effects of climate change include sea level rise, increased frequency and magnitude of severe weather events, changes in air and water temperatures, and changes in precipitation patterns, all of which are likely to impact ESA resources. The NOAA climate information portal provides basic background information on these and other measured or anticipated climate change effects (see https://www.climate.gov).

In order to evaluate the implications of different climate outcomes and associated impacts throughout the 21st century, many factors have to be considered. The amount of future greenhouse gas (GHG) emissions is a key variable. Developments in technology, changes in energy generation and land use, global and regional economic circumstances, and population growth must also be considered.

A set of five scenarios were developed by the Intergovernmental Panel on Climate Change (IPCC) to ensure that starting conditions, historical data, and projections of future emissions or concentrations of GHGs are employed consistently across the various branches of climate science while taking into consideration assumptions of how socio-economic systems could evolve over the course of the 21st century. Scenario uncertainty is explored by assessing alternative socio-economic futures; the five scenarios described in IPCC (2021) are based on Shared Socio-economic Pathways

(SSPs). These five new SSP scenarios cover a broader range of GHG and air pollutant futures than did the previous IPCC scenarios, or representative concentration pathways (RCPs) described in IPCC (2014). Although not directly comparable, both sets of scenarios are labeled by the level of radiative forcing that will be reached in 2100, and modeling studies relying on RCPs complement the assessment based on SSP scenarios (IPCC 2021).

The five SSP scenarios start in 2015 and project to either 2100 or 2300, and they include both high-CO2 emissions pathways without climate change mitigation as well as new low-CO2 emissions pathways. Differences in the level of climate change mitigation and air pollution control strongly affect anthropogenic emissions trajectories of short-lived climate forcers (SLCFs) (IPCC 2021). Scenario SSP1-1.9 represents the low end of future emissions pathways, leading to warming below 1.5°C in 2100 and limited temperature overshoot of 1.5°C over the 21st century; it is characterized by very low GHG emissions. Scenario SSP1-2.6 is characterized by low GHG emissions and, along with SSP1-1.9, CO_2 emissions declining to net zero around or after 2050 followed by varying levels of net negative CO_2 emissions. Scenario SSP2-4.5 is characterized by intermediate GHG emissions and CO_2 emissions remaining around current levels until the middle of the century. Scenario SSP3-7.0 is characterized by high GHG and CO_2 emissions that will approximately double from the current levels by 2100. Scenario SSP5-8.5 represents the very high warming end of the range of future emissions pathways that have been presented in the literature, and is characterized by very high GHG and CO_2 emissions that will approximately double from the current levels by 2050 (IPCC 2021). SSP2-4.5 and SSP1-2.6 represent scenarios with stronger climate change mitigation and thus lower GHG emissions, but only SSP1-2.6 was designed to limit warming to below 2°C. The Paris Agreement aims to limit the future rise in global average temperature to 2°C, but the observed acceleration in carbon emissions over the last 15 to 20 years, even with a lower trend in 2016, has been consistent with higher future scenarios (Hayhoe et al. 2018).

For ESA decisions involving species influenced by climate change, NMFS evaluates conditions as projected under SSP3-7.0 when data are available to allow such evaluation. When specific data are not available, we will use information that is most consistent with the underlying direction of SSP3-7.0.

RCP 7.0, a new pathway in CMIP6 associated with SSP3, represents the medium-to-high end of the range of future forcing pathways. SSP3-7.0 assumes no additional mitigation from national climate policies beyond those in place in the Paris Agreement. It is one of the required scenarios for modeling teams to participate in CMIP6, ensuring that the standard climate model outputs are available for NMFS scientists to use in ESA decision support. The socioeconomic storyline underlying SSP3-7.0 is one characterized by high global challenges to both mitigation and adaptation to climate change. The National Intelligence Council's (NIC) strategic outlook for the next two decades—based on input from a broad and diverse list of contributors, including think tanks, universities, consultants, business leaders, individual scholars and experts, students, and colleagues inside and outside government—describes a future very consistent with the SSP3-7.0 (National Intelligence Council 2021, Riahi et al. 2017). Both the NIC outlook and the SSP3

storyline envision a global future in which the effects of climate change and environmental degradation are likely to exacerbate food and water insecurity, increase migration, create new health challenges, and contribute to biodiversity losses.

Global mean surface temperature, calculated by merging sea surface temperature over the ocean and air temperature two m over land and sea ice areas, is used in most paleo, historical, and present-day observational estimates of global warming (IPCC 2021). Warming greater than the global average has already been experienced in many regions and seasons, with most land regions experiencing greater warming than over the ocean and with the Arctic region warming most rapidly (Allen et al. 2018b, IPCC 2021). Global warming has led to more frequent heatwaves in most land regions and an increase in the frequency and duration of marine heatwaves (Allen et al. 2018b). Global mean surface temperature has increased by 1.09 (0.95 to 1.20)°C from pre-industrial times to 2011-2020; global temperatures have risen at an unprecedented rate since 2012, with the period from 2016-2020 being the hottest 5-year period between 1850 and 2020 (IPCC 2021). Average global warming up to 1.5°C as compared to pre-industrial levels is expected to lead to regional changes in extreme temperatures, and increases in the frequency and intensity of precipitation and drought (Allen et al. 2018b). Projections show that the average global surface temperature during the period from 2081-2100 is very likely to be higher by 1.0°C to 1.8°C under the low CO_2 emissions scenario SSP1-1.9 and by 3.3°C to 5.7°C under the high CO_2 emissions scenario SSP5-8.5 as compared to 1850-1900 (IPCC 2021).

Climate change has the potential to impact species abundance, geographic distribution, migration patterns, and susceptibility to disease and contaminants, as well as the timing of seasonal activities and community composition and structure (MacLeod et al. 2005, Robinson et al. 2005, Kintisch 2006, Learmonth et al. 2006, McMahon and Hays 2006, Evans and Bjørge 2013, Pachauri and Meyer 2014). Though predicting the precise consequences of climate change on highly mobile marine species is difficult (Simmonds and Isaac 2007), recent research has indicated a range of consequences already occurring.

Changes in the marine ecosystems caused by global climate change (e.g., ocean acidification, salinity, oceanic currents, dissolved oxygen levels, nutrient distribution) could influence the distribution and abundance of lower trophic levels (e.g., phytoplankton, zooplankton, submerged aquatic vegetation, crustaceans, mollusks, forage fish), ultimately affecting primary foraging areas of ESA-listed species including marine mammals, sea turtles, and fish. Marine species ranges are expected to shift as they align their distributions to match their physiological tolerances under changing environmental conditions (Doney et al. 2012). Hazen et al. (2012) examined top predator distribution and diversity in the Pacific Ocean in light of rising sea surface temperatures using a database of electronic tags and output from a global climate model. They predicted up to a 35% change in core habitat area for some key marine predators in the Pacific Ocean, with some species predicted to experience gains in available core habitat and some predicted to experience losses.

These changes will not be spatially homogeneous. 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 (Mote et al. 2014, Mote 2016). Rain-dominated watersheds and those with significant contributions from groundwater may be less sensitive to predicted changes in climate (Tague et al. 2013, Mote et al. 2014).

Decreases in summer precipitation of as much as 30% by the end of the century are consistently predicted across climate models (Abatzoglou et al. 2014). Precipitation is more likely to occur during October through March and less during summer months. More winter precipitation will be rain than snow (ISAB 2007, Mote et al. 2013, Mote et al. 2014). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and water temperatures will be warmer (ISAB 2007, Mote et al. 2014). Models consistently predict increases in the frequency of severe winter precipitation events (i.e., 20-year and 50-year events), in the western U.S. (Dominguez et al. 2012). The largest increases in winter flood frequency and magnitude are predicted in mixed rain-snow watersheds (Mote et al. 2014).

The combined effects of increasing air temperatures and decreasing spring through fall flows are expected to cause increasing stream temperatures; in 2015 this resulted in 3.5-5.3 degree increases in Columbia Basin streams and a peak temperature of 26 °C in the Willamette (NWFSC 2015b). Overall, about one-third of the current cold-water salmonid habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (Mantua et al. 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 (Mantua and Hamlet 2010, Isaak et al. 2012). Temperature increases shift timing of key life cycle events for salmonids and species forming the base of their aquatic foodwebs (Winder and Schindler 2004, Crozier et al. 2008, Tillmann and Siemann 2011). 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 (Meyer et al. 1999, Winder and Schindler 2004, Raymondi et al. 2013). Higher temperatures are likely to cause several species to become more susceptible to parasites, disease, and higher predation rates (Crozier et al. 2008, Raymondi et al. 2013, 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 (McMahon and Hartman 1989, Lawson et al. 2004). In addition to changes in freshwater conditions, predicted changes for coastal waters in the Pacific Northwest as a result of climate change include increasing surface water temperature, increasing but highly variable acidity, and increasing storm frequency and magnitude (Mote et al. 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, Reeder et al.

2013). In a recent modeling study that investigated impacts to a variety of salmon populations across multiple life stages using a stochastic, age-structured life-cycle model with both density-dependent and density-independent climate effects, it was found that salmon populations rapidly declined in response to climate change (Crozier et al. 2021b). In the freshwater life stages, migration timing shifted earlier in response to warmer freshwater conditions, but this did not prevent population declines under RCP climate change projections. The marine life stages were the most vulnerable to warming, with rising sea surface temperatures across diverse model assumptions and climate scenarios leading to a 90% decline in survival (Crozier et al. 2021b).

7.4.2 Non-Native Species

The BLM manages over two-hundred million acres of public lands primarily in the Western U.S., including Alaska. Seventy-nine million of these acres are impacted by noxious and invasive weeds. One of the BLM's highest priorities is to promote ecosystem health and one of the greatest obstacles to achieving this goal is the rapid expansion of weeds across public lands. These invasive plants can dominate and often cause permanent damage to natural plant communities. If not eradicated or controlled, noxious weeds will continue to jeopardize the health of the public lands and to constrain the myriad activities that occur on public lands.

Non-native species are introduced to the aquatic environment in a variety of ways, including through ballast water contamination and release, intentional or accidental releases of aquaculture or aquarium species, and releases of live bait. The Aquatic Nuisance Species Task Force suggests that it is inevitable that cultured species will eventually escape confinement and enter U.S. waterways. In 1989, non-native species were cited as a contributing cause in the extinction of 27 species and 13 subspecies of North American fishes over the previous 100 years (Miller et al. 1989). In 2018, a systemic review was conducted on the interactions between invasive species and ESA federally-listed species in the U.S. and 175 unique case studies containing listed species were analyzed (Dueñas et al. 2018). Within these case studies, 116 ESA-listed species were mentioned, and of these, 85 listed species were impacted negatively, making up 6.2% of the entire ESA list. The authors found that the proportion of ESA-listed species that were negatively impacted was higher for marine species than it was for terrestrial species. These negatively impacted marine animals included four species of sea turtles (impacted on the terrestrial portion of their range) and 3 species of anadromous fish impacted in freshwater habitat (Dueñas et al. 2018).

Non-native species can interact with native species both directly, as competitors and predators, or indirectly, as vectors of new disease pathogens or as plants that alter the aquatic habitats in which the native species live (Thorstad et al. 2021). Non-native species also may be affected by increased temperatures resulting from climate change which could lead new and/or different combinations of species to invade native waterways (Thorstad et al. 2021). By competing with native species for food and habitat, preying on them, infecting them with new diseases, or altering their habitats, non-native species can reduce or eliminate populations of native species.

7.4.3 Impaired Water Bodies

The Aquatic Resources Program conserves and restores riparian, fisheries, and water resources. Riparian and wetland areas, lakes, streams, and aquifers on public lands managed by the BLM are among the most important, productive, and diverse resources in the Nation. They provide habitat for myriad species of plants, fish, and wildlife; provide ecosystem services such as drinking water, pollination, and nutrient cycling; attenuate effects of wildfires, floods, and drought; and are key to the vitality of local economies and communities. Of increasing interest is the ability of riparian and wetland areas such as fens, riparian wetlands, prairie wetlands, and peatlands to sequester carbon and combat climate change. These resources also support permitted activities on public lands such as livestock grazing, energy and mineral development, timber production, and recreation. Healthy riparian areas, fisheries, and watersheds are essential to achieving the agency's multiple use and sustained yield mandate as directed by the Federal Land Policy and Management Act and ensure the agency complies with the Clean Water Act, ESA, Wild and Scenic Rivers Act, and NEPA.

Under the authority of the CWA, states periodically prepare a list of all surface waters in the state for which beneficial uses including drinking, recreation, aquatic habitat, and industrial uses are impaired by pollutants. This process is in accordance with section 303(d) of the CWA. Estuaries, lakes, and streams listed under 303(d) are those that are considered impaired or threatened by pollution, and are not expected to improve within the next two years.

Each state has unique 303(d) listing criteria and processes. Generally, a water body is listed separately for each standard it exceeds, so it may appear on the list more than once. If a water body is not on the 303(d) list, it is not necessarily contaminant-free; rather it may not have been tested. Therefore, the 303(d) list is a minimum list for each state regarding polluted water bodies by parameter. After states develop their lists of impaired waters, they are required to prioritize and submit their lists to EPA for review and approval. Each state establishes a priority ranking for such waters, considering the severity of the pollution and the uses to be made of such waters. States are expected to identify high priority waters targeted for TMDL development within two years of the 303(d) listing process.

Elevated temperature is considered a pollutant in most states with approved Water Quality Standards under the federal CWA. Temperature is significant for the health of aquatic life. Water temperatures affects dissolved oxygen saturation levels. Temperature and dissolved oxygen are inversely related. Increases in stream temperatures can be caused by many factors. Land-use and water withdrawals are primary causes, and increases in global temperatures with climate change will exacerbate the local conditions found in our Nation's watersheds. This, in turn, affects aquatic life. The local and cumulative conditions within watersheds affect the distribution, health, and survival of native cold-blooded listed fish species distributed over the action area. These fish will experience adverse health effects when exposed to temperatures outside their optimal range. For the various listed fish species, water temperature tolerance varies between species and life stages. For various listed salmon species, optimal temperatures for rearing salmonids range from 10ºC to 16ºC. Warm temperatures can reduce fecundity, reduce egg survival, retard growth of fry and smolts,

reduce rearing densities, increase susceptibility to disease, decrease the ability of young salmon and trout to compete with other species for food, and to avoid predation (Spence et al. 1996, McCullough 1999). Sublethal temperatures (above 24ºC) could be detrimental to salmon by increasing susceptibility to disease (Colgrove and Wood 1966) or elevating metabolic demand (Brett 1995). Substantial research demonstrates that many fish diseases become more virulent at temperatures over 15.6ºC (McCullough 1999). Migrating adult salmonids and upstream migration can be delayed by excessively warm stream temperatures (Crossin et al. 2008). Ambient stream temperatures may also negatively affect incubating and rearing salmonids when too high (Gregory and Bisson 1997). In a recent modeling study that investigated impacts to a variety of salmon populations across multiple life stages, it was found that salmon populations rapidly declined in response to rising sea surface temperatures across diverse model assumptions and climate scenarios, with the marine life stage showing a 90% decline (Crozier et al. 2021a). Sturgeon are also dependent on temperature; generally, sturgeon overwinter until temperatures reach about 7 ºC in the spring. They get a little more active and begin foraging and spawning.. Due to the sensitivity of listed fish species to temperature, states have established lower temperature thresholds for habitat as part of their water quality standards.

Other water quality impairments found in waterbodies that can lead to adverse effects to listed aquatic organisms include: dissolved oxygen, nutrients, biological oxygen demand (BOD), toxics and other chemical inputs, and total suspended solids, to name a few. In general, the abundance of aquatic life and other fish is markedly reduced with the increased exposure to stressful water temperatures, depressed DO levels, and/or exposures to toxics. The reduction of suitable habitat caused by drought conditions exacerbate the response to other stressful variables and further reduce the abundance of fish.

Excessive stream temperatures affect dissolved oxygen (DO) concentrations in the water column. DO is the requirement for aquatic life respiration, and high DO levels contribute to the diversity of aquatic life that would benefit Pacific salmon and other listed species. In addition to the inverse association with temperature, DO concentrations can be compressed by other aquatic inputs that can lead to exceeding standards. Nutrients from agricultural and urban inputs allow phytoplankton and aquatic plants to flourish causing diurnal pulses in DO concentrations. As the season progresses into the warmer months, DO consumption is greater than what is produced. Plant senescence, along with low flows can cause excessive demand on DO. Decay requires DO to complete its process; use of oxygen for this purpose is referred to as biological oxygen demand (BOD). The higher the decay needs, the higher the BOD in the system. High BOD is also inversely related to DO. High temperatures and BOD combined can suppress DO enough to cause lethal conditions for fish and other aquatic life. Thus water bodies that exceed standards for nutrients and BOD levels can affect the distribution of aquatic life including Pacific salmonids and other fish. As stated above, DO is a requirement for aquatic life respiration. High DO levels contribute to the diversity of aquatic life that would benefit Pacific salmon and other species.

Toxics and other chemical inputs also contribute to adverse responses in the aquatic environment. In addition to causing acute or chronic harm to aquatic species, chemical inputs can indirectly affect them by contributing to reductions in DO through their decay known as the chemical oxygen demand (COD). Areas where these inputs occur can greatly affect the distribution of fish and other organisms. Pollutants carried into streams from urban runoff include pesticides, heavy metals, PCBs, polybrominated diphenyl ethers (PBDEs) compounds, PAHs, nutrients (phosphorus and nitrogen), and sediment. Other ions generally elevated in urban streams include calcium, sodium, potassium, magnesium, and chloride ions where sodium chloride is used as the principal road deicing salt (Paul and Meyer 2001, Moore et al. 2017). The combined effect of increased concentrations of ions in streams is the elevated conductivity observed in most urban streams.

Many other metals have been found in elevated concentrations in urban stream sediments including arsenic, iron, boron, cobalt, silver, strontium, rubidium, antimony, scandium, molybdenum, lithium, and tin (Wheeler et al. 2005). The concentration, storage, and transport of metals in urban streams are connected to particulate organic matter content and sediment characteristics. Organic matter has a high binding capacity for metals and both bed and suspended sediments with high organic matter content frequently exhibit 50 - 7,500 times higher concentrations of zinc, lead, chromium, copper, mercury, and cadmium than sediments with lower organic matter content.

PAH compounds also have distinct and specific effects on fish at early life history stages (Incardona et al. 2004). PAHs tend to adsorb to organic or inorganic matter in sediments, where they can be trapped in long-term reservoirs (Johnson et al. 2002). Only a portion of sediment-adsorbed PAHs are readily bioavailable to marine organisms, but there is substantial uptake of these compounds by resident benthic fish through the diet, through exposure to contaminated water in the benthic boundary layer, and through direct contact with sediment. Benthic invertebrate prey are a particularly important source of PAH exposure for marine fishes, as PAHs are bioaccumulated in many invertebrate species (Varanasi et al. 1989, Varanasi et al. 1992, Meador et al. 1995, Honda and Suzuki 2020).

PAHs and their metabolites in invertebrate prey can be passed on to consuming fish species, PAHs are metabolized extensively in vertebrates, including fishes (Johnson et al. 2002). Although PAHs do not bioaccumulate in vertebrate tissues, PAHs cause a variety of deleterious effects in exposed animals. Some PAHs are known to be immunotoxic and to have adverse effects on reproduction and development. Studies show that PAHs exhibit many of the same toxic effects in fish as they do in mammals (Honda and Suzuki 2020). There have been several toxicological studies on the early development, bone metabolism, liver metabolism, and reproduction of fish in response to exposure to PAHs (Honda and Suzuki 2020). Total suspended solids can affect aquatic life by limiting photosynthetic activities (also affecting DO). Excessive sedimentation can blanket substrates needed for spawning, incubation, and emergence of Pacific and Atlantic salmon and suppress inter-gravel DO concentrations.

8 EFFECTS OF THE ACTION

8.1 Introduction

Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action. (50 C.F.R. 402.02)

In this section, we revisit the potential stressors associated with the proposed action, the probability of individuals of ESA-listed species being exposed to these stressors based on the best scientific and commercial evidence available, and the probable responses of those individuals (given probable exposures) based on the available evidence. For any responses that would be expected to reduce an individual's fitness (i.e., growth, survival, annual reproductive success, or lifetime reproductive success), the assessment would consider the risk posed to the viability of the population(s) those individuals comprise and to the ESA-listed species those populations represent. The purpose of this assessment and, ultimately, of this programmatic consultation is to determine if it is reasonable to expect the proposed action to have effects on ESA-listed species that could appreciably reduce their likelihood of surviving and recovering in the wild.

This section also assesses the potential consequences to designated critical habitat from exposure to the stressors of the action. This assessment is based on potential impacts to those PBFs essential to the conservation of the species which may require special management considerations or protection (see Appendix C for a description of the PBFs for each of the designated critical habitats). The critical habitat effects analysis concludes with our determination of the risk posed to all the PBFs taken together for a particular species.

As was described in the *Stressors of the Proposed Action*, the magnitude of the anticipated adverse effects depends on the buffer size associated with the aquatic habitats. For areas outside the PULA the no-application buffer size is 100 ft for aerial and 25 ft for ground. At those distances we found that many of the herbicides, in addition to stressors associated with the other treatment methods, are capable of reaching aquatic habitats at concentrations (in the case of herbicides) capable of causing adverse effects. However, in these areas the potential for exposure – to species or habitat – is highly unlikely. This is because the known distribution of each species as well as their designated critical habitat are largely contained within the PULA. In other words, adverse effects would likely occur if not for the fact that species and their habitats are not present in these areas.

For areas within the PULA, where species and habitats do occur, the buffer size is extended to 300 m. At that distance, we found that only a few of the herbicides were capable of reaching aquatic

habitats at concentrations still toxicologically relevant. Based on comparisons of exposure estimates and toxicological data, we anticipate mortality levels to both fish and their invertebrate prey to be at levels less than one percent, at most. Thus, in order to characterize risk we evaluated the extent, and locations, where these effect levels could occur i.e. the BLM lands within each species range. We compared the spatial and temporal distribution of species and habitat PBFs to the spatial and temporal distribution of BLM land and vegetation treatments to estimate the risk to each species and habitat.

For each species and habitat, the effects analysis concludes with a characterization of risk as either low, medium, or high. A low risk indicates that we anticipate adverse effects, but only to very small percentage of the population or habitat. Species and habitats in this category tend to be those where BLM acreage is low, and not associated with areas of particular importance to the species (e.g. spawning grounds). A medium risk indicates that we anticipate adverse effects, but still to a small percentage of the population or habitat. Species and habitats in this category either have ranges with greater proportions of BLM land, or the BLM acreage is low, but directly associated with important habitat. For these species the exposure potential is higher but the response potential is low due to PULA buffers. This level of risk is highly unlikely to translate to an appreciable reduction in the reproduction, numbers or distribution of the species, or to an overall diminishment of the designated critical habitat. A high risk indicates that we anticipate adverse effects to a sufficient portion of the population such that an overall reduction in the reproduction, numbers, or distribution, or an overall reduction of the conservation value of the designated critical habitat, is possible. See Appendix C for a description of the PBFs for each of the designated critical habitats.

8.2 Chum, Columbia River ESU

Effects analysis summary:

Chum salmon typically spawn in the lower reaches of rivers, with redds usually dug in the mainstem or in side channels of rivers from just above tidal influence to 100 km from the sea. Spawning occurs between the beginning of November and the end of January. Juveniles out-migrate to seawater almost immediately after emerging from the gravel covered redds. Fry emergence from the gravel to saltwater entry spans four months for a typical year-class. Emergence begins in February and juvenile migration to the sea is usually completed by the end of May.

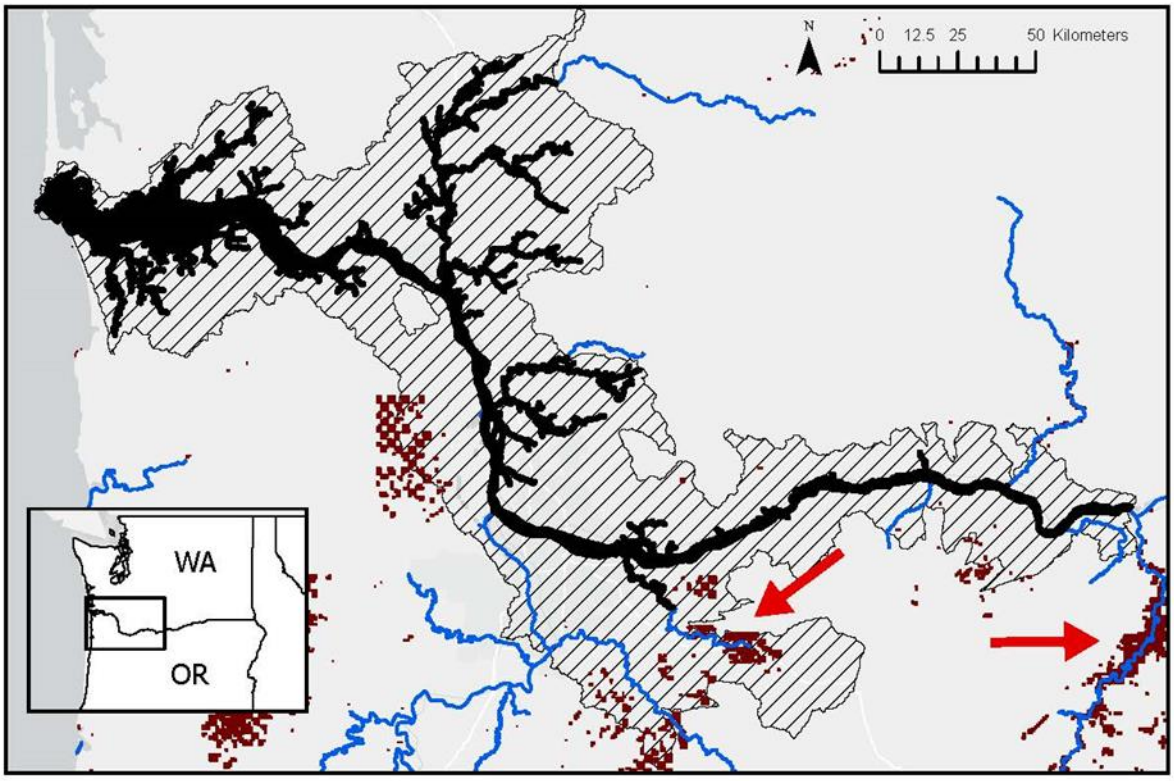


Figure 40. Chum, Columbia River ESU range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

For this species, BLM land is sparse and generally removed from the species designated critical habitat. However, there are two general areas where vegetation treatment on BLM lands may contribute to exposure. The first is the Deschutes River (left arrow), which is outside the species range but flows directly into it. The second is the Sandy River (right arrow), which is inside the species range and part of the Sandy River fall-run population. However, the majority of BLM land is upriver of an impassable dam on this river. These habitats are not associated with the PULA, therefore the potential for adverse responses increases.

In aquatic habitats outside the PULA, buffers are reduced from 300 m to 100 ft and 25 ft for aerial and ground applications respectively. These smaller buffers result in greater higher EECs and

greater adverse effects, if exposed. Of the 28 herbicides authorized by BLM, 15 can contribute to toxic effects at this distance. In these situations impacts to invertebrate prey as well as direct mortality to fish may occur. In addition to the herbicide treatments, stressors from fire mechanical, and biological control treatments can also result in adverse effects in these areas. Increased sedimentation, loss riparian vegetation, and disturbances due to noise, and the movement of heavy machinery are all likely to occur.

The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) Water quality and forage supporting juvenile development; and, 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

Although the potential adverse effects to species and habitat PBFs is greater, the potential for exposure is considerably less. This is because the PULA encompasses all designated critical habitat and the vast majority of species distribution. In this way, the distribution of this species' populations and habitats relative to the location of BLM lands ensures that the vast majority of habitat – and individuals - will experience only minimal impacts.

Overall we have a high degree of confidence that the effects of the action represents a low risk to this species and its designated critical habitat.

8.3 Chinook, Central Valley spring-run ESU

Effects analysis summary:

Adult Central Valley spring-run Chinook salmon leave the ocean to begin their upstream migration in late January and early February, and enter the Sacramento River between March and September, primarily in May and June. Spring-run Chinook salmon generally enter rivers sexually immature and must hold in freshwater for up to several months before spawning. Spawning normally occurs between mid- August and early October, peaking in September. Spring-run Chinook fry emerge from the gravel from November to March. Juveniles may reside in freshwater for 12 to 16 months, but some migrate to the ocean as young-of-the-year in the winter or spring months within eight months of hatching.

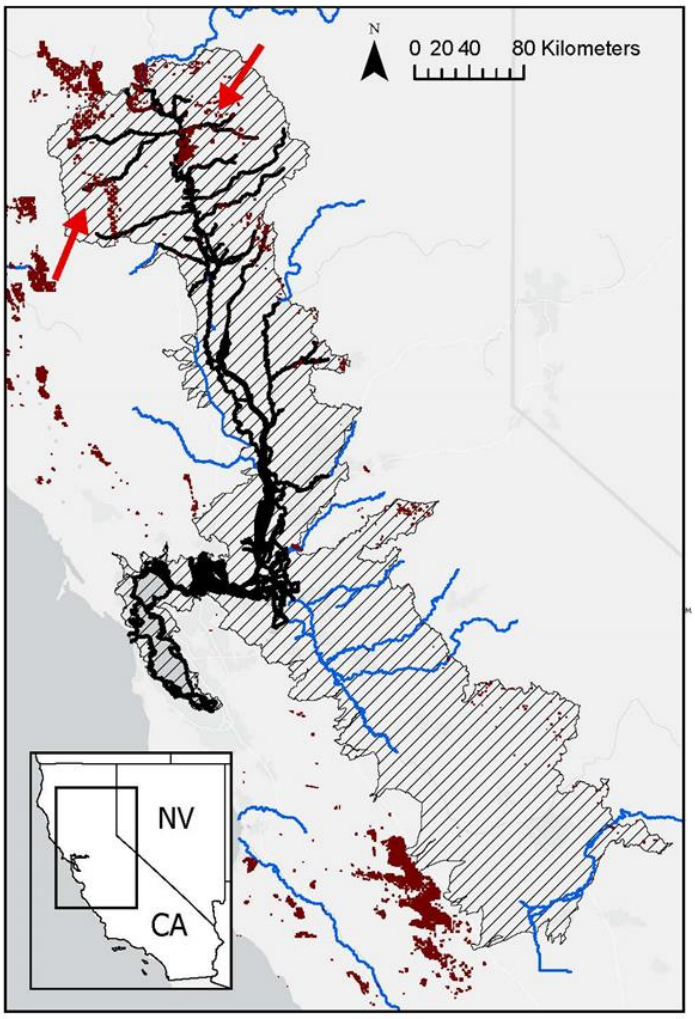


Figure 41. Chinook, Central Valley spring-run range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

For this species, BLM lands are primarily found in the northern portion of this species' range. Portions of Clear Creek, Cottonwood Creek and Battle Creek all run through BLM land in this area. As described in the status of the species section, Battle Creek, in particular, is an area of importance to the species where individual density is likely to be high. However the habitat in this area is with the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) water quantity and quality conditions and substrate supporting spawning, incubation and larval development, and 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands suggest that, although minor, the impacts of these stressors could occur result in reductions in prey availability. This is because juvenile salmon may reside in the northern BLM-dominated spawning reaches for extended periods.

Overall we have a high degree of confidence that the effects of the action represents a medium risk to this species and its designated critical habitat.

8.4 Chinook, Snake River spring/summer-run ESU

Effects analysis summary:

Snake River summer-run Chinook salmon return to the Columbia River from June through July. Adults from both runs hold in deep pools in the mainstem Columbia and Snake Rivers and the lower ends of the spawning tributaries until late summer, when they migrate into the higher elevation spawning reaches. Generally, Snake River spring-run Chinook salmon spawn in mid- through late August. Snake River summer-run Chinook salmon spawn approximately one month later than spring-run fish and tend to spawn lower in the tributary drainages, although their spawning areas often overlap with those of spring-run spawners. The eggs that Snake River spring and summer Chinook salmon deposit in late summer and early fall incubate over the following winter, and hatch in late winter and early spring. Juveniles rear through the summer, overwinter, and typically migrate to sea in the spring of their second year of life, although some juveniles may spend an additional year in fresh water. Depending on the tributary and the specific habitat conditions, juveniles may migrate extensively from natal reaches into alternative summer-rearing or overwintering areas. Most yearling fish are thought to spend relatively little time in the estuary compared to sub-yearling ocean-type fish.

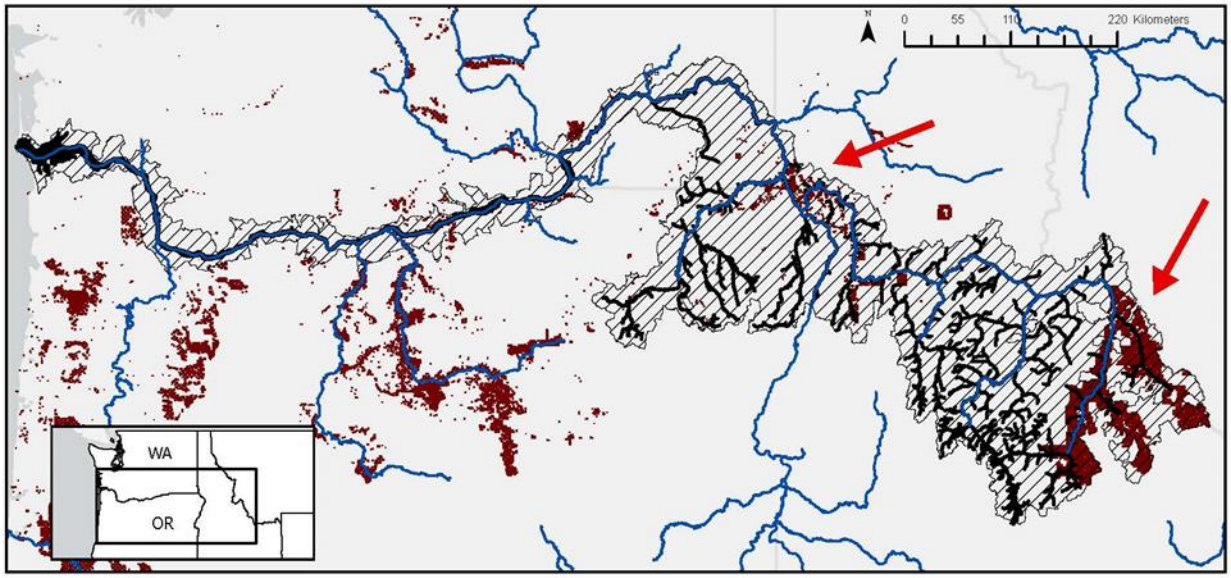


Figure 42. Chinook, Snake River spring/summer-run ESU range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

The Upper Salmon river major population group is strongly associated with BLM lands, particularly the Lemhi River, Pahsimeroi River, and Salmon River populations. These three populations must be viable or maintained in order for the species to recover. BLM land is also located in several places along the migratory corridor, for example at the confluence of the Snake, Salmon, and Grand Ronde Rivers. BLM vegetation treatment activities in these areas are likely to result in exposure to adults and juveniles in these populations. However, these areas are also within a PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) water quantity and quality conditions and substrate supporting spawning, incubation and larval development, and 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands suggest that, although minor, the impacts of these stressors could occur result in reductions in prey availability. This is because juvenile salmon may reside in the BLM-dominated spawning reaches for extended periods.

Overall we have a high degree of confidence that the effects of the action represents a medium risk to this species and its designated critical habitat.

8.5 Chinook, Snake River fall-run ESU

Effects analysis summary:

The primary spawning area in the extant Lower Snake River population is the 96-km Upper Hells Canyon reach, extending upriver from the confluence of the Snake and Salmon Rivers to the Hells Canyon Dam. The other four spawning sites are: Lower Hells Canyon, Grande Ronde River, Clearwater River, and Tucannon River. Annual redd surveys show that fall Chinook salmon spawning occurs in all five of these sites. Snake River fall-run Chinook are present in the accessible freshwater habitats year-round, sometimes in multiple life-history stages and year-classes. Snake River fall-run Chinook return to the Columbia River in August and September, pass Bonneville Dam from mid-August to the end of September, and enter the Snake River between early September and mid-October. Once they reach the Snake River, fall Chinook salmon generally travel to one of the above listed five major spawning areas and spawn from late October through early December. Fry emerge from the gravels through the end of February. Upon emergence, most young fall Chinook salmon move to very shallow shoreline riverine habitat. With growth, some fall Chinook salmon smolts sustain active migration after passing Lower Granite Dam and enter the ocean as subyearlings, whereas some delay seaward migration and enter the ocean as yearlings. Snake River fall Chinook salmon can be present in the estuary as juveniles in winter, as fry from March to May, and as fingerlings throughout the summer and fall.

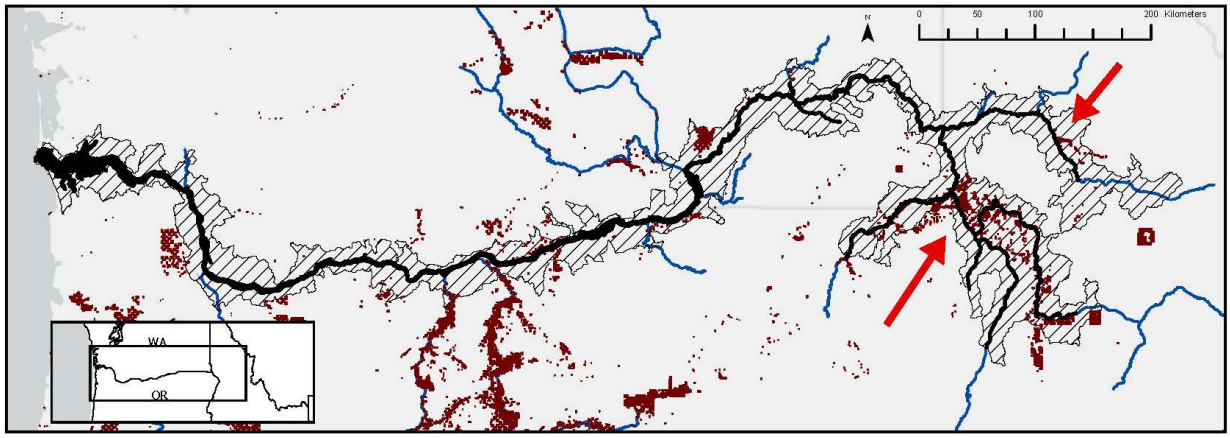


Figure 43. Chinook, Snake River fall-run ESU range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

BLM lands are present in proximity to spawning habitat within the Snake River, Salmon River, Grand Ronde River as well as the Clearwater River. Unlike the spring/summer-run, this species primarily spawns in the mainstem, rather than within tributaries. BLM vegetation treatment activities in these areas are likely to result in exposure to a significant portion of the adults and juveniles that make up this species. However, these areas are also within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations,

impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) water quantity and quality conditions and substrate supporting spawning, incubation and larval development, and 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands suggest that, although minor, the impacts of these stressors could occur result in reductions in prey availability. This is because juvenile salmon may reside in the BLM-dominated spawning reaches for extended periods.

Overall we have a high degree of confidence that the effects of the action represents a medium risk to this species and its designated critical habitat.

8.6 Chinook, Puget Sound ESU

Effects analysis summary:

Chinook salmon within the Puget Sound generally exhibit an “ocean-type” life history, meaning juveniles migrate directly to saltwater. However, substantial variation occurs with regard to juvenile residence time in freshwater and estuarine environments. Puget Sound Chinook salmon also has several estuarine rearing juvenile life history types that are highly dependent on estuarine areas for rearing. In the estuaries, fry use tidal marshes and connected tidal channels including dikes and ditches developed to protect and drain agricultural land. During their first year in saltwater, immature Chinook salmon use shallow nearshore areas of Puget Sound during all seasons and can be found long distances from their natal river systems.

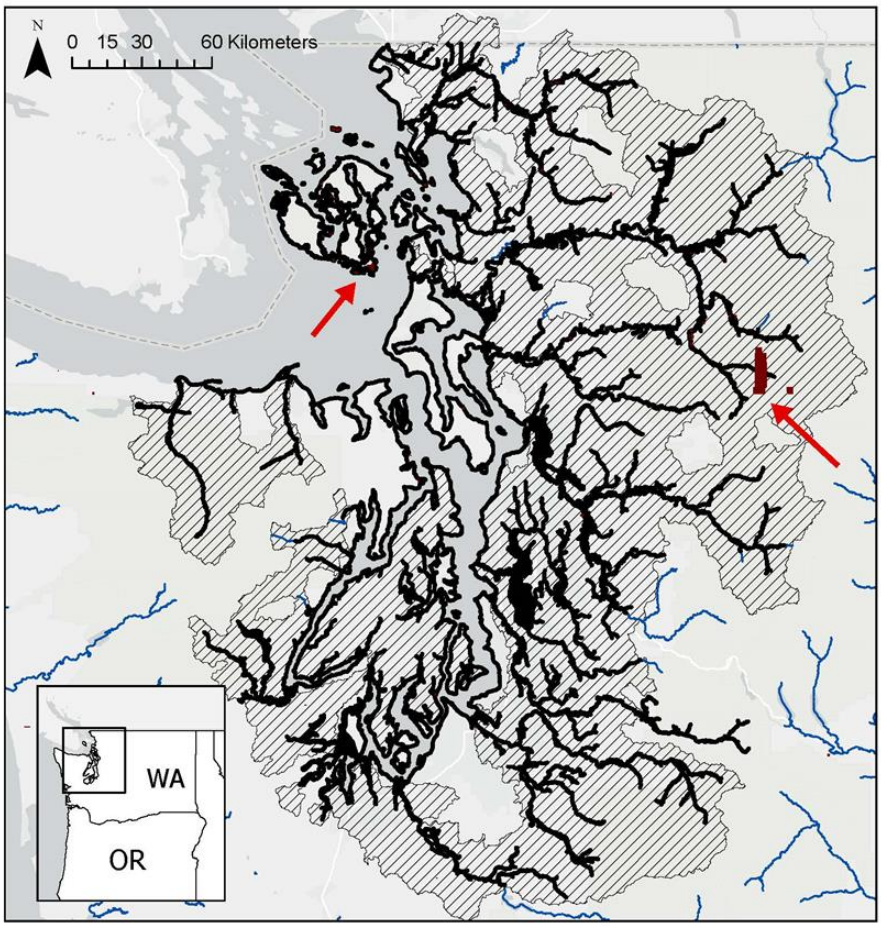


Figure 44. Chinook, Puget Sound ESU range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

The extent of BLM lands within this species’ range is low. However, there are two general areas where vegetation treatment on BLM lands may contribute to exposure. The first is the White Chuck River, a contributing tributary to the Sauk River population. The second is coastal locations throughout the San Juan Islands, where juvenile Chinook forage. However, both of these areas are

within the PULA. Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) Water quality and forage supporting juvenile development; and, 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands ensures that the vast majority of habitat will not experience even the low-level effects associated with PULA buffered habitats.

Overall we have a high degree of confidence that the effects of the action represents a low risk to this species and its designated critical habitat.

8.7 Chinook, California coastal ESU

Effects analysis summary:

California coastal Chinook salmon are reduced to a fall-run, ocean-type fish. They are present in the watersheds between October and June. Adults enter the rivers in the fall. The juveniles exit the rivers in the spring. Although a spring-run (river-type) component existed historically, it is now considered extinct. The different populations among the rivers supporting this ESU vary in run timing depending on latitude and hydrological differences between watersheds. Entry of California coastal Chinook salmon into the Russian River depends on increased flow from fall storms, usually in November to January. Juveniles of this ESU migrate downstream from April through June and may reside in the various estuaries for an extended period before entering the ocean.

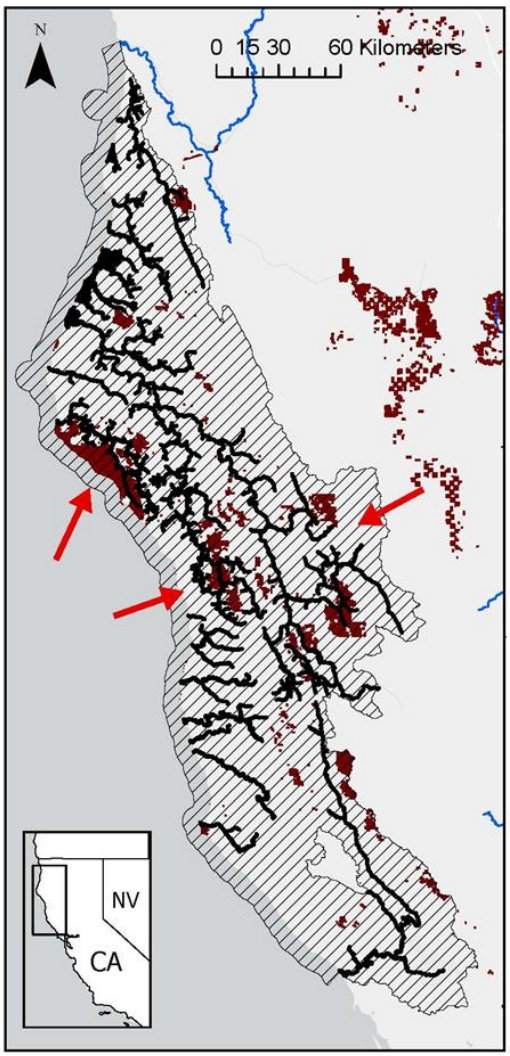


Figure 45. Chinook, California coastal ESU range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

Several populations of this species occupy BLM lands. Within the North Coastal diversity strata, the Mattole River and South fork Eel River populations have spawning and rearing habitat in BLM lands. The Upper Eel River population also traverses BLM land. All three of these populations have been deemed essential to the recovery of the species. BLM vegetation treatment activities in these areas are likely to result in exposure to adults and juveniles in these populations. However, the rivers and streams associated with these populations are all within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) water quantity and quality conditions and substrate supporting spawning, incubation and larval development, and 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' essential populations relative to the location of BLM lands suggest that, although minor, the impacts of these stressors could occur result in reductions in prey.

Overall we have a high degree of confidence that the effects of the action represents a medium risk to this species and its designated critical habitat.

8.8 Chinook, Upper Columbia River spring-run ESU

Effects analysis summary:

Spring Chinook enter the Upper Columbia tributaries from April through July. After migration, they hold in freshwater tributaries until spawning occurs in the late summer, peaking in mid to late August. Fry begin emerging from the spawning grounds as early as November and continue through April. Juvenile spring Chinook spend a year in freshwater in the shallows along the edges of their natal river before migrating in the shallows following the Columbia River to saltwater in the spring of their second year of life. Most UCR spring Chinook return as adults after two or three years in the ocean. Some precocious males, or jacks, return after one winter at sea. A few other males mature sexually in freshwater without migrating to the sea.

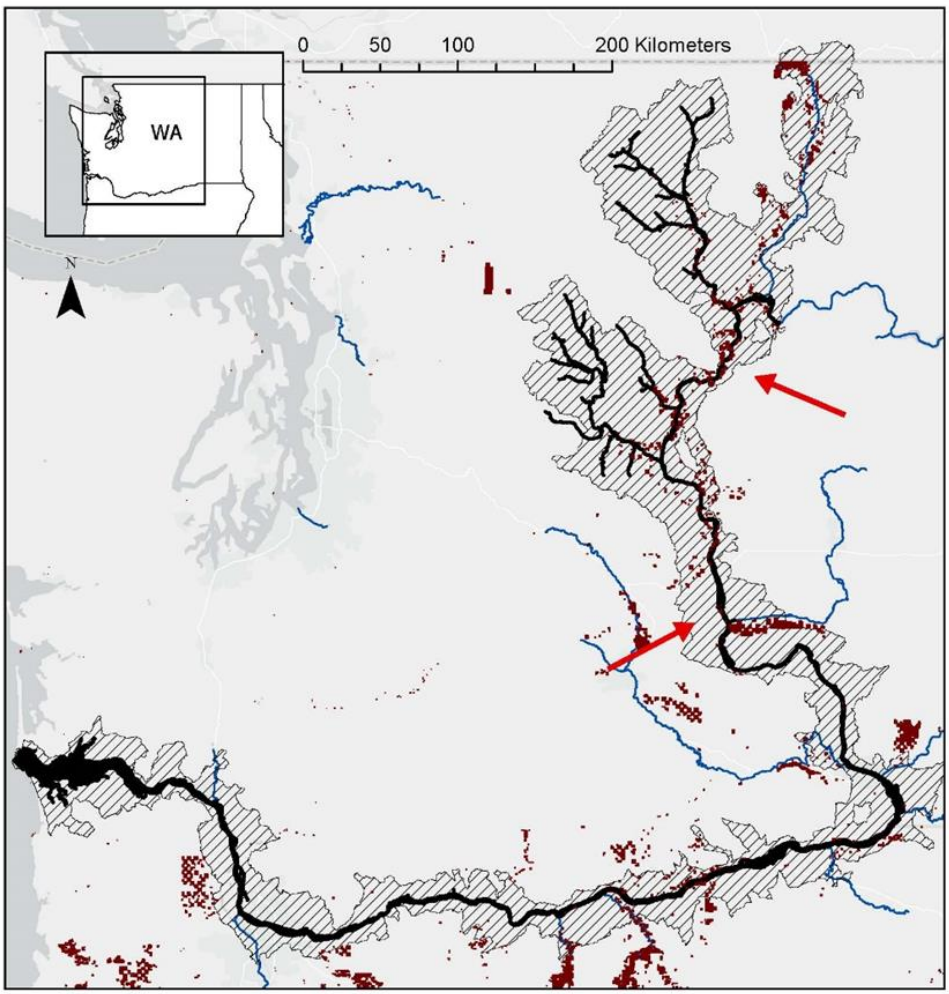


Figure 46. Chinook, Upper Columbia River spring-run ESU range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

BLM lands are dispersed throughout this species' range in the upper Columbia River. In addition to areas along the migratory corridor, BLM lands are within each of the three extant populations:

Wenatchee River, Entiat River and Methow River. All three of these populations are at high overall risk of extinction. BLM vegetation treatment activities in these areas are likely to result in exposure to a significant portion of the adults and juveniles that make up this species. However, these areas are also within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) water quantity and quality conditions and substrate supporting spawning, incubation and larval development, and 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands suggest that, although minor, the impacts of these stressors could occur result in reductions in prey availability. This is because juvenile salmon may reside in the BLM-dominated spawning reaches for extended periods.

Overall we have a high degree of confidence that the effects of the action represents a medium risk to this species and its designated critical habitat.

8.9 Chinook, Lower Columbia River ESU

Effects analysis summary:

Lower Columbia River Chinook salmon display three run types including early fall-runs, late fall-runs, and spring-runs. While Spring-run Chinook salmon were numerous historically, presently the fall-run is the predominant life history type. Multiple year-classes and life-history phases of the Lower Columbia River Chinook salmon can be present in their rearing and migration corridors year-round. Fall-run Chinook salmon enter fresh water typically in August through October. Spring-run Chinook salmon enter fresh water in March through June to spawn in upstream tributaries in August and September. Fry emerge from the gravels from January to the end of April. Fry may migrate to the ocean soon after yolk absorption, or they may remain in freshwater for their entire first year before emigrating. The spring-run Chinook salmon migrates to the sea as yearlings, typically in spring. Juvenile Chinook salmon rear in shallow areas throughout, along natal stream and river edges, along the Columbia River and Estuary. Once at sea, the ocean-type Lower Columbia River Chinook salmon tend to migrate along the coast, while stream-type Lower Columbia River Chinook salmon appear to move far off the coast into the central North Pacific Ocean.

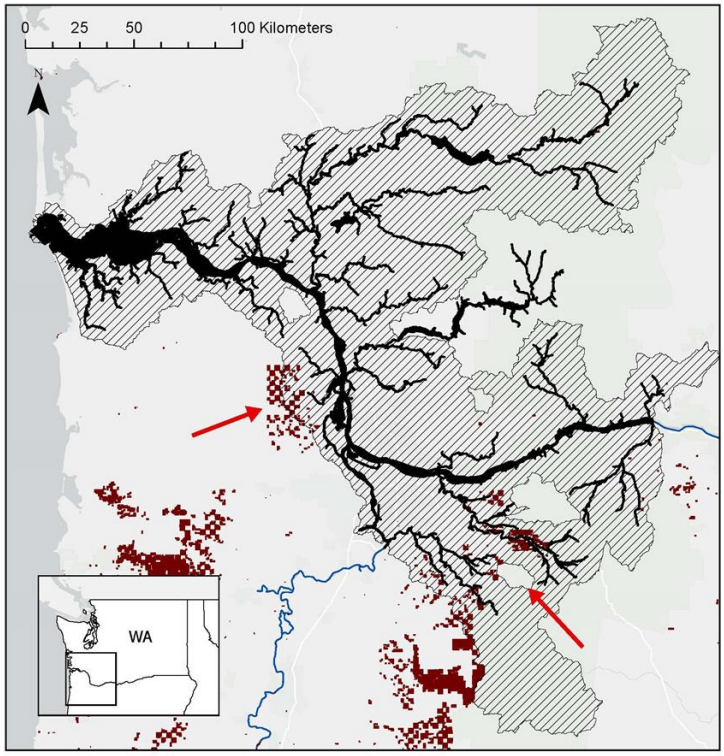


Figure 47. Chinook, Lower Columbia River ESU range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

BLM land occurs in several places within this species' range. Areas where individuals are likely to be exposed include Scappoose Creek, Clackamas River and Sandy River, each of which comprise their own populations. BLM vegetation treatment activities in these areas are likely to result in exposure to adults and juveniles in these populations. However, each of these rivers are within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) Water quality and forage supporting juvenile development; and, 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands ensures that the vast majority of habitat will not experience even the low-level effects associated with PULA buffered habitats.

Overall we have a high degree of confidence that the effects of the action represents a low risk to this species and its designated critical habitat.

8.10 Chinook, Sacramento River winter-run ESU

Effects analysis summary:

This ESU consists of one small population. Their spawning habitat is limited to a reach of the Sacramento River below Keswick Dam downstream to the Red Bluff Diversion Dam. Winter-run Chinook salmon are unique because they spawn during summer months when air temperatures usually approach their yearly maximum. As a result, winter-run Chinook salmon require stream reaches with cold water sources that will protect embryos and juveniles from the warm ambient conditions in summer. The winter-run Chinook are present in the Sacramento year-round. Spawning occurs between late-April and mid-August, with a peak in June and July. Winter-run Chinook salmon embryo incubation in the Sacramento River can extend into October. Winter-run Chinook salmon fry rearing in the upper Sacramento River exhibit peak abundance during September. Juveniles rear along the edges of the river and continue to forage in estuarine shallow areas with protective cover, such as tidally influenced sandy beaches and vegetated zones.

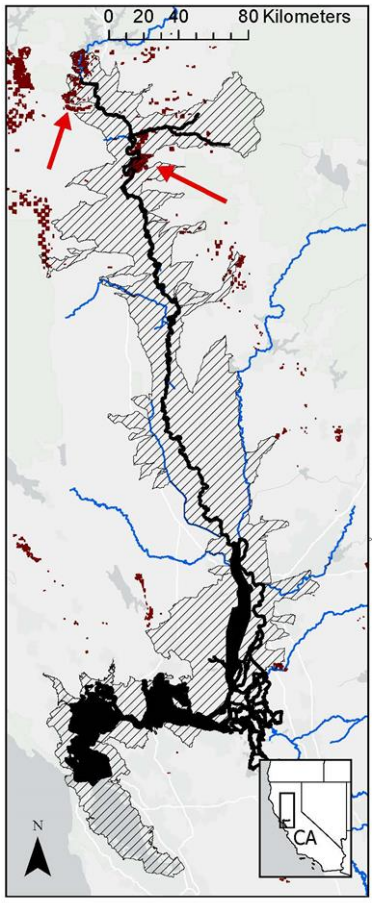


Figure 48. Chinook, Sacramento River winter-run ESU range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

BLM lands are present in the upper parts of this species' range between the Red Bluff diversion dam and Redding. This stretch of the Sacramento River is highly important to this species as it represents the spawning area of the single extant population. BLM vegetation treatment activities in these areas are likely to result in exposure to a significant portion of the adults and juveniles that make up this species. However, these areas are also within a PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) water quantity and quality conditions and substrate supporting spawning, incubation and larval development, and 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands suggest that, although minor, the impacts of these stressors could occur result in reductions in prey availability. This is because juvenile salmon may reside in the northern BLM-dominated spawning reaches for extended periods.

Overall we have a high degree of confidence that the effects of the action represents a medium risk to this species and its designated critical habitat.

8.11 Chinook, Upper Willamette River ESU

Effects analysis summary:

Multiple year classes and life history phases of Upper Willamette River Chinook are present year-round in the rivers and streams that make up the ESU. Adults appear in the lower Willamette River in February, but the majority of the run ascends Willamette Falls in April and May, with a peak in mid- to late May. The adults hold in deep pools over summer and spawn in late fall or early winter when winter storms augment river flows. Fry may emerge from February to March and sometimes as late as June. Juvenile migration varies with three distinct juvenile emigration runs: fry migration in late winter and early spring; sub-yearling migration in fall to early winter; and yearlings migrating in late winter to spring. Sub-yearlings and yearlings rear in the mainstem Willamette River where they also use floodplain wetlands in the lower Willamette River during the winter-spring floodplain inundation period. Juvenile Chinook salmon forage in shallow areas with protective cover along the edges of their natal streams and rivers and within the tidally influenced sandy beaches and vegetated zones.

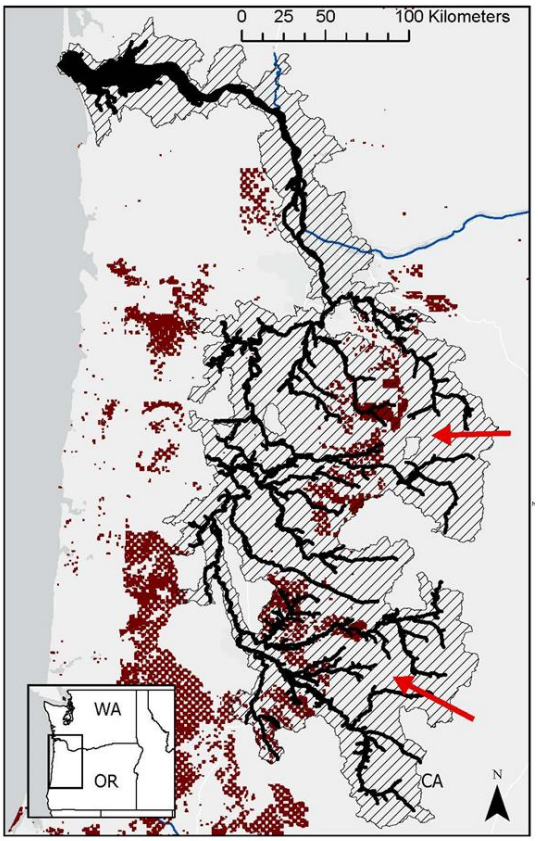


Figure 49. Chinook, Upper Willamette River ESU range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

Most of the populations of this species co-occur with BLM lands. For the Molalla River spring, North Santiam River spring, and South Santiam River spring populations, individuals spawn in BLM land. The McKenzie River spring and the Middle Fork Willamette River spring populations have BLM land in both spawning and rearing areas. BLM vegetation treatment activities in these areas are likely to result in exposure to a significant portion of the adults and juveniles that make up this species. However, these areas are also within a PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) water quantity and quality conditions and substrate supporting spawning, incubation and larval development, and 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands suggest that, although minor, the impacts of these stressors could occur result in reductions in prey availability. This is because juvenile salmon may reside in the BLM-dominated spawning reaches for extended periods.

Overall we have a high degree of confidence that the effects of the action represents a medium risk to this species and its designated critical habitat.

8.12 Coho, Oregon Coast ESU

Effects analysis summary:

The Oregon Coast coho salmon are present year-round in the rivers and streams that make up the ESU. The Oregon Coast coho salmon follow a yearling-type life history strategy, with most juvenile coho salmon migrating to the ocean as smolts in the spring, typically from as late as March into June. Coho salmon smolts out migrating from freshwater reaches may feed and grow in lower mainstem and estuarine habitats for a period of days or weeks before entering the nearshore ocean environment. The areas can serve as acclimation areas, allowing coho salmon juveniles to adapt to saltwater. Oregon Coast coho adults enter fresh water from October through January. The majority of coho salmon adults return to spawn as three-year old fish, having spent about 18 months in freshwater and 18 months in saltwater. The primary exceptions to this pattern are ‘‘jacks,’’ sexually mature males that return to freshwater to spawn after only five to seven months in the ocean.

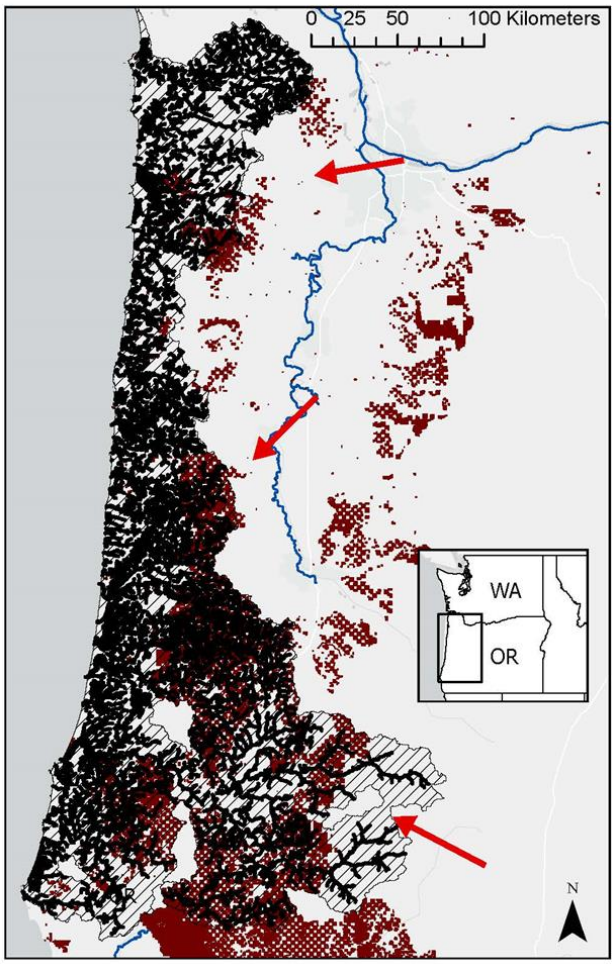


Figure 50. Coho, Oregon Coast ESU range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

BLM land is dominant within this species' range, particularly in the south. In the upper reaches of the Nestucca River fall, Alsea River fall, and Siuslaw River fall populations, spawning and rearing areas are likely to occur in BLM lands. Individuals are also highly likely to occupy BLM lands in the Lower and Middle Umpqua River populations, Coos River fall, and Floras Creek/New River fall populations. BLM vegetation treatment activities in these areas are likely to result in exposure to a significant portion of the adults and juveniles that make up this species. However, these areas are also within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) water quantity and quality conditions and substrate supporting spawning, incubation and larval development, and 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands suggest that, although minor, the impacts of these stressors could occur result in reductions in prey availability. This is because juvenile salmon may reside in the BLM-dominated spawning reaches for extended periods.

Overall we have a high degree of confidence that the effects of the action represents a medium risk to this species and its designated critical habitat.

8.13 Coho, Southern Oregon/Northern California Coast ESU

Effects analysis summary:

Southern Oregon/Northern California coho salmon are present year-round within the rivers and streams that comprise the ESU. Adults typically begin their freshwater spawning migration in the late summer and fall, spawn by mid-winter, and then die. The run and spawning times vary between and within populations. Depending on river temperatures, eggs incubate in redds for 1.5 to four months (October through January) before hatching as alevins. Once most of the yolk sac is absorbed, the 30 to 35 millimeter fry begin emerging from the gravel in search of shallow stream margins for foraging and safety. Coho salmon fry typically transition to the juvenile stage by about mid-June when they are about 50 to 60 mm. Juveniles develop vertical dark bands, and begin partitioning available instream habitat through aggressive interactions with other juvenile fish. Juveniles rear in freshwater for up to 15 months, then migrate to the ocean as smolts in the spring. Coho salmon typically spend two growing seasons in the ocean before returning to their natal stream to spawn as three-year-olds. Some males return to spawn after only six months at sea.

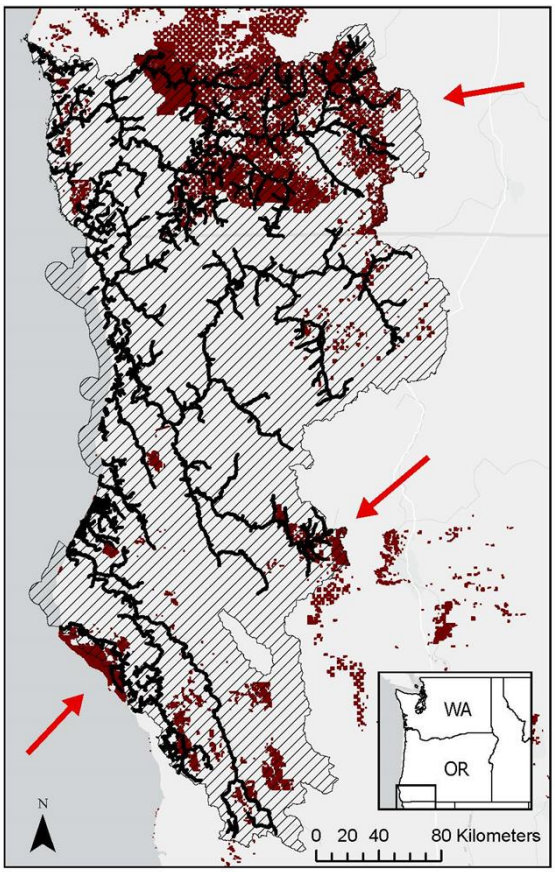


Figure 51. Coho, Southern Oregon/Northern California Coast ESU range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

BLM land is dominant in the northern portions of this species' range. For the Upper Rogue, Middle Rogue and Applegate River populations most high density rearing occurs in the upper watersheds and often immediately below BLM lands. In the south, BLM land is found in the upper reaches of the South fork Trinity River population, and along the coast in the Mattole River and South fork Eel river populations. BLM vegetation treatment activities in these areas are likely to result in exposure to adults and juveniles in these populations. However, these areas are also within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) water quantity and quality conditions and substrate supporting spawning, incubation and larval development, and 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands suggest that, although minor, the impacts of these stressors could occur result in reductions in prey availability. This is because juvenile salmon may reside in the BLM-dominated spawning reaches for extended periods.

Overall we have a high degree of confidence that the effects of the action represents a medium risk to this species and its designated critical habitat.

8.14 Coho, Central California Coast ESU

Effects analysis summary:

Central California coast coho salmon are present year-round within the rivers and streams comprising the ESU. Adults typically enter freshwater from November through January, and spawn into February or early March. The upstream migration towards spawning areas coincides with large increases in stream flow. Coho salmon often are not able to enter freshwater until heavy rains have caused breaching of sand bars that form at the mouths of many coastal California streams. Spawning occurs in streams with direct flow to the ocean, or in large river tributaries. Eggs incubate in redds from November through April, and hatch into alevins after a period of 35-50 days. The period of incubation is inversely related to water temperature. Alevins remain in the gravel for two to ten weeks then emerge into the water column as young juveniles. Juveniles form schools in shallow water along the undercut banks of the stream to avoid predation. The juveniles feed heavily during this time, and as they grow they set up individual territories. Smolts may spend time residing in the estuarine habitat prior to ocean entry, to allow for the transition to the saline environment. After entering the ocean, the immature salmon initially remain in the nearshore waters close to their natal stream.

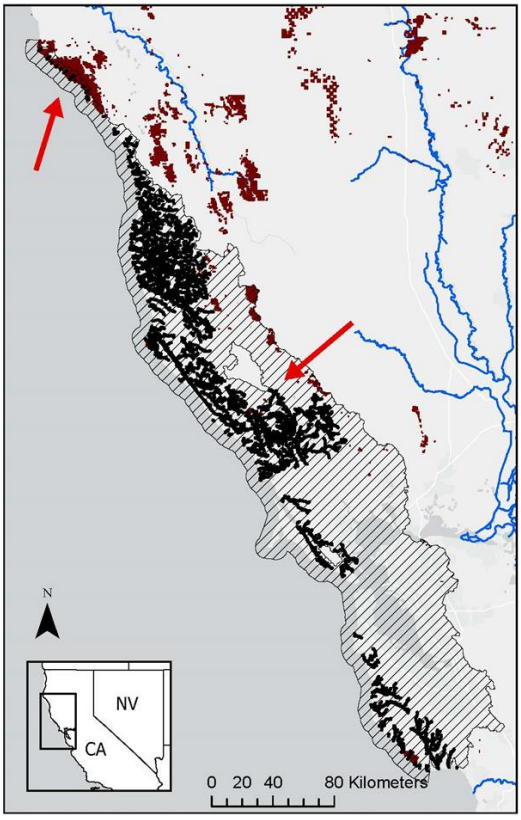


Figure 52. Coho, Central California Coast ESU range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

The extent of BLM lands within this species' range is low. Coho streams in the north are within BLM lands, and there are several other isolated areas in headwaters. BLM vegetation treatment activities in these areas are likely to result in exposure to adults and juveniles, however the overall level of exposure to this species is low. However, these areas are within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) Water quality and forage supporting juvenile development; and, 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands ensures that the vast majority of habitat will not experience even the low-level effects associated with PULA buffered habitats.

Overall we have a high degree of confidence that the effects of the action represents a low risk to this species and its designated critical habitat.

8.15 Coho, Lower Columbia River ESU

Effects analysis summary:

Lower Columbia River coho salmon are present year-round within the rivers and streams comprising the ESU. Most spawning occurs from November to January, but some occurs as late as March. Coho salmon typically spawn in small to medium, low- to-moderate elevation streams from valley bottoms to stream headwaters. Juveniles typically rear in freshwater for more than a year. After emergence, coho salmon fry move to shallow, low-velocity rearing areas, primarily along the stream edges and inside channels. Juvenile coho salmon favor pool habitat and often congregate in quiet backwaters, side channels, and small creeks with riparian cover and woody debris. Side-channel rearing areas are particularly critical for overwinter survival, which is a key regulator of freshwater productivity. Most juvenile coho salmon migrate seaward as smolts in April to June, typically during their second year. Salmon that have stream-type life histories, such as coho, typically do not linger for extended periods in the Columbia River estuary, but the estuary is a critical habitat used for feeding during the physiological adjustment to salt water. Juvenile coho salmon are present in the Columbia River estuary from March to August.

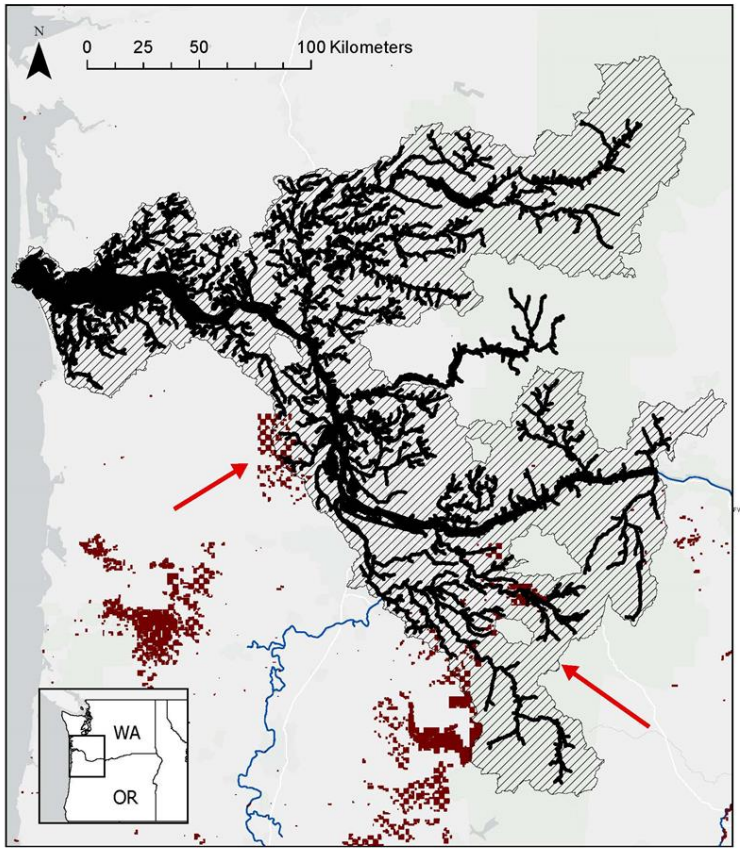


Figure 53. Coho, Lower Columbia River ESU range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

BLM land occurs in several places within this species' range. Areas where individuals are likely to be exposed include Scappoose Creek and Sandy River, both of which comprise their own populations. BLM vegetation treatment activities in these areas are likely to result in exposure to adults and juveniles in these populations. However, these areas are within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) Water quality and forage supporting juvenile development; and, 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands ensures that the vast majority of habitat will not experience even the low-level effects associated with PULA buffered habitats.

Overall we have a high degree of confidence that the effects of the action represents a low risk to this species and its designated critical habitat.

8.16 Sockeye, Snake River ESU

Effects analysis summary:

The Snake River sockeye salmon ESU includes all naturally spawned anadromous and residual sockeye salmon originating from the Snake River basin, as well as sockeye salmon from the Redfish Lake Captive Broodstock Program, and the Snake River Sockeye Salmon Hatchery Program. Snake River sockeye are present year-round within the ESU boundaries. Spawning generally occurs in late summer and fall. In lakes, sockeye salmon commonly spawn along "beaches" where underground seepage provides fresh oxygenated water. Incubation period is a function of water temperature and generally lasts 100-200 days. Lakeshore-emerged and river-emerged sockeye salmon fry primarily rear in the lakes. In the early fry stage from spring to early summer, juveniles forage exclusively in the warmer shoreline zone of the lake. Sub-yearling sockeye salmon move from the shoreline habitat to open water to feed. Juveniles generally rear in lakes from one to three years after emergence. However, some river-spawned sockeye may migrate to sea in their first year.

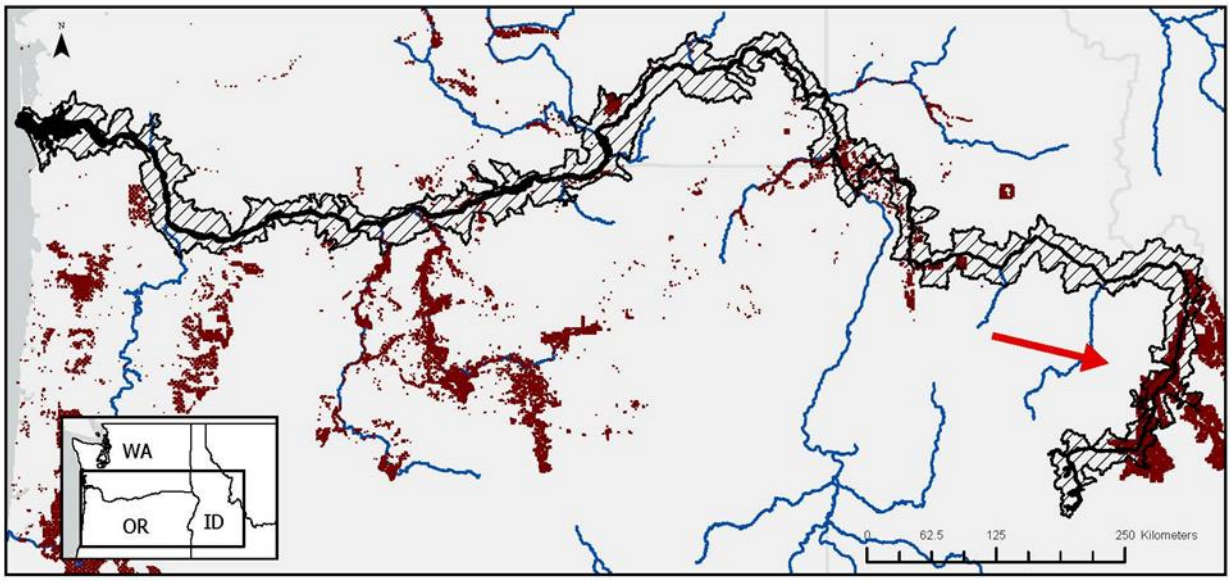


Figure 54. Sockeye, Snake River ESU range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

This species is comprised of a single population whose native spawning areas are a series of lakes in the Sawtooth Valley, ID. The Columbia River, Snake River and Salmon River migratory corridors all traverse BLM lands. BLM vegetation treatment activities in these areas are likely to result in exposure to a significant portion of the adults and juveniles that make up this species. However, these areas are also within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one

percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) water quantity and quality conditions and substrate supporting spawning, incubation and larval development, and 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands suggest that, although minor, the impacts of these stressors could occur result in reductions in prey availability. This is because juvenile salmon may reside in the BLM-dominated spawning reaches for extended periods.

Overall we have a high degree of confidence that the effects of the action represents a medium risk to this species and its designated critical habitat.

8.17 Steelhead, Northern California DPS

Effects analysis summary:

The Northern California steelhead are present year-round in the rivers and streams that make up the DPS. This DPS includes both winter- and summer-run steelhead. In the Mad and Eel Rivers, immature steelhead may return to fresh water as "half-pounders" after spending only two to four months in the ocean. Generally, a half-pounder will overwinter in fresh water and return to the ocean in the following spring. Full grown adults return to freshwater between November and February. Spawning typically occurs from December to February. Fry emergence is dependent on water temperature, but generally takes place between March and May. Rearing takes place year-round with multiple year-classes stacking. Juvenile out-migration appears throughout the year with peaks in the late spring/early summer and in the late fall/early winter periods.

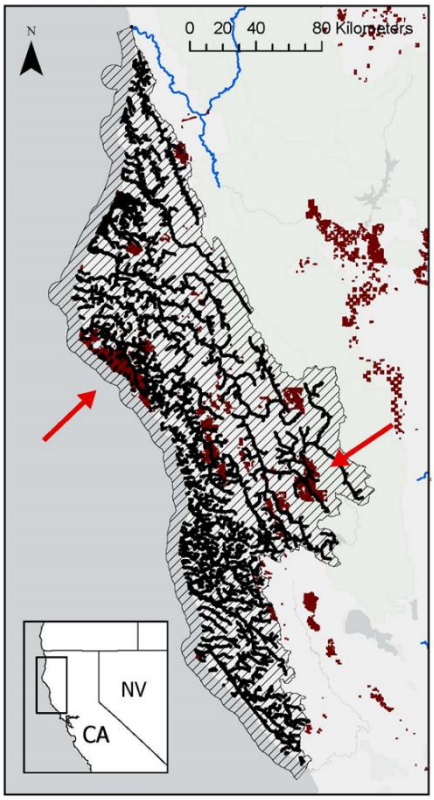


Figure 55. Steelhead, Northern California DPS range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

Several populations of this species occupy BLM lands. Within the North Coastal diversity strata, the Mattole River and South fork Eel River populations have spawning and rearing habitat in BLM lands. The Upper Eel River population also traverses BLM land. All three of these populations have been deemed essential to the recovery of the species. BLM vegetation treatment activities in these areas are likely to result in exposure to adults and juveniles in these populations. However, these areas are also within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) water quantity and quality conditions and substrate supporting spawning, incubation and larval development, and 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands suggest that, although minor, the impacts of these stressors could occur result in reductions in prey availability. This is because juvenile salmon may reside in the BLM-dominated spawning reaches for extended periods.

Overall we have a high degree of confidence that the effects of the action represents a medium risk to this species and its designated critical habitat.

8.18 Steelhead, Upper Columbia River DPS

Effects analysis summary:

The Upper Columbia River steelhead DPS is composed of four populations: the Wenatchee, Entiat, Methow, and Okanogan. All UCR steelhead are summer-run steelhead. Multiple year-classes of steelhead are present year-round in the rivers and streams that make up the DPS. Adults return in the late summer and early fall, with most migrating relatively quickly to their natal tributaries. A portion of the returning adult steelhead overwinters in mainstem reservoirs, passing over upper-mid-Columbia dams in April and May of the following year. Spawning occurs in the late spring of the year following river entry. Juvenile steelhead spend one to seven years rearing in freshwater before migrating to sea. Smolt outmigrations are predominantly year class two and three (juveniles), although some of the oldest smolts are reported from this DPS at seven years. Most adult steelhead return to freshwater after one or two years at sea.

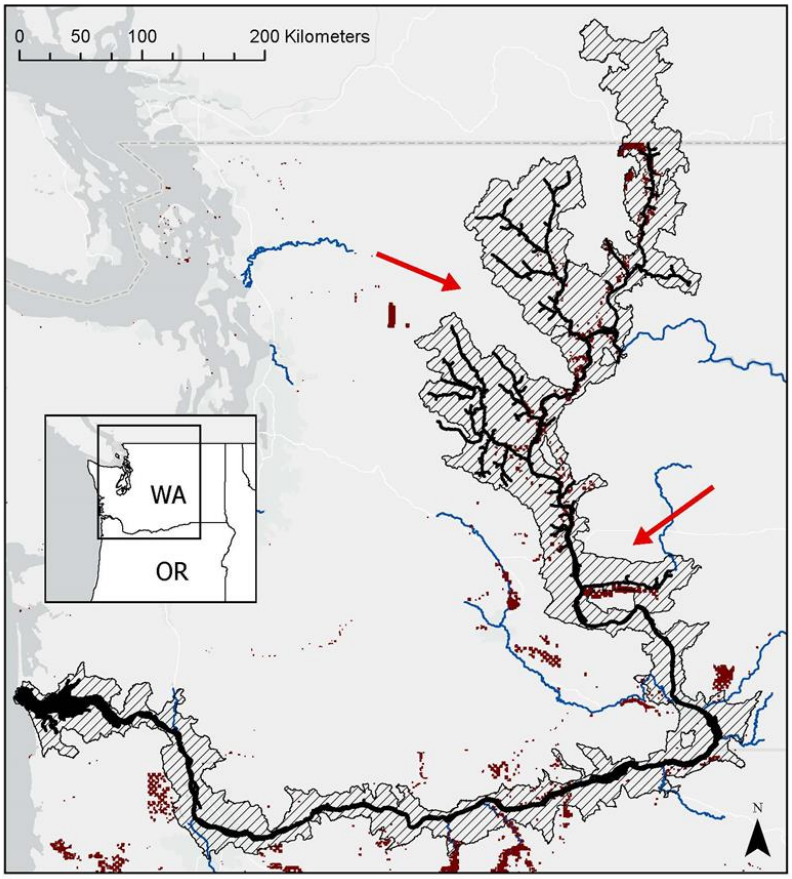


Figure 56. Steelhead, Upper Columbia River DPS range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

BLM lands are dispersed throughout this species' range in the upper Columbia River. In addition to areas along the migratory corridor, BLM lands are within each of the three extant populations: Wenatchee River, Entiat River and Methow River. All three of these populations are at high overall

risk of extinction. BLM vegetation treatment activities in these areas are likely to result in exposure to a significant portion of the adults and juveniles that make up this species. However, these areas are also within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) water quantity and quality conditions and substrate supporting spawning, incubation and larval development, and 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands suggest that, although minor, the impacts of these stressors could occur result in reductions in prey availability. This is because juvenile salmon may reside in the BLM-dominated spawning reaches for extended periods.

Overall we have a high degree of confidence that the effects of the action represents a medium risk to this species and its designated critical habitat.

8.19 Steelhead, South-Central California Coast DPS

Effects analysis summary:

The South Central California coast steelhead are present year-round in the rivers and streams that make up the habitat within the range of this DPS. Only winter-run steelhead are found in this DPS. Adults return to freshwater between January and March. Spawning typically occurs from February to March. Fry emergence is dependent on water temperature, but generally takes place between April and May. Rearing takes place year-round with multiple year-classes stacking. Juvenile out-migration appears throughout the year with peaks in the late spring/early summer and in the late fall/early winter periods.

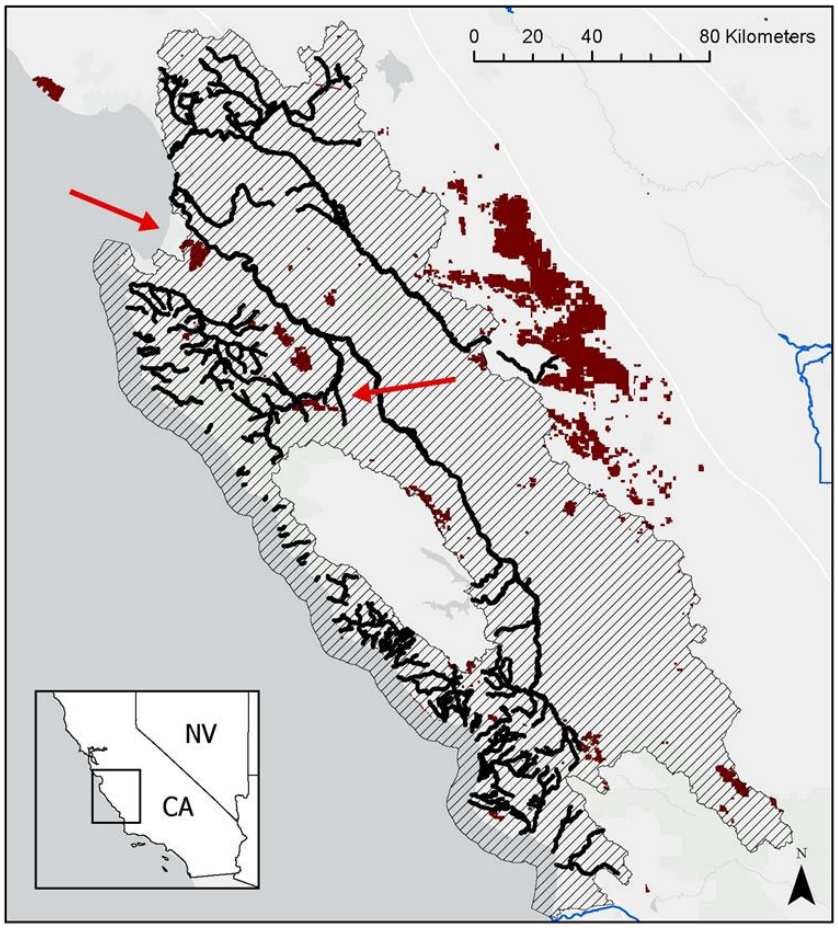


Figure 57. Steelhead, South-Central California Coast DPS range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

BLM land occurs only minimally within this species' range. Areas where individuals are likely to be exposed include Lower Salinas River and within the Arroyo Seco basin. BLM vegetation treatment activities in these areas are likely to result in exposure to adults and juveniles in these populations. However, these areas are within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) Water quality and forage supporting juvenile development; and, 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands ensures that the vast majority of habitat will not experience even the low-level effects associated with PULA buffered habitats.

Overall we have a high degree of confidence that the effects of the action represents a low risk to this species and its designated critical habitat.

8.20 Steelhead, Central California Coast DPS

Effects analysis summary:

Multiple year-classes of Central California coast steelhead are present year-round in the rivers and streams that make up the DPS range. The DPS is composed of winter-run fish. Adults return to the Russian River and migrate upstream from December – April, and smolts emigrate between March – May. Most spawning takes place from January through April. Fry emergence takes place from March to May. Age at smoltification typically ranges for one to four years.

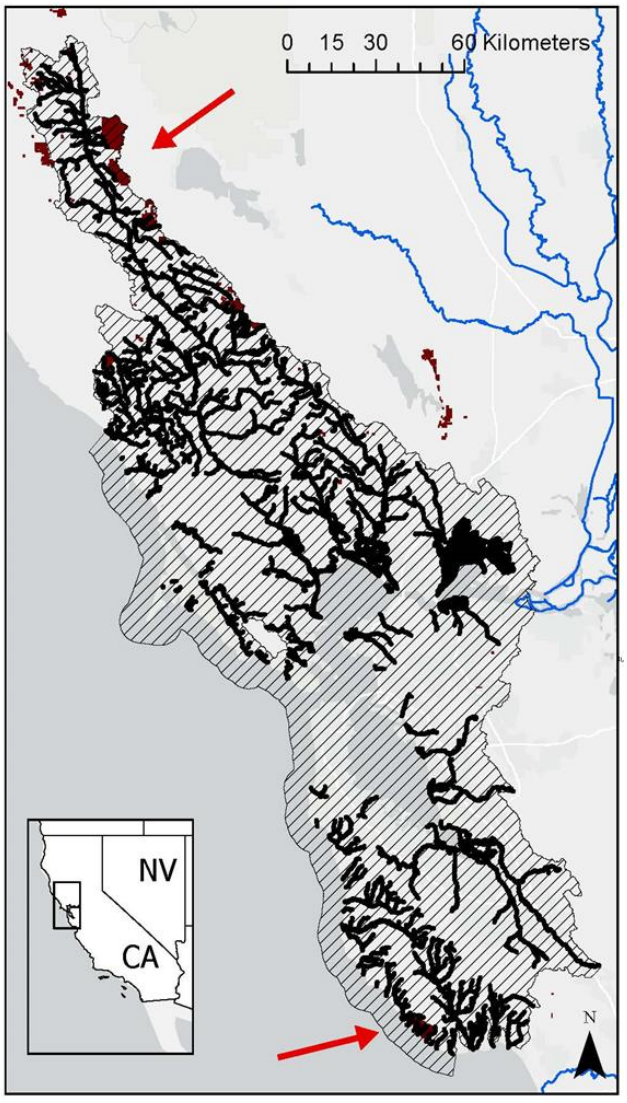


Figure 58. Steelhead, Central California Coast DPS range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

BLM land occurs in several places within this species' range. Areas where vegetation treatment activities are likely to result in exposure to individuals are the tributaries to the upper Russian River population and coastal areas in the Santa Cruz Mountains diversity strata. Activities in these areas

are likely to result in exposure to adults and juveniles in these populations. However, these areas are within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) Water quality and forage supporting juvenile development; and, 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands ensures that the vast majority of habitat will not experience even the low-level effects associated with PULA buffered habitats.

Overall we have a high degree of confidence that the effects of the action represents a low risk to this species and its designated critical habitat.

8.21 Steelhead, Upper Willamette River DPS

Effects analysis summary:

The Upper Willamette River steelhead are present year-round in the rivers and streams that make up the DPS. Upper Willamette River steelhead do not ascend to their spawning areas until late March or April, which is late compared to other West Coast winter steelhead. Spawning occurs from April to June 1. The unusual run timing may be an adaptation for ascending the Willamette Falls, which may have facilitated reproductive isolation of the stock. Fry emerge from the gravels between July and September. The smolt migration past Willamette Falls also begins in early April and proceeds into early June, peaking in early- to mid-May. Smolts generally migrate through the Columbia via the Multnomah Channel rather than the mouth of the Willamette River. As with other coastal steelhead, the majority of juveniles smolt and outmigrate after two years; adults return to their natal rivers to spawn after spending two years in the ocean. Repeat spawners are predominantly female and generally account for less than 10 percent of the total run size.

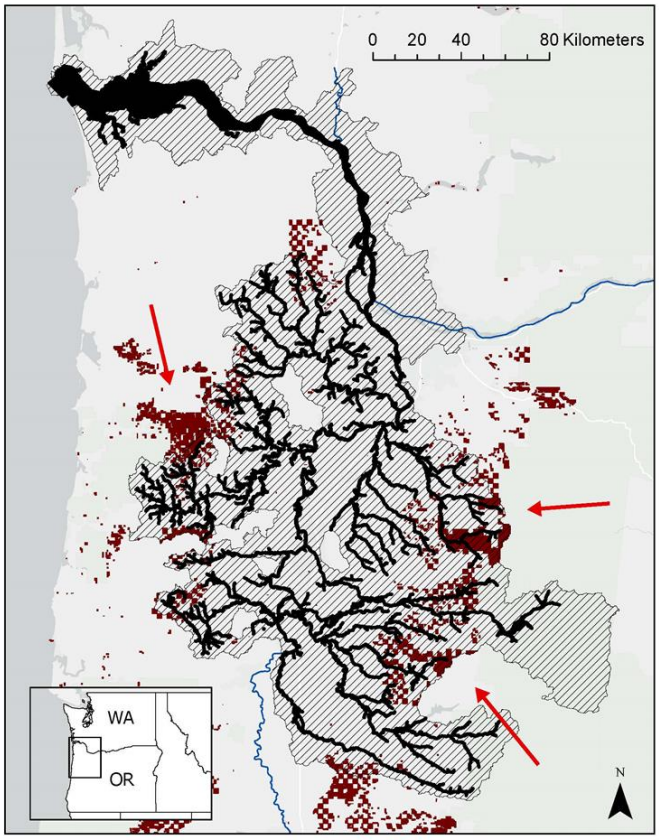


Figure 59. Steelhead, Upper Willamette River DPS range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

Most of the populations of this species co-occur with BLM lands. For the Molalla River spring, North Santiam River spring, and South Santiam River spring populations, individuals spawn in

BLM land. BLM vegetation treatment activities in these areas are likely to result in exposure to a significant portion of the adults and juveniles that make up this species. However, these areas are also within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) water quantity and quality conditions and substrate supporting spawning, incubation and larval development, and 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands suggest that, although minor, the impacts of these stressors could occur result in reductions in prey availability. This is because juvenile salmon may reside in the BLM-dominated spawning reaches for extended periods.

Overall we have a high degree of confidence that the effects of the action represents a medium risk to this species and its designated critical habitat.

8.22 Steelhead, California Central Valley DPS

Effects analysis summary:

Central Valley steelhead adults enter fresh water from August through April. They hold until flows are high enough in tributaries to enter for spawning. Steelhead adults typically spawn from December through April, with peaks from January through March in small streams and tributaries where cool, well oxygenated water is available year-round. Central Valley steelhead spawn downstream of dams on every major tributary within the Sacramento and San Joaquin River systems. Regardless of life history strategy, for the first year or two of life steelhead are found in cool, clear, fast flowing permanent streams and rivers where riffles predominate over pools, there is ample cover from riparian vegetation or undercut banks, and invertebrate life is diverse and abundant. Steelhead typically migrate to marine waters after spending two years in freshwater. They reside in marine waters for typically two or three years prior to returning to their natal stream to spawn as four- or five-year-olds.

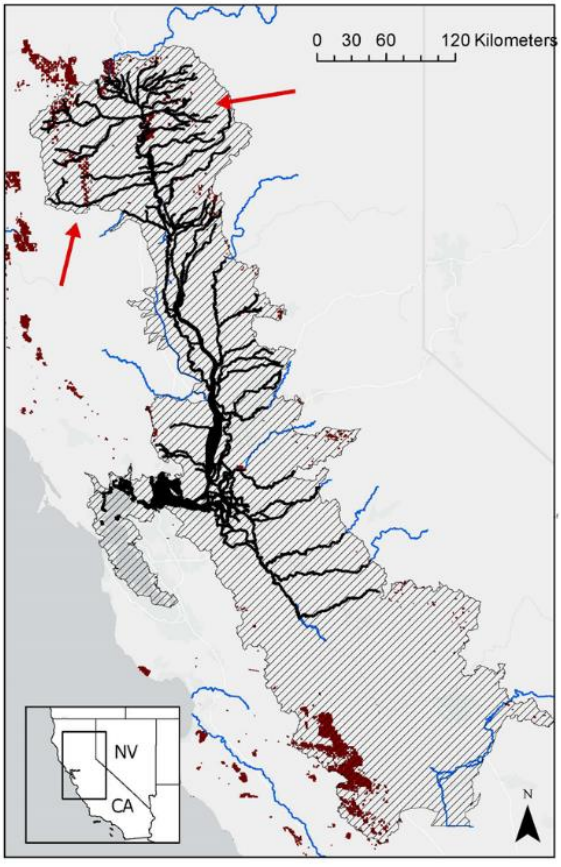


Figure 60. Steelhead, California Central Valley DPS range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

BLM lands are found in the northern portion of this species' range. Portions of Clear Creek, Cottonwood Creek and Battle Creek all run through BLM land in this area. As described in the

status of the species section, Battle Creek, in particular, is an area of importance to the species where individual density is likely to be high. BLM vegetation treatment activities in these areas are likely to result in exposure to a significant portion of the adults and juveniles that make up this species. However, these areas are also within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) water quantity and quality conditions and substrate supporting spawning, incubation and larval development, and 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands suggest that, although minor, the impacts of these stressors could occur result in reductions in prey availability. This is because juvenile salmon may reside in the BLM-dominated spawning reaches for extended periods.

Overall we have a high degree of confidence that the effects of the action represents a medium risk to this species and its designated critical habitat.

8.23 Steelhead, Southern California DPS

Effects analysis summary:

In general, migration and life history patterns of Southern California steelhead populations are dependent on rainfall and streamflow. Steelhead within this DPS can withstand higher temperatures compared to populations to the north. The relatively warm and productive waters of the Ventura River have resulted in more rapid growth of juvenile steelhead compared to the more northerly populations. The Southern California steelhead are present year-round in the rivers and streams that make up the DPS. Adults typically enter freshwater between February and May and spawning occurs between April and late May. Fry emergence from the gravel takes place in the early summer months between June and July. Juveniles rear for one or more years before migrating to the estuaries and the ocean.

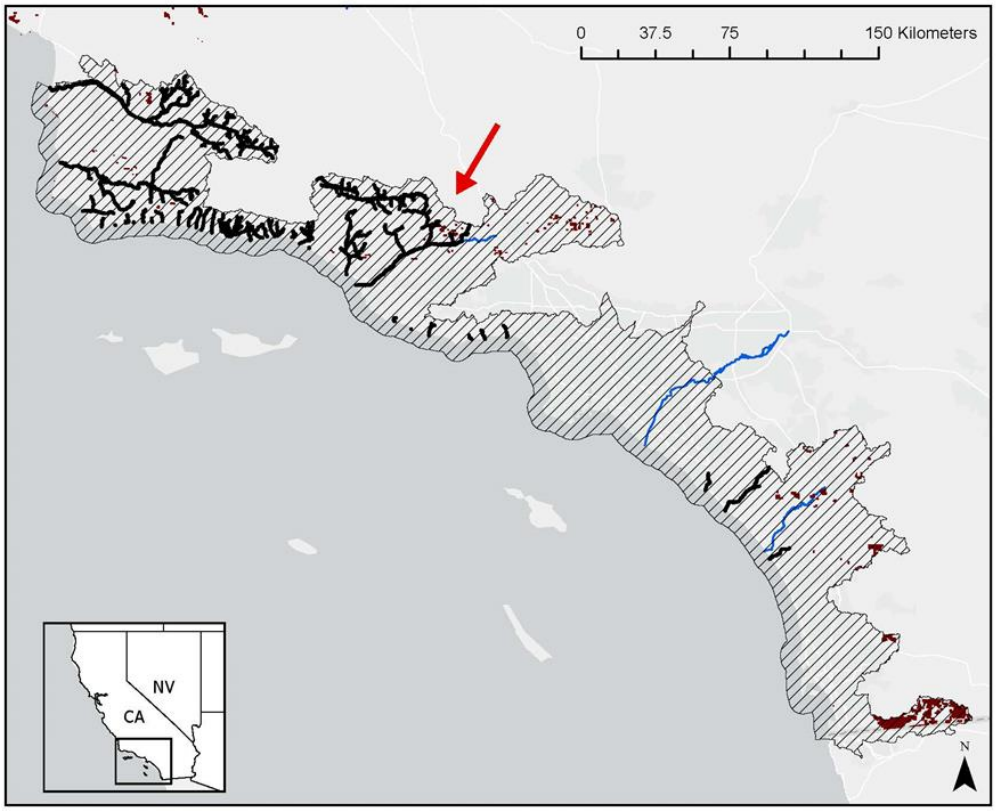


Figure 61. Steelhead, Southern California DPS range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

BLM land occurs in several places within this species' range. Areas where vegetation treatment activities are likely to result in exposure to individuals include Sespe Creek, a tributary to the Santa Clara River. This area is designated critical habitat for this species. Activities in these areas are likely to result in exposure to adults and juveniles in these populations. However, these areas are within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) Water quality and forage supporting juvenile development; and, 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands ensures that the vast majority of habitat will not experience even the low-level effects associated with PULA buffered habitats.

Overall we have a high degree of confidence that the effects of the action represents a low risk to this species and its designated critical habitat.

8.24 Steelhead, Middle Columbia River DPS

Effects analysis summary:

The Middle Columbia River steelhead are present year-round in the rivers and streams that make up the DPS. Adult steelhead enter freshwater from June through August. The only exceptions are populations of inland winter-run steelhead which occur in the Klickitat River and Fifteenmile Creek. The majority of juveniles smolt and outmigrate as two-year olds. Most of the rivers in this region produce about equal or higher numbers of adults that spend one year in the ocean versus two years. However, summer-run steelhead in Klickitat River have a life cycle more like LCR steelhead whereby the majority of returning adults have spent two years in the ocean. Adults may hold in the river up to a year before spawning. Spawning takes place January through July. Fry typically emerge from the gravels from April through August.

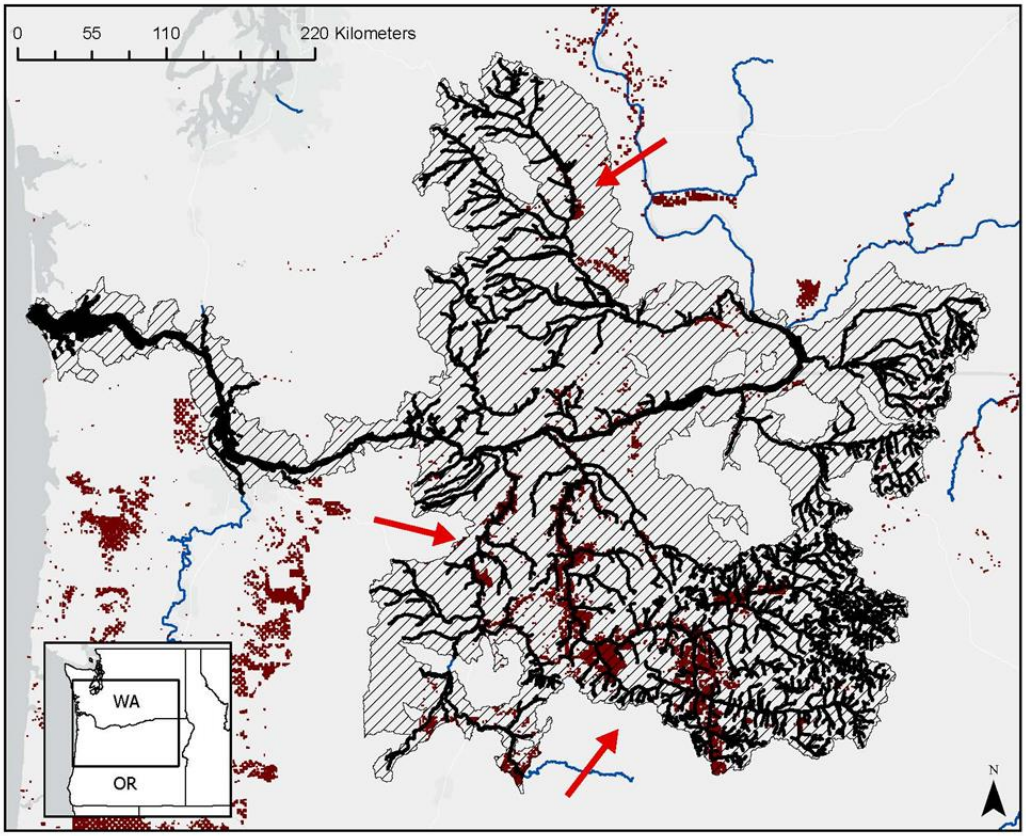


Figure 62. Steelhead, Middle Columbia River DPS range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

BLM lands are dispersed throughout this species' range. In addition to areas along the migratory corridors, BLM lands can be found throughout the spawning and rearing areas within the John Day River major population group. BLM lands are also found within the Deschutes River and Yakima River upper mainstem populations. BLM vegetation treatment activities in these areas are likely to

result in exposure to a significant portion of the adults and juveniles that make up this species. However, these areas are also within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) water quantity and quality conditions and substrate supporting spawning, incubation and larval development, and 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands suggest that, although minor, the impacts of these stressors could occur result in reductions in prey availability. This is because juvenile salmon may reside in the BLM-dominated spawning reaches for extended periods.

Overall we have a high degree of confidence that the effects of the action represents a medium risk to this species and its designated critical habitat.

8.25 Steelhead, Lower Columbia River DPS

Effects analysis summary:

Lower Columbia River steelhead includes both summer- and winter-run stocks. Summer-run steelhead return sexually immature to the Columbia River from May to November, and spend several months in fresh water prior to spawning. Winter-run steelhead enter fresh water from November to April, are close to sexual maturation during freshwater entry, and spawn shortly after arrival in their natal streams. Between the two runs, spawning extends from March to the end of June. Fry will begin to emerge in May and will continue to do so into August. The majority of juvenile steelhead remain for two years in freshwater environments before ocean entry in spring. Both winter- and summer-run adults normally return after two years in the marine environment.

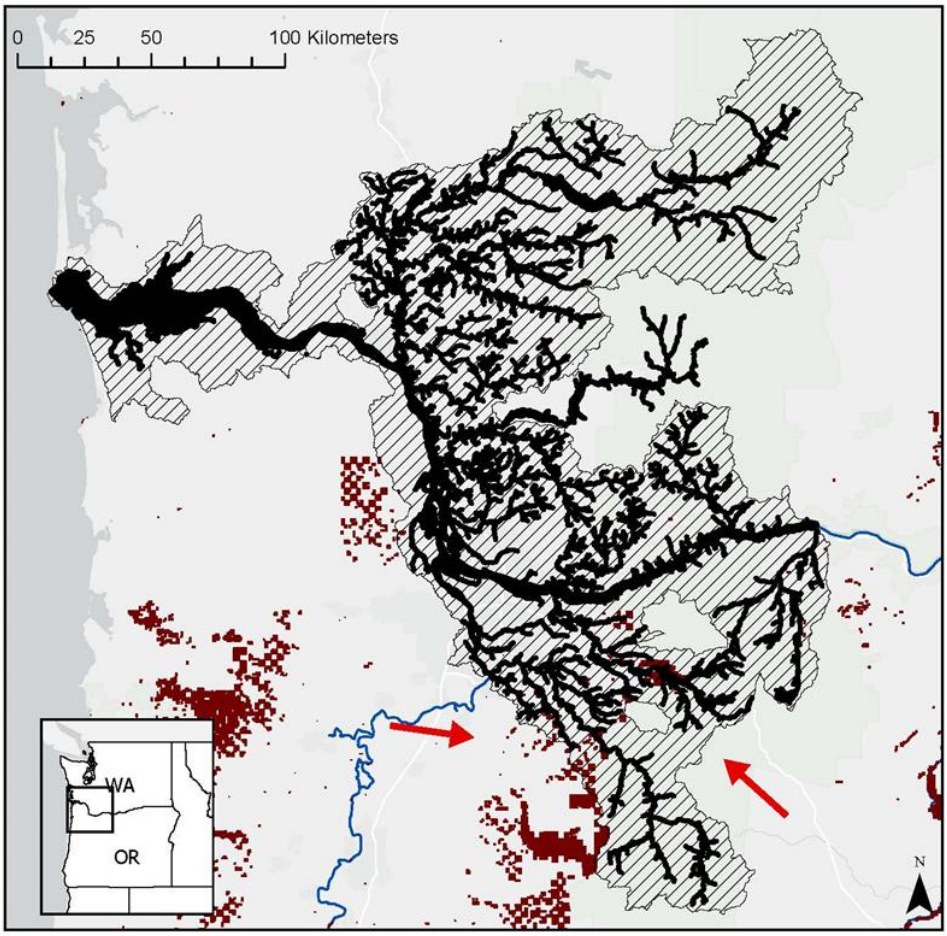


Figure 63. Lower Columbia River DPS range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

BLM land occurs in several places within this species' range. Areas where individuals are likely to be exposed include the Clackamas River and Sandy River, both of which comprise their own populations. BLM vegetation treatment activities in these areas are likely to result in exposure to adults and juveniles in these populations. However, these areas are within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) Water quality and forage supporting juvenile development; and, 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands ensures that the vast majority of habitat will not experience even the low-level effects associated with PULA buffered habitats.

Overall we have a high degree of confidence that the effects of the action represents a low risk to this species and its designated critical habitat.

8.26 Steelhead, Snake River Basin DPS

Effects analysis summary:

Multiple year-classes of the Snake River Basin steelhead are present year-round in the rivers and streams that make up the DPS. They enter the Columbia River from late June to October. After remaining in the river through the winter, steelhead spawn the following spring (March to May). A-run steelhead are typically smaller, have a shorter freshwater and ocean residence (generally one year in the ocean), and begin their up-river migration earlier in the year. B-run steelhead are larger, spend more time in fresh water and the ocean (generally two years in ocean), and appear to start their upstream migration later in the year. Snake Rriver basin steelhead usually smolt after two or three years. Typically, fry emergence occurs between April and July. Juveniles will rear in fresh water for two years or more before migrating down the Columbia River to the estuary and ocean.

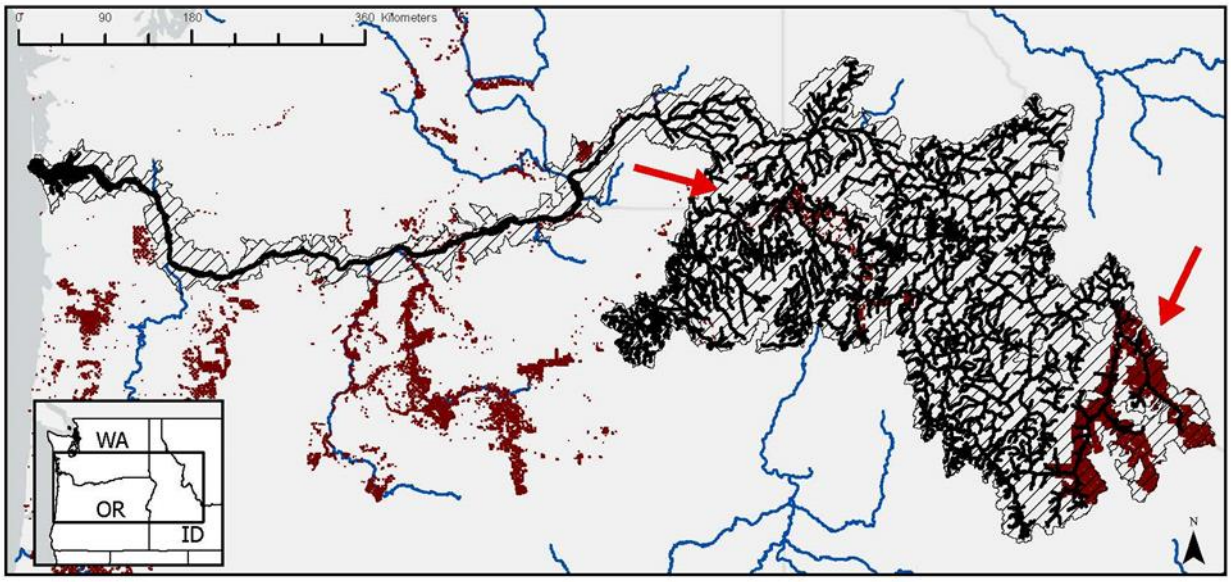


Figure 64. Steelhead, Snake River Basin DPS range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

The Salmon river major population group is strongly associated with BLM lands, particularly the Pahsimeroi River and Salmon River populations. BLM land is also located around the confluence of the Snake, Salmon, and Grand Ronde Rivers. BLM vegetation treatment activities in these areas are likely to result in exposure to adults and juveniles in these populations. However, these areas are also within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) water quantity and quality conditions

and substrate supporting spawning, incubation and larval development, and 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands suggest that, although minor, the impacts of these stressors could occur result in reductions in prey availability. This is because juvenile salmon may reside in the BLM-dominated spawning reaches for extended periods.

Overall we have a high degree of confidence that the effects of the action represents a medium risk to this species and its designated critical habitat.

8.27 Steelhead, Puget Sound DPS

Effects analysis summary:

The Puget Sound steelhead DPS contains both winter-run and summer-run steelhead. Adult winter-run steelhead generally return to Puget Sound tributaries from December to April. Spawning occurs from January to mid-July, with peak spawning occurring from mid-April through May. Prior to spawning, maturing adults hold in pools or in side channels to avoid high winter flows. Fry emergence can take place between April and September. The majority of juveniles reside in the river system for two years with a minority migrating to the ocean as one- or three-year-olds. Smoltification and seaward migration occur from April to mid-May. The ocean growth period for Puget Sound steelhead ranges from one to three years. Juveniles or adults may spend considerable time in the protected marine environment of the fjord-like Puget Sound during migration to the ocean.

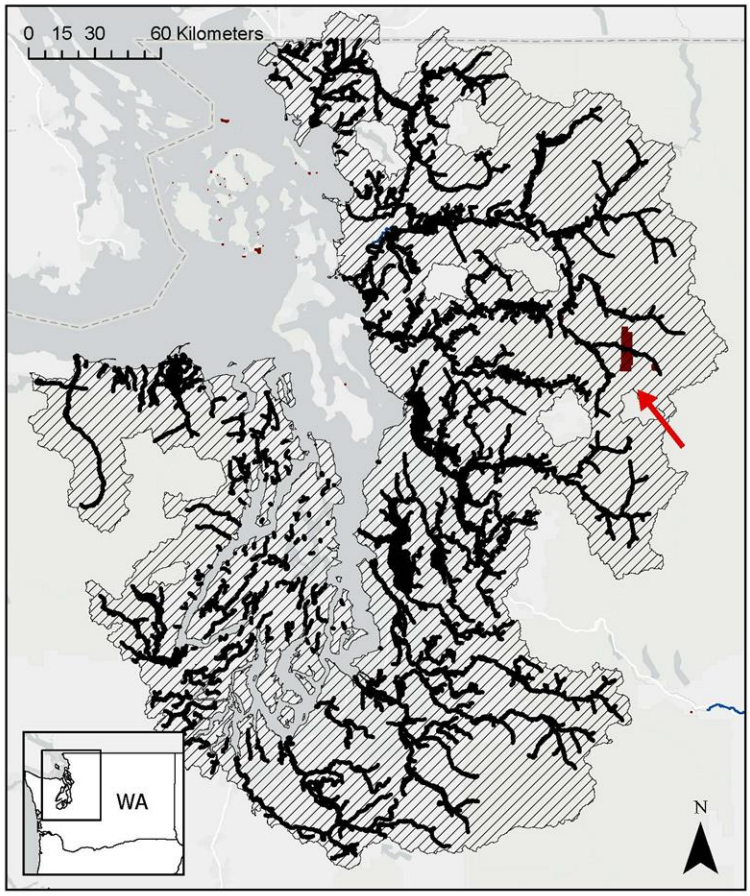


Figure 65. Steelhead, Puget Sound DPS range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

The extent of BLM lands within this species' range is low. The largest area of BLM land is along the White Chuck River, a contributing tributary to the Sauk River population. Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats

within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) Water quality and forage supporting juvenile development; and, 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks etc.

The distribution of this species' populations relative to the location of BLM lands ensures that the vast majority of habitat will not experience even the low-level effects associated with PULA buffered habitats.

Overall we have a high degree of confidence that the effects of the action represents a low risk to this species and its designated critical habitat.

8.28 Green Sturgeon, Southern DPS

Effects analysis summary:

Green sturgeon are present in the Sacramento River year-round. Adult Southern DPS green sturgeon enter San Francisco Bay in late winter through early spring, migrate upstream, and spawn from April through early July. Post-spawn fish typically congregate and hold for several months in a few deep pools in the upper mainstem Sacramento River near spawning sites and migrate back downstream when river flows increase in fall. They re-enter the ocean during the winter months (November through January) and begin their marine migration north along the coast. Green sturgeon eggs primarily adhere to gravel or cobble substrates, or settle into crevices. Larvae disperse at approximately 12 days post-hatch, and are suspected to remain near spawning habitats. Juveniles typically enter the Delta as sub-yearlings or yearlings to rear prior to ocean entry. The San Francisco Bay Delta Estuary provides year-round rearing habitat for juveniles, as well as foraging habitat for non-spawning adults and subadults in the summer months.

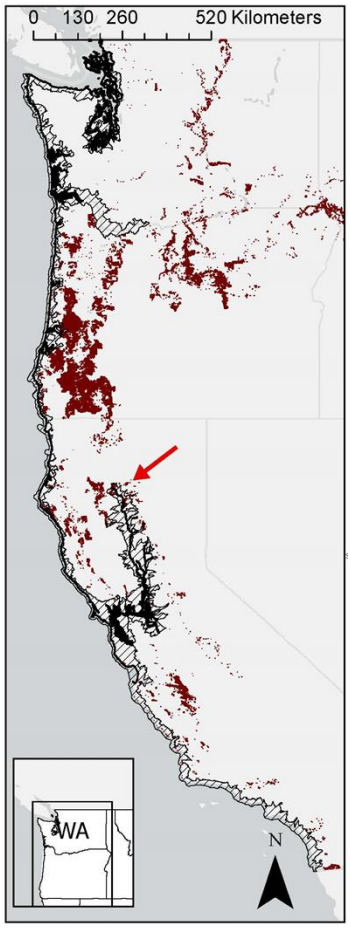


Figure 66. Green Sturgeon, Southern DPS range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

The extent of BLM lands within this species' range is low. However, BLM land in the upper Sacramento River coincide with the key spawning and rearing locations of this species. Although the extent is low, BLM vegetation treatment activities in these areas are likely to result in exposure to a significant portion of the adults and juveniles that make up this species. However, these areas are also within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth. The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) Abundant prey items for larval, juvenile, subadult, and adult life stages; and 2) Water quality, including temperature, salinity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages.

The distribution of this species' populations relative to the location of BLM lands suggest that, although minor, the impacts of these stressors could occur result in reductions in prey availability. This is because juvenile salmon may reside in the BLM-dominated spawning reaches for extended periods.

Overall we have a high degree of confidence that the effects of the action represents a medium risk to this species and its designated critical habitat.

8.29 Eulachon, Southern DPS

Effects analysis summary:

In the portion of the species' range that lies south of the U.S.–Canada border, most eulachon production originates in the Columbia River Basin, including the Columbia River, the Cowlitz River the Grays River, the Kalama River, the Lewis River, and the Sandy River. In the Columbia River and further south, spawning occurs from late January to March. Further north, the peak of eulachon runs in Washington State from February through March. Females lay between 7,000 and 60,000 eggs over sand, course gravel or detrital substrate. Eggs attach to gravel or sand and incubate for 30 to 40 days after which larvae drift to estuaries and coastal marine waters. Larvae and young juveniles become widely distributed in coastal waters. Adult eulachon are found in coastal and offshore marine habitats. With the exception of some individuals in Alaska, eulachon generally die after spawning.

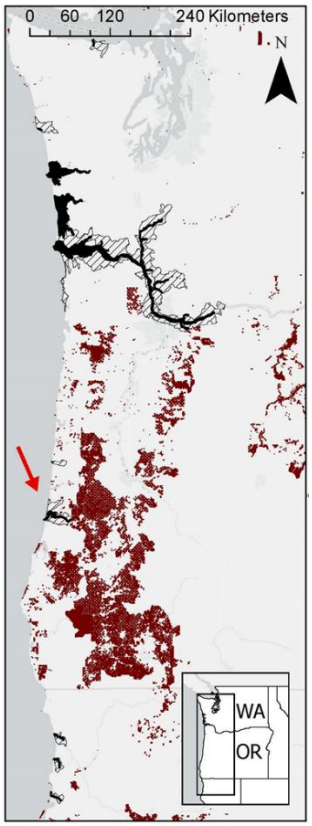


Figure 67. Eulachon, Southern DPS range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

The extent of BLM lands within this species' range is low. The main area of co-occurrence is the Umpqua River, which is designated critical habitat for this species. However, these areas are within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) Water quality suitable for spawning and viability of all eulachon life stages; and 2) Prey resources to support larval eulachon survival. The distribution of this species' populations relative to the location of BLM lands ensures that the vast majority of habitat will not experience even the low-level effects associated with PULA buffered habitats.

Overall we have a high degree of confidence that the effects of the action represents a low risk to this species and its designated critical habitat.

8.30 Black Abalone

Effects analysis summary:

The black abalone has separate sexes and is a broadcast spawner. As spawning occurs, gametes are dispersed from the gonads of both parents into the sea and fertilization is entirely external. The embryos and larvae that result from this process are small and unprotected, obtain no parental care or safeguard of any kind, and are exposed to a wide range of physical and biological sources of mortality. The average life expectancy for an abalone that reaches adulthood is 30 years. Adults attain a maximum shell length of approximately 200 millimeters. Female black abalone become sexually mature at a length of about 50 millimeters, and males at about 40 millimeters. Black abalone spawning season is between April and September with peak times occurring during the late summer and early autumn. Black abalone are most commonly observed in the mid to low intertidal, in complex habitats with deep crevices that provide shelter for juvenile recruitment and adult survival.

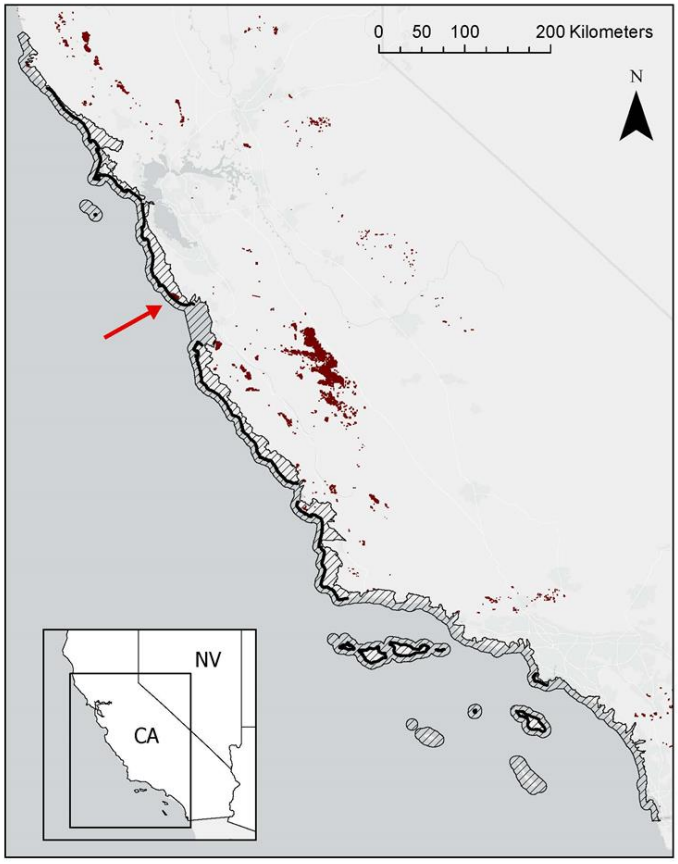


Figure 68. Black Abalone range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

The extent of BLM lands within this species' range is low. The main area of proximity is along the coast near Santa Cruz, CA. Black abalone are most commonly observed in the mid to low intertidal,

in complex habitats with deep crevices that provide shelter for juvenile recruitment and adult survival. The coastal areas north of Santa Cruz is designated critical habitat for this species. However, these areas are within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

The complete list of PBFs for this species is provided in Appendix C. The PBF most vulnerable to the effects of this action are: 1) Food resources: Bacterial and diatom films, algae; and 2) Suitable water quality. The distribution of this species' populations relative to the location of BLM lands ensures that the vast majority of habitat will not experience even the low-level effects associated with PULA buffered habitats.

Overall we have a high degree of confidence that the effects of the action represents a low risk to this species and its designated critical habitat.

8.31 Sunflower Sea Star, Proposed

Effects analysis summary:

The sunflower sea star (*Pycnopodia helianthoides*) spans the Northeastern Pacific Ocean from the Aleutian Islands to Baja California. They dwell in the low intertidal and subtidal zones to a depth of 435 m (1,427 ft) but are most common at depths less than 25 m (82 ft) and rare in waters deeper than 120 m (394 ft) (Fisher 1928; Gravem et al. 2021; Lambert 2000). Sunflower sea stars are broadcast spawners that require close proximity to mates for successful fertilization (Hodin et al. 2021; Lambert 2000; Lundquist and Botsford 2004; Morris et al. 1980). While individuals are generally considered solitary, documentation of seasonal, patchy distribution suggests that individuals aggregate to spawn (Gravem et al. 2021; Mauzey et al. 1968). Spawning has been reported to occur between November and July, and larval duration may be as short as seven weeks or as long as 21 (Lowry et al. 2022). The diet of adult *P. helianthoides* generally consists of benthic and mobile epibenthic invertebrates, including sea urchins, snails, crab, sea cucumbers, and other sea stars (Mauzey et al. 1968; Shivji et al. 1983), and appears to be driven largely by prey availability. Larval and pre-metamorphic life stages are planktonic feeders and no data exist to suggest a prey preference.

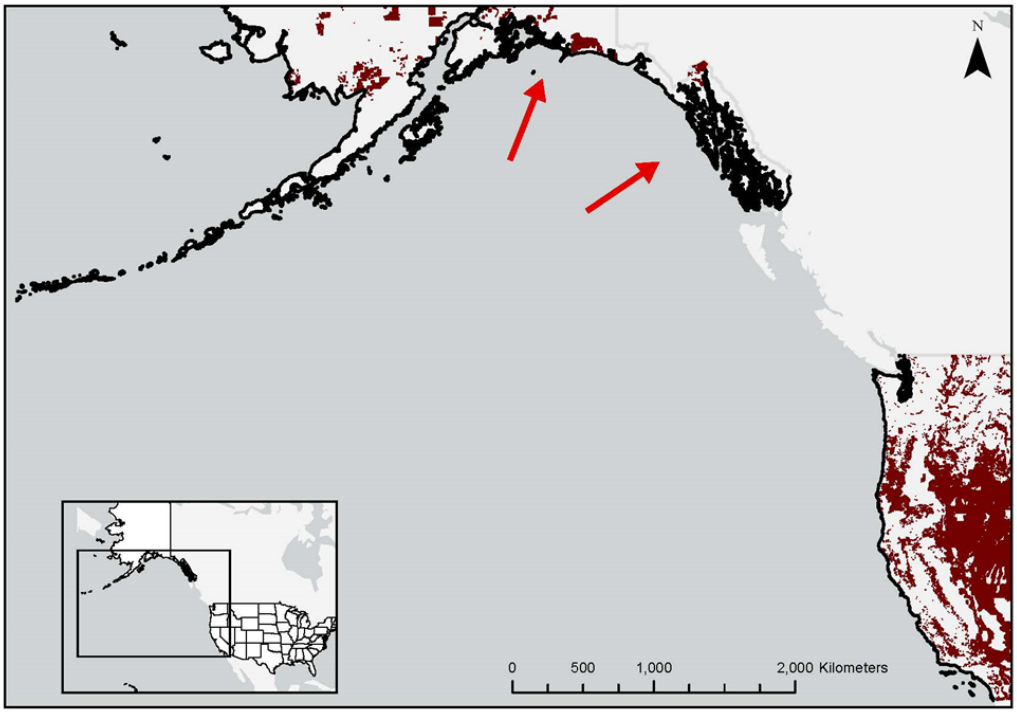


Figure 69. Sunflower Sea Star range, PULA and BLM lands. The species range is shown as the areas in hatch marks. The PULA is shown by thick black lines. Rivers are shown by thin blue lines. The red areas are BLM lands. Arrows point to BLM areas highlighted in the narrative.

The extent of BLM lands within this species' range is low. The only areas of proximity are along the southern coast of Alaska. BLM lands are present along the U.S. West coast as well, but the

occurrence of individuals in these areas is low. Sunflower sea star dwell in the low intertidal and subtidal zones to a depth of 435 m (1,427 ft) but are most common at depths less than 25 m. It is possible that sunflower sea stars would be exposed to herbicide drift or other stressors of the action during low tide. However, these coastal areas are within the PULA.

Of the authorized herbicides, only Triclopyr BEE, Glyphosate, and 2,4-D ester have the potential to reach habitats within the PULA at concentrations associated with toxic effects. In these situations, impacts to invertebrate prey may occur, however the expected mortality level is less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

Overall we have a high degree of confidence that the effects of the action represents a low risk to this proposed species.

9 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 areas of the Federal actions 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(a)(2) of the ESA.

During this programmatic consultation, we searched for information on future state, tribal, local, or private (non-Federal) actions reasonably certain to occur in the action area. We did not find any information about non-Federal actions other than what has already been described in the Environmental Baseline, which we expect will continue in the future. Anthropogenic effects include climate change, ship strikes, sound, fisheries, dams, and pollution. An increase in these activities could result in an increased effect on ESA-listed species; however, the magnitude and significance of any anticipated effects remain unknown at this time. The best scientific and commercial data available provide little specific information on any long-term effects of these potential sources of disturbance.

10 INTEGRATION AND SYNTHESIS: SPECIES

10.1 Introduction

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 Proposed Action* to the *Environmental Baseline* and the *Cumulative Effects* to formulate the agency's biological opinion as to whether the proposed action is likely to reduce appreciably the likelihood of both the survival and recovery of an ESA-listed species in the wild by reducing its numbers, reproduction, or distribution. These assessments are made in full consideration of the *Species and Designated Critical Habitat Likely to be Adversely Affected* chapter. Where species determinations were made in the *Species and Designated Critical Habitat Not Likely to be Adversely Affected* chapter, they are not discussed further here because the stressors associated with this proposed action are not likely to adversely affect those species or critical habitats.

"Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of an ESA-listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 C.F.R. §402.02).

In this section we present a summary for each species. The summary includes the influence of each section (e.g., environmental baseline, effects analysis, etc.). The status of the species, environmental baseline, and cumulative effects have been characterized on a qualitative scale of "very poor", "poor", "neutral", "good" and "very good". For example, if the status of the species is "very poor" that is an indicator that the species may be less resilient to the stressors of the action.

The effects analysis is characterized at the species-level in terms of risk: low, medium, or high.

A low risk indicates that we anticipate adverse effects, but only to very small percentage of the population. Species and habitats in this category tend to be those where BLM acreage is low, and not associated with areas of particular importance to the species (e.g. spawning grounds). A medium risk indicates that we anticipate adverse effects, but still to a small percentage of the population. Species and habitats in this category either have ranges with greater proportions of BLM land, or the BLM acreage is low, but it is associated with important habitat. For these species the exposure potential is higher but the response potential is low due to PULA buffers. This level of risk is highly unlikely to translate to an appreciable reduction in the reproduction, numbers or distribution of the species. A high risk indicates that we anticipate adverse effects to a sufficient portion of the population such that an overall reduction in the reproduction, numbers, or distribution is possible.

Each characterization is accompanied by a confidence ranking, which takes into consideration the quality and uncertainty in the information available for that section. Finally, a conclusion is reached which considers the effects of the action within the action area on populations or subpopulations, when added to the environmental baseline and the cumulative effects. The jeopardy determination

for each species is based on best commercial and scientific data available following ecological risk assessment principles.

10.2 Chum salmon, Columbia River ESU

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Direct mortality to fish, reductions in prey, and potential decrease in growth would likely occur to individuals residing outside of the PULA, however the use of habitat outside the PULA is uncommon.

Status of the Species: Poor/ High confidence

- According to Ford (2022), the 2020 extinction risk category for this species was moderate. The latest update indicates that this viability level is unchanged.
- The Proposed action may hinder attainment of some recovery goals.

Environmental Baseline: Poor/ High confidence

- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Elevated temperatures occur in freshwater habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence

- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas that may affect species;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures along with the limited extent of BLM land within this species range will mitigate that risk. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.3 Chinook salmon, Central Valley spring-run ESU

Effects Analysis: Medium Risk/ High confidence
- The extent and location of BLM lands within the range translates to a moderate exposure potential.
- Given the PULA, direct mortality to fish is not expected. Impacts to invertebrate prey may occur, with an expected mortality level of less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

Status of the Species: Very poor/ High confidence
- Stable to declining abundance trends, low abundances and fragmented populations;
- Recovery criteria not being met and the proposed action may further hinder attainment of some recovery goals.

Environmental Baseline: Very poor/ High confidence
- Loss of most historic spawning habitat through dams and diversions, and degradation of the remaining spawning habitat;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Elevated temperatures occur in freshwater habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence
- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.4 Chinook salmon, California coastal ESU

Effects Analysis: Medium Risk/ High confidence
- The extent and location of BLM lands within the range translates to a moderate exposure potential.
- Given the PULA, direct mortality to fish is not expected. Impacts to invertebrate prey may occur, with an expected mortality level of less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

Status of the Species: Very poor/ Low confidence
- The ESU was historically comprised of 38 populations. All of the spring-run populations were classified as functionally independent, but are considered extinct;
- Recovery criteria not being met and the proposed action may further hinder attainment of some recovery goals.

Environmental Baseline: Poor/ High confidence
- Threats to recovery of this ESU are from channel modification, right-of-ways, logging and wood harvesting, water diversion and impoundments and severe weather patterns;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Elevated temperatures occur in freshwater habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence
- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.5 Chinook salmon, Lower Columbia River ESU

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Direct mortality to fish, reductions in prey, and potential decrease in growth would likely occur to individuals residing outside of the PULA, however the use of habitat outside the PULA is uncommon.

Status of the Species: Poor/ High confidence

- In some populations there are declining trends in abundance, and low genetic diversity;
- According to Ford (2022), the 2020 extinction risk category for this species was moderate. The latest update indicates that this viability level is unchanged;
- Recovery criteria not being met and the proposed action may further hinder attainment of some recovery goals.

Environmental Baseline: Poor/ High confidence

- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Elevated temperatures occur in freshwater habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence

- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within this species range will mitigate that risk. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.6 Chinook salmon, Puget Sound ESU

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Direct mortality to fish, reductions in prey, and potential decrease in growth would likely occur to individuals residing outside of the PULA, however the use of habitat outside the PULA is uncommon.

Status of the Species: Poor/ High confidence

- According to Ford (2022), the 2020 extinction risk category for this species was moderate. The latest update indicates that this viability level is unchanged.
- Recovery criteria not being met and the proposed action may further hinder attainment of some recovery goals.

Environmental Baseline: Poor/ High confidence

- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Loss of most historic spawning habitat through dams and diversions, and degradation of much of the remaining spawning habitat;
- Elevated temperatures occur in freshwater habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence

- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within this species range will mitigate that risk. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.7 Chinook salmon, Sacramento River winter-run ESU

Effects Analysis: Medium Risk/ High confidence

- The extent and location of BLM lands within the range translates to a moderate exposure potential.
- Given the PULA, direct mortality to fish is not expected. Impacts to invertebrate prey may occur, with an expected mortality level of less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

Status of the Species: Very poor/ High confidence

- Species limited to one extant population, which has declining abundance trends, and is hatchery-supported;
- Recovery criteria not being met and the proposed action may further hinder attainment of some recovery goals; ESU at moderate to high risk of extinction.

Environmental Baseline: Very poor/ High confidence

- Prolonged drought could have devastating impacts, possibly leading to the species' extinction;
- Lack of suitable rearing habitat in the Sacramento River and Delta to allow for sufficient juvenile growth and survival;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Elevated temperatures occur in freshwater habitats;
- Environmental mixtures occur in freshwater habitats;

Cumulative Effects: Poor/ Low confidence

- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.8 Chinook salmon, Snake River fall-run ESU

Effects Analysis: Medium Risk/ High confidence
- The extent and location of BLM lands within the range translates to a moderate exposure potential.
- Given the PULA, direct mortality to fish is not expected. Impacts to invertebrate prey may occur, with an expected mortality level of less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

Status of the Species: Poor/ High confidence
- ESU as a whole is not meeting the recovery goals described in the recovery plan for the species;
- According to Ford (2022), the 2020 extinction risk category for this species was moderate-to-low; The latest update indicates that this viability level is unchanged.

Environmental Baseline: Poor/ High confidence
- Loss of most historic spawning habitat through dams;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Elevated temperatures occur in freshwater habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence
- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.9 Chinook salmon, Snake River spring/summer run ESU

Effects Analysis: Medium Risk/ High confidence
- The extent and location of BLM lands within the range translates to a moderate exposure potential.
- Given the PULA, direct mortality to fish is not expected. Impacts to invertebrate prey may occur, with an expected mortality level of less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

Status of the Species: Poor/ High confidence
- According to Ford (2022), the 2020 extinction risk category for this species was moderate-to-high. The latest update indicates that this viability level is unchanged;
- Abundance estimates for 26 of the 27 populations are lower than the corresponding estimates for the previous five-year period;
- Recovery criteria not being met and the proposed action may further hinder attainment of some recovery goals.

Environmental Baseline: Poor/ High confidence
- Loss of most historic spawning habitat through dams;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff;
- potential into species habitats;
- Elevated temperatures occur in freshwater habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence
- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- new threats ─ such as those posed by toxic contamination, increased predation by non-native;
- species, and effects due to climate change ─ are emerging;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.10 Chinook salmon, Upper Columbia River spring-run ESU

Effects Analysis: Medium Risk/ High confidence
- The extent and location of BLM lands within the range translates to a moderate exposure potential.
- Given the PULA, direct mortality to fish is not expected. Impacts to invertebrate prey may occur, with an expected mortality level of less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

Status of the Species: Very poor/ High confidence
- Large-scale supplementation efforts in two of the three remaining populations are ongoing;
- According to Ford (2022), the 2020 extinction risk category for this species was high. The latest update indicates that this viability level is unchanged;
- Recovery criteria not being met and the proposed action may further hinder attainment of some recovery goals.

Environmental Baseline: Very poor/ High confidence
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Loss of historic spawning habitat through dams;
- Elevated temperatures occur in freshwater habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence
- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.11 Chinook salmon, Upper Willamette River ESU

Effects Analysis: Medium Risk/ High confidence
- The extent and location of BLM lands within the range translates to a moderate exposure potential.
- Given the PULA, direct mortality to fish is not expected. Impacts to invertebrate prey may occur, with an expected mortality level of less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

Status of the Species: Very poor/ Low confidence
- Decreasing abundance trends, one of 7 remaining naturally reproducing populations;
- According to Ford (2022), the 2020 extinction risk category for this species was moderate. The latest update indicates that the viability is decreasing;
- Recovery criteria not being met and the proposed action may further hinder attainment of some recovery goals.

Environmental Baseline: Very poor/ High confidence
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Elevated temperatures occur in freshwater habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence
- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.12 Coho salmon, Central California coast ESU

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Direct mortality to fish, reductions in prey, and potential decrease in growth would likely occur to individuals residing outside of the PULA, however the use of habitat outside the PULA is uncommon.

Status of the Species: Very poor/ High confidence

- Low survival of juveniles in freshwater; summer and winter rearing survival are very low;
- Recovery criteria not being met and the proposed action may further hinder attainment of some recovery goals; ESU remains at critically low levels.

Environmental Baseline: Poor/ High confidence

- Elevated temperatures occur in freshwater habitats with poor in-stream flow;
- Poor water quality persists throughout ESU;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence

- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within this species range will mitigate that risk. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.13 Coho salmon, Lower Columbia River ESU

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Direct mortality to fish, reductions in prey, and potential decrease in growth would likely occur to individuals residing outside of the PULA, however the use of habitat outside the PULA is uncommon.

Status of the Species: Poor/ High confidence

- According to Ford (2022), the 2020 extinction risk category for this species was moderate. The latest update indicates that this viability level is unchanged;
- Species with 90% reduction in abundance of all independent populations;
- Recovery criteria not being met and the proposed action may further hinder attainment of some recovery goals.

Environmental Baseline: Poor/ High confidence

- Elevated temperatures occur in freshwater habitats;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence

- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within this species range will mitigate that risk. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.14 Coho salmon, Oregon coast ESU

Effects Analysis: Medium Risk/ High confidence

- The extent and location of BLM lands within the range translates to a moderate exposure potential.
- Given the PULA, direct mortality to fish is not expected. Impacts to invertebrate prey may occur, with an expected mortality level of less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

Status of the Species: Neutral/ High confidence

- Variable abundances with periods of severe declines; long term trends are positive;
- According to Ford (2022), the 2020 extinction risk category for this species was moderate-to-low. The latest update indicates that this viability level is unchanged;
- Some recovery criteria are being met; the action may hinder attainment of some recovery goals; ESU abundance remains strongly correlated with juvenile rearing success and with marine survival rates.

Environmental Baseline: Poor/ High confidence

- Elevated temperatures occur in freshwater habitats;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence

- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.15 Coho salmon, S. Oregon and N. California Coasts ESU

Effects Analysis: Medium Risk/ High confidence
- The extent and location of BLM lands within the range translates to a moderate exposure potential.
- Given the PULA, direct mortality to fish is not expected. Impacts to invertebrate prey may occur, with an expected mortality level of less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

Status of the Species: Very poor/ Low confidence
- Limited data on population abundance, thus trend data unavailable;
- ESU remains at critically low levels, 24 out of 31 independent populations are at high risk of extinction and 6 are at moderate Risk of extinction;
- Recovery criteria not being met and the proposed action may further hinder attainment of some recovery goals.

Environmental Baseline: Poor/ High confidence
- Elevated temperatures occur in freshwater habitats;
- Poor water quality persists throughout ESU;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence
- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.16 Sockeye, Snake River ESU

Effects Analysis: Medium Risk/ High confidence
- The extent and location of BLM lands within the range translates to a moderate exposure potential.
- Given the PULA, direct mortality to fish is not expected. Impacts to invertebrate prey may occur, with an expected mortality level of less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

Status of the Species: Very poor/ High confidence
- According to Ford (2022), the 2020 extinction risk category for this species was high. The latest update indicates that the viability is further decreasing;
- Abundance only one percent of historical levels; single population;
- Recovery criteria not being met and the proposed action may further hinder attainment of recovery goals.

Environmental Baseline: Poor/ High confidence
- Elevated temperatures occur in freshwater habitats;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Loss of productive spawning, rearing and migratory habitat due to dams;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence
- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.17 Steelhead, California Central Valley DPS

Effects Analysis: Medium Risk/ High confidence
- The extent and location of BLM lands within the range translates to a moderate exposure potential.
- Given the PULA, direct mortality to fish is not expected. Impacts to invertebrate prey may occur, with an expected mortality level of less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

Status of the Species: Very poor/ High confidence
- Long-term trend of declining abundances and reduced genetic diversity with populations supplemented by hatchery propagation;
- There are indications that natural production of steelhead continues to decline and is now at a very low level;
- Recovery criteria not being met and the proposed action may further hinder attainment of recovery goals.

Environmental Baseline: Very poor/ High confidence
- Elevated temperatures occur in freshwater habitats;
- Loss of most historic spawning and rearing habitat through dams and diversions, and degradation of the remaining spawning habitat;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence
- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.18 Steelhead, Central California coast DPS

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Direct mortality to fish, reductions in prey, and potential decrease in growth would likely occur to individuals residing outside of the PULA, however the use of habitat outside the PULA is uncommon.

Status of the Species: Very poor/ High confidence

- 5-year population trend uncertain. Population abundance supplemented by hatchery propagation. Populations likely not viable, and have lost spatial structure;
- Recovery criteria not being met and the proposed action may further hinder attainment of recovery goals.

Environmental Baseline: Poor/ High confidence

- Elevated temperatures occur in freshwater habitats;
- Loss of most historic spawning and rearing habitat through dams and diversions, and degradation of the remaining spawning habitat;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence

- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within this species range will mitigate that risk. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.19 Steelhead, Lower Columbia River DPS

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Direct mortality to fish, reductions in prey, and potential decrease in growth would likely occur to individuals residing outside of the PULA, however the use of habitat outside the PULA is uncommon.

Status of the Species: Poor/ High confidence

- 5-year population trend stable. Populations exhibit low genetic diversity and impacted by a loss of available habitat;
- According to Ford (2022), the 2020 extinction risk category for this species was moderate. The latest update indicates that this viability level is unchanged;
- Recovery criteria not being met and the proposed action may further hinder attainment of recovery goals.

Environmental Baseline: Poor/ High confidence

- Elevated temperatures occur in freshwater habitats;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence

- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within this species range will mitigate that risk. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.20 Steelhead, Middle Columbia River DPS

Effects Analysis: Medium Risk/ High confidence

- The extent and location of BLM lands within the range translates to a moderate exposure potential.
- Given the PULA, direct mortality to fish is not expected. Impacts to invertebrate prey may occur, with an expected mortality level of less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

Status of the Species: Neutral/ High confidence

- 5-year population trend stable to improving; abundances remain low compared to historical numbers
- According to Ford (2022), the 2020 extinction risk category for this species was moderate. The latest update indicates that this viability level is unchanged;
- Recovery criteria not being met and the proposed action may further hinder attainment of recovery goals.

Environmental Baseline: Poor/ High confidence

- Elevated temperatures occur in freshwater habitats and water quality may be limiting;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Loss of most historically productive spawning and rearing habitat through dams and diversions, much of remaining spawning habitat is degraded;
- Rearing adversely affected by reduced invertebrate prey and loss of riparian vegetation;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence

- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.21 Steelhead, Northern California DPS

Effects Analysis: Medium Risk/ High confidence
- The extent and location of BLM lands within the range translates to a moderate exposure potential.
- Given the PULA, direct mortality to fish is not expected. Impacts to invertebrate prey may occur, with an expected mortality level of less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

Status of the Species: Very poor/ High confidence
- Variable 5-year population abundance trends; population supplemented by hatchery propagation. Populations exhibit low abundances and productivity;
- All populations are well below viability targets, most being between five percent and 13% of these goals;
- Recovery criteria not being met and the proposed action may further hinder attainment of recovery goals.

Environmental Baseline: Poor/ High confidence
- Elevated temperatures occur in freshwater habitats;
- Poor water quality persists throughout ESU;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence
- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.22 Steelhead, Puget Sound DPS

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Direct mortality to fish, reductions in prey, and potential decrease in growth would likely occur to individuals residing outside of the PULA, however the use of habitat outside the PULA is uncommon.

Status of the Species: Neutral/ High confidence

- According to Ford (2022), the 2020 extinction risk category for this species was moderate. The latest update indicates that the viability is increasing;
- Recovery criteria not being met and the proposed action may further hinder attainment of recovery goals.

Environmental Baseline: Poor/ High confidence

- Elevated temperatures occur in freshwater habitats;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Loss of historic spawning and rearing habitat through dams and diversions, and degradation of much of the remaining spawning habitat;
- Rearing, migration and spawning habitats are degraded by forestry, agriculture, urbanization, loss of floodplain habitat, and poor water quality;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor / Low confidence

- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within this species range will mitigate that risk. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.23 Steelhead, Snake River Basin DPS

Effects Analysis: Medium Risk/ High confidence
- The extent and location of BLM lands within the range translates to a moderate exposure potential.
- Given the PULA, direct mortality to fish is not expected. Impacts to invertebrate prey may occur, with an expected mortality level of less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

Status of the Species: Poor/ High confidence
- Overall abundances remain below thresholds necessary for recovery;
- According to Ford (2022), the 2020 extinction risk category for this species was moderate. The latest update indicates that this viability level is unchanged;
- Recovery criteria not being met and the proposed action may further hinder attainment of recovery goals.

Environmental Baseline: Poor/ High confidence
- Elevated temperatures occur in freshwater habitats;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Loss of historic spawning and rearing habitat through dams and diversions, and degradation of much of the remaining spawning habitat;
- Rearing degraded by agricultural runoff affecting prey;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence
- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.24 Steelhead, South-Central California coast DPS

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Direct mortality to fish, reductions in prey, and potential decrease in growth would likely occur to individuals residing outside of the PULA, however the use of habitat outside the PULA is uncommon.

Status of the Species: Very poor/ High confidence

- 5-year population trend declining; depressed abundances continue;
- Recovery criteria not being met and the proposed action may further hinder attainment of recovery goals.

Environmental Baseline: Very poor/ High confidence

- Rearing and migration by elevated temperatures and contaminants from urban and agricultural runoff; Estuarine rearing success degraded by altered habitat, and contaminated runoff;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Loss of historic spawning and rearing habitat through dams and diversions, and degradation of much of the remaining spawning habitat;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence

- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within this species range will mitigate that risk. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.25 Steelhead, Southern California DPS

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Direct mortality to fish, reductions in prey, and potential decrease in growth would likely occur to individuals residing outside of the PULA, however the use of habitat outside the PULA is uncommon.

Status of the Species: Very poor / High confidence

- 5-year population trend uncertain (large annual variations); supplemented by hatchery propagation; fragmented distributions;
- Recovery criteria not being met and the proposed action may further hinder attainment of recovery goals.

Environmental Baseline: Very poor/ High confidence

- Habitats degraded by pollutants in urban and agricultural runoff, elevated temperatures, erosion, and low instream flows;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor / Low confidence

- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within this species range will mitigate that risk. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.26 Steelhead, Upper Columbia River DPS

Effects Analysis: Medium Risk/ High confidence
- The extent and location of BLM lands within the range translates to a moderate exposure potential.
- Given the PULA, direct mortality to fish is not expected. Impacts to invertebrate prey may occur, with an expected mortality level of less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

Status of the Species: Very poor / High confidence
- According to Ford (2022), the 2020 extinction risk category for this species was high. The latest update indicates that this viability level is unchanged;
- DPS is at high Risk driven by low abundance and productivity;
- Recovery criteria not being met and the proposed action may further hinder attainment of recovery goals.

Environmental Baseline: Very poor/ High confidence
- Elevated temperatures occur in freshwater habitats;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Loss of historic spawning habitat through dams;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor / Low confidence
- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.27 Steelhead, Upper Willamette River DPS

Effects Analysis: Medium Risk/ High confidence
- The extent and location of BLM lands within the range translates to a moderate exposure potential.
- Given the PULA, direct mortality to fish is not expected. Impacts to invertebrate prey may occur, with an expected mortality level of less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

Status of the Species: Very poor / High confidence
- According to Ford (2022), the 2020 extinction risk category for this species was moderate-to-high. The latest update indicates that the viability is further decreasing;
- Natural-origin spawner abundance have declined dramatically from the last 5 year review;
- Recovery criteria not being met and the proposed action may further hinder attainment of recovery goals.

Environmental Baseline: Very poor/ High confidence
- Elevated temperatures occur in freshwater habitats;
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Loss of historic spawning habitat through dams;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor / Low confidence
- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.28 Eulachon, Pacific smelt, Southern DPS

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Direct mortality to fish, reductions in prey, and potential decrease in growth would likely occur to individuals residing outside of the PULA, however the use of habitat outside the PULA is uncommon.

Status of the Species: Good/ Low confidence

- Population abundance generally improving;
- Severely depressed abundance mid-late 1990s to late 2000s;
- Recovery criteria not met and reduced likelihood of attaining recovery goals.

Environmental Baseline: Poor/ High confidence

- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Elevated temperatures occur in freshwater habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence

- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas;
- Anticipated increased frequency of adverse ocean conditions.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within this species range will mitigate that risk. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.29 Green sturgeon, Southern DPS

Effects Analysis: Medium Risk/ High confidence
- The extent and location of BLM lands within the range translates to a moderate exposure potential.
- Given the PULA, direct mortality to fish is not expected. Impacts to invertebrate prey may occur, with an expected mortality level of less than one percent of the most sensitive species. However, where prey abundance is decreased, listed fish may experience reduced growth.

Status of the Species: Very poor/ High confidence
- Small population size, little population data, spawning reduced to a limited area in the Sacramento River;
- Recovery criteria not met and reduced likelihood of attaining recovery goals.

Environmental Baseline: Very poor/ High confidence
- Degraded riparian zones, which allows for increased sedimentation and more drift and runoff potential into species habitats;
- Elevated temperatures occur in freshwater habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/ Low confidence
- Future elevated temperatures anticipated;
- Anticipated hydrologic effects in freshwater areas.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.30 Black abalone

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Direct mortality to abalone, particularly in the larval stage, as well as reductions in prey would likely occur to individuals residing outside of the PULA, however the use of habitat outside the PULA is uncommon.

Status of the Species: Very poor/ Low confidence

- Five percent of historical abundance; declining population trend;
- Recovery criteria not identified.

Environmental Baseline: Neutral/ Low confidence

- Elevated water temperatures and environmental mixtures of pesticides do occur in habitats, but have not substantially impacted this species.

Cumulative Effects: Neutral/ Low confidence

- Future elevated temperatures are anticipated in nearshore and intertidal marine waters, and decreases in dissolved oxygen can be expected.

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within this species range will mitigate that risk. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

10.31 Sunflower Sea Star –Proposed

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Direct mortality to sunflower sea stars, particularly in the larval stage, as well as reductions in prey would likely occur to individuals residing outside of the PULA, however the use of habitat outside the PULA is uncommon.

Status of the Species: Very poor/ High confidence

- >90% loss in overall abundance since 2013, range wide occurrence has dropped by 52%; largely as a direct consequence of the sea star wasting syndrome.

Environmental Baseline: Very poor/ High confidence

- Increased temperature and decreased dissolved oxygen may contribute sea star wasting syndrome;
- Contaminants may have contributed to, or exacerbated conditions leading to seas star wasting syndrome;
- Exposures to existing environmental contaminants or other poor water quality conditions may impede recovery.

Cumulative Effects: Poor/ Low confidence

- Future elevated temperatures are anticipated in nearshore and intertidal marine waters, and decreases in dissolved oxygen can be expected;
- Increases in contaminant loading or other causes of water quality degradation could exacerbate sea star wasting

Conclusion: Individuals and their prey are most at risk in shallow habitats in proximity to BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within this species range will mitigate that risk. We determine that BLM is able to insure that its action is not likely to jeopardize the continued existence of this species. This determination takes into consideration the species' status, baseline conditions, and concerns associated with cumulative effects.

11 INTEGRATION AND SYNTHESIS: DESIGNATED CRITICAL HABITAT

11.1 Introduction

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 Proposed Action* to the *Environmental Baseline* and the *Cumulative Effects* to formulate the agency's biological opinion as to whether the proposed action is likely to reduce appreciably the likelihood of both the survival and recovery of an ESA-listed species in the wild by reducing its numbers, reproduction, or distribution. These assessments are made in full consideration of the *Species and Designated Critical Habitat Likely to be Adversely Affected* chapter. Where species determinations were made in the *Species and Designated Critical Habitat Not Likely to be Adversely Affected* chapter, they are not discussed further here because the stressors associated with this proposed action are not likely to adversely affect those species or critical habitats.

"Destruction or adverse modification" means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of an ESA-listed species (50 C.F.R. §402.02).

In this section we present a summary for each species' designated critical habitat. The summary includes the influence of each section (e.g., environmental baseline, effects analysis, etc.). The status of the species' designated critical habitat, environmental baseline, and cumulative effects have been characterized on a qualitative scale of "very poor", "poor", "neutral", "good" and "very good". For example, if the status of the habitat is "very poor" that is an indicator that the PBFs may be less resilient to the stressors of the action.

The effects analysis is characterized at the overall habitat level in terms of risk: low, medium, or high.

A low risk indicates that we anticipate adverse effects, but only to very small percentage of areas containing PBFs. Designated critical habitats in this category tend to be those where BLM acreage is low, and not associated with areas of particular importance to the species (e.g. spawning grounds). A medium risk indicates that we anticipate adverse effects, but still to a small percentage of the areas containing PBFs. Designated critical habitats in this category either have greater proportions of BLM land, or the BLM acreage is low, but it is associated with important areas. For these habitats and PBFs the exposure potential is higher but the response potential is low due to PULA buffers. This level of risk is highly unlikely to translate to an overall diminishment of the designated critical habitat. A high risk indicates that we anticipate adverse effects to PBFs sufficient to result in an overall reduction of the conservation value of the designated critical habitat. See Appendix C for a description of the PBFs for each of the designated critical habitats.

Each characterization is accompanied by a confidence ranking, which takes into consideration the quality and uncertainty in the information available for that section. Finally, a conclusion is reached which considers the effects of the action within the action area on the PBFs, when added to the

environmental baseline and the cumulative effects. The destruction or adverse modification determination for each designated critical habitat is based on best commercial and scientific data available following ecological risk assessment principles.

11.2 Chum salmon, Columbia River ESU: Designated Critical Habitat

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Impacts to PBFs for water quality, forage, and natural cover are not expected given the lack of BLM land within designated critical habitat.

Status and Baseline: Poor/ High confidence

- Rearing PBFs (water quality and cover) are degraded
- Migration PBFs significantly impacted by dams
- Elevated water temperatures and environmental mixtures do occur in habitats
- All 19 watersheds of high or medium conservation value

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs
- Anticipated hydrologic effects in freshwater areas may impact PBFs

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA buffer, along with the limited extent of BLM land within proximity to the designated critical habitat will mitigate that risk. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.3 Chinook salmon, Central Valley spring-run ESU: Designated Critical Habitat

Effects Analysis: Medium Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Given the 300 m PULA, as well as SOPs and conservation measures, impacts to PBFs for water quality, forage, and natural cover are anticipated to be minimal.

Status and Baseline: Very Poor/ High confidence

- Spawning and rearing PBFs are degraded by elevated temperatures, lost access to historic spawning sites, and loss of floodplain habitat;
- Migration PBFs degraded by loss of cover and water diversions;
- Elevated water temperatures and environmental mixtures do occur in habitats;
- Of 38 watersheds, 28 are of high and 3 are of medium conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.4 Chinook salmon, California coastal ESU: Designated Critical Habitat

Effects Analysis: Medium Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Given the 300 m PULA, as well as SOPs and conservation measures, impacts to PBFs for water quality, forage, and natural cover are anticipated to be minimal.

Status and Baseline: Poor/Low confidence

- Spawning PBFs are degraded by timber harvest;
- Rearing and migration PBFs impacted by dams and invasive species;
- Estuarine PBFs degraded by water quality and saltwater mixing;
- Elevated water temperatures and environmental mixtures do occur in habitats;
- Of 45 watersheds, 27 are of high and 10 are of medium conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.5 Chinook salmon, Lower Columbia River ESU: Designated Critical Habitat

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Impacts to PBFs for water quality, forage, and natural cover are not expected given the lack of BLM land within designated critical habitat.

Status and Baseline: Poor/ High confidence

- Elevated water temperatures and environmental mixtures do occur in habitats;
- Of occupied watersheds, 31 are of high and 13 are of medium conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within proximity to the designated critical habitat will mitigate that risk. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.6 Chinook salmon, Puget Sound ESU: Designated Critical Habitat

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Impacts to PBFs for water quality, forage, and natural cover are not expected given the lack of BLM land within designated critical habitat.

Status and Baseline: Poor/ High confidence

- Spawning, rearing and migration PBFs are degraded by forestry, agriculture, urbanization, and loss of habitat
- Estuarine PBFs degraded by water quality, altered salinity, and lack of natural cover
- Elevated water temperatures and environmental mixtures do occur in habitats
- Of 61 watersheds, 40 are of high and 9 are of medium conservation value

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs
- Anticipated hydrologic effects in freshwater areas may impact PBFs

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within proximity to the designated critical habitat will mitigate that risk. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.7 Chinook salmon, Sacramento River winter-run ESU: Designated Critical Habitat

Effects Analysis: Medium Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Given the 300 m PULA, as well as SOPs and conservation measures, impacts to PBFs for water quality, forage, and natural cover are anticipated to be minimal.

Status and Baseline: Very poor/ High confidence

- Spawning and rearing PBFs are degraded by elevated temperatures and loss of habitat;
- Migration PBFs degraded by lack of natural cover and water diversions;
- Elevated water temperatures and environmental mixtures do occur in habitats;
- The entire Sacramento River and delta are considered of high conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.8 Chinook salmon, Snake River fall-run ESU: Designated Critical Habitat

Effects Analysis: Medium Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Given the 300 m PULA, as well as SOPs and conservation measures, impacts to PBFs for water quality, forage, and natural cover are anticipated to be minimal.

Status and Baseline: Poor/ High confidence

- Elevated water temperatures and environmental mixtures do occur in habitats;
- The entire river corridor is considered of high conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.9 Chinook salmon, Snake River spring/summer run ESU: Designated Critical Habitat

Effects Analysis: Medium Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Given the 300 m PULA, as well as SOPs and conservation measures, impacts to PBFs for water quality, forage, and natural cover are anticipated to be minimal.

Status and Baseline: Poor/ High confidence

- Spawning, rearing and migration PBFs are degraded by loss of habitat, altered stream flows, barriers to fish passage, dams, loss of cover, and poor water quality;
- Elevated water temperatures and environmental mixtures do occur in habitats;
- The entire river corridor is considered of high conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.10 Chinook salmon, Upper Columbia River spring-run ESU: Designated Critical Habitat

Effects Analysis: Medium Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Given the 300 m PULA, as well as SOPs and conservation measures, impacts to PBFs for water quality, forage, and natural cover are anticipated to be minimal.

Status and Baseline: Very poor/ High confidence

- Spawning and rearing PBFs are degraded by urbanization and irrigation water diversions;
- Migration PBFs degraded by numerous dams;
- Elevated water temperatures and environmental mixtures do occur in habitats;
- Of occupied watersheds, 26 are of high and 5 are of medium conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.11 Chinook salmon, Upper Willamette River ESU: Designated Critical Habitat

Effects Analysis: Medium Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Given the 300 m PULA, as well as SOPs and conservation measures, impacts to PBFs for water quality, forage, and natural cover are anticipated to be minimal.

Status and Baseline: Very poor/ High confidence

- Migration, rearing, and estuary PBFs are degraded by dams, water management, loss of riparian vegetation, and quality of floodplain habitat;
- Elevated water temperatures and environmental mixtures do occur in habitats;
- Of 59 assessed watersheds, 22 are of high and 18 are of medium conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.12 Coho salmon, Central California coast ESU: Designated Critical Habitat

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Impacts to PBFs for water quality, forage, and natural cover are not expected given the lack of BLM land within designated critical habitat.

Status and Baseline: Poor/ High confidence

- Degradation in quality and quantity of PBFs, especially in southern end of range;
- Rearing PBFs degraded by loss of suitable incubation substrate and loss of habitat;
- Elevated temperatures anticipated in freshwater habitats;
- Environmental mixtures anticipated in freshwater habitats may impact PBFs.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within proximity to the designated critical habitat will mitigate that risk. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.13 Coho salmon, Lower Columbia River ESU: Designated Critical Habitat

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Impacts to PBFs for water quality, forage, and natural cover are not expected given the lack of BLM land within designated critical habitat.

Status and Baseline: Poor/ High confidence

- Spawning and rearing PBFs are degraded by timber harvest, agriculture, urbanization, loss of floodplain habitat, and reduced natural cover;
- Migration PBFs impacted by dams;
- Elevated water temperatures and environmental mixtures do occur in habitats.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within proximity to the designated critical habitat will mitigate that risk. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.14 Coho salmon, Oregon coast ESU: Designated Critical Habitat

Effects Analysis: Medium Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Given the 300 m PULA, as well as SOPs and conservation measures, impacts to PBFs for water quality, forage, and natural cover are anticipated to be minimal.

Status and Baseline: Poor/ High confidence

- Rearing PBFs are degraded by elevated water temperature;
- All PBFs degraded by reduced water quality from contaminants and excess nutrients;
- Elevated water temperatures and environmental mixtures do occur in habitats;
- Of 80 assessed watersheds, 45 are of high and 27 are of medium conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.15 Coho salmon, S. Oregon and N. California coasts ESU: Designated Critical Habitat

Effects Analysis: Medium Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Given the 300 m PULA, as well as SOPs and conservation measures, impacts to PBFs for water quality, forage, and natural cover are anticipated to be minimal.

Status and Baseline: Poor/ High confidence

- Spawning PBFs are degraded by logging;
- Rearing and migration PBFs degraded by loss of riparian vegetation and loss of floodplain habitat;
- Elevated water temperatures and environmental mixtures do occur in habitats.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.16 Sockeye, Snake River ESU: Designated Critical Habitat

Effects Analysis: Medium Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Given the 300 m PULA, as well as SOPs and conservation measures, impacts to PBFs for water quality, forage, and natural cover are anticipated to be minimal.

Status and Baseline: Poor/ High confidence

- Rearing and migration PBFs are degraded by impaired water quality from adjacent land uses;
- Migration PBFs are degraded by multiple dams;
- Elevated water temperatures and environmental mixtures do occur in habitats;
- All occupied and used areas of the watershed are of high conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.17 Steelhead, California Central Valley DPS: Designated Critical Habitat

Effects Analysis: Medium Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Given the 300 m PULA, as well as SOPs and conservation measures, impacts to PBFs for water quality, forage, and natural cover are anticipated to be minimal.

Status and Baseline: Very poor/ High confidence

- Spawning PBFs are degraded by altered water flows and temperature;
- Rearing and migration PBFs are degraded by altered riverine habitat, dense urbanization and agriculture, poor water quality, and water diversions;
- Elevated water temperatures and environmental mixtures do occur in habitats;
- Of 67 occupied watersheds, 37 are of high and 18 are of medium conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.18 Steelhead, Central California coast DPS: Designated Critical Habitat

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Impacts to PBFs for water quality, forage, and natural cover are not expected given the lack of BLM land within designated critical habitat.

Status and Baseline: Poor/ High confidence

- Spawning and rearing PBFs are degraded by sedimentation and elevated temperature;
- All PBFs are degraded by loss of habitat, low summer flows, erosion, and contaminants;
- Elevated water temperatures and environmental mixtures do occur in habitats;
- Of 47 occupied watersheds, 19 are of high and 15 are of medium conservation value;

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs;

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within proximity to the designated critical habitat will mitigate that risk. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.19 Steelhead, Lower Columbia River DPS: Designated Critical Habitat

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Impacts to PBFs for water quality, forage, and natural cover are not expected given the lack of BLM land within designated critical habitat.

Status and Baseline: Poor/ High confidence

- Rearing PBFs are degraded by agricultural runoff and lack of available prey;
- Spawning, rearing and migration PBFs are degraded by timber harvests, dams, and loss of floodplain habitat;
- Elevated water temperatures and environmental mixtures do occur in habitats;
- Of 41 occupied watersheds, 28 are of high and 11 are of medium conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within proximity to the designated critical habitat will mitigate that risk. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.20 Steelhead, Middle Columbia River DPS: Designated Critical Habitat

Effects Analysis: Medium Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Given the 300 m PULA, as well as SOPs and conservation measures, impacts to PBFs for water quality, forage, and natural cover are anticipated to be minimal.

Status and Baseline: Poor/ High confidence

- Rearing PBFs are degraded by water quality, reduced invertebrate prey, and loss of riparian vegetation;
- Migration PBFs are degraded by several dams;
- Elevated water temperatures and environmental mixtures do occur in habitats;
- Of 106 assessed watersheds, 73 are of high and 24 are of medium conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.21 Steelhead, Northern California DPS: Designated Critical Habitat

Effects Analysis: Medium Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Given the 300 m PULA, as well as SOPs and conservation measures, impacts to PBFs for water quality, forage, and natural cover are anticipated to be minimal.

Status and Baseline: Very poor/ High confidence

- Rearing PBFs are degraded by loss of riparian vegetation and elevated temperature;
- Spawning PBFs are degraded by lack of quality substrate and sedimentation;
- Migration PBFs are degraded by bridges, culverts, and forest road construction;
- Elevated water temperatures and environmental mixtures do occur in habitats;
- Of 50 assessed watersheds, 27 are of high and 14 are of medium conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.22 Steelhead, Puget Sound DPS: Designated Critical Habitat

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Impacts to PBFs for water quality, forage, and natural cover are not expected given the lack of BLM land within designated critical habitat.

Status and Baseline: Poor/ High confidence

- Elevated water temperatures and environmental mixtures do occur in habitats;
- Most watersheds are of high or medium conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within proximity to the designated critical habitat will mitigate that risk. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.23 Steelhead, Snake River Basin DPS: Designated Critical Habitat

Effects Analysis: Medium Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Given the 300 m PULA, as well as SOPs and conservation measures, impacts to PBFs for water quality, forage, and natural cover are anticipated to be minimal.

Status and Baseline: Poor/ High confidence

- Rearing PBFs are degraded by agricultural runoff, reduced invertebrate prey, loss of riparian vegetation, and elevated temperature;
- Migration PBFs are degraded by several dams;
- Elevated water temperatures and environmental mixtures do occur in habitats;
- Of assessed watersheds, 229 are of high and 41 are of medium conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.24 Steelhead, South-Central California coast DPS: Designated Critical Habitat

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Impacts to PBFs for water quality, forage, and natural cover are not expected given the lack of BLM land within designated critical habitat.

Status and Baseline: Very poor/ High confidence

- Rearing and migration PBFs are degraded by elevated temperatures and contaminants from urban and agricultural runoff;
- Estuarine PBFs are degraded by altered habitat and contaminated runoff;
- Elevated water temperatures and environmental mixtures do occur in habitats;
- Of 29 occupied watersheds, 12 are of high and 11 are of medium conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within proximity to the designated critical habitat will mitigate that risk. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.25 Steelhead, Southern California DPS: Designated Critical Habitat

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Impacts to PBFs for water quality, forage, and natural cover are not expected given the lack of BLM land within designated critical habitat.

Status and Baseline: Very poor/ High confidence

- All PBFs are degraded by pollutants in urban and agricultural runoff, elevated temperatures, erosion, and low water flows;
- Elevated water temperatures and environmental mixtures do occur in habitats;
- Of 29 freshwater and estuarine watersheds, 21 are of high and 5 are of medium conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within proximity to the designated critical habitat will mitigate that risk. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.26 Steelhead, Upper Columbia River DPS: Designated Critical Habitat

Effects Analysis: Medium Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Given the 300 m PULA, as well as SOPs and conservation measures, impacts to PBFs for water quality, forage, and natural cover are anticipated to be minimal.

Status and Baseline: Very poor/ High confidence

- Rearing PBFs are degraded by agricultural runoff and lack of available prey;
- Migration PBFs are degraded by several dams;
- Elevated water temperatures and environmental mixtures do occur in habitats;
- Of 41 occupied watersheds, 31 are of high and 7 are of medium conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.27 Steelhead, Upper Willamette River DPS: Designated Critical Habitat

Effects Analysis: Medium Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Given the 300 m PULA, as well as SOPs and conservation measures, impacts to PBFs for water quality, forage, and natural cover are anticipated to be minimal.

Status and Baseline: Very poor/ High confidence

- Rearing PBFs are degraded by agricultural runoff and lack of available prey;
- Migration PBFs are degraded by dams and elevated temperatures;
- Elevated water temperatures and environmental mixtures do occur in habitats;
- Of assessed watersheds, 14 are of high and 6 are of medium conservation value.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely; climate change may threaten PBFs;
- Anticipated hydrologic effects in freshwater areas may impact PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.28 Pacific Eulachon, Southern DPS: Designated Critical Habitat

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Impacts to PBFs for water quality, forage, and natural cover are not expected given the lack of BLM land within designated critical habitat.

Status and Baseline: Poor/ High confidence

- Spawning, incubation, and rearing PBFs are degraded;
- Dams block flow and access to historical spawning grounds and are cause for degraded spawning substrates below;
- Elevated temperatures occur in freshwater habitats;
- Environmental mixtures occur in freshwater habitats.

Cumulative Effects: Poor/Low confidence

- Future elevated temperatures likely. Climate change may threaten eulachon, particularly in the southern portion of their range where ocean warming trends may be the most pronounced and may alter prey, spawning, and rearing success;
- Anticipated hydrologic changes in freshwater areas may affect PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within proximity to the designated critical habitat will mitigate that risk. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.29 Green sturgeon, Southern DPS: Designated Critical Habitat

Effects Analysis: Medium Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Given the 300 m PULA, as well as SOPs and conservation measures, impacts to PBFs for water quality and natural cover are anticipated to be minimal.

Status and Baseline: Very poor/ High confidence

- Insufficient freshwater flow rates in spawning areas;
- Contaminants (e.g., pesticides) prevalent in freshwater habitat;
- Impassable barriers limit spawning to limited sections in Sacramento River;
- Elevated water temperatures persist in freshwater.

Cumulative Effects: Poor/Low confidence

- Elevated temperatures likely to remain. Climate change may threaten PBFs;
- Anticipated hydrologic changes in freshwater areas may further affect PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA, as well as SOPs and conservation measures will largely mitigate these risks. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

11.30 Black abalone: Designated Critical Habitat

Effects Analysis: Low Risk/ High confidence

- The extent of BLM lands within the range is low; the potential for exposure to species and habitats is low.
- Impacts to PBFs for water quality or prey are not expected given the limited extent of BLM land within designated critical habitat.

Status and Baseline: Poor/Low confidence

- Habitat destruction;
- Disease.

Cumulative Effects: Poor/Low confidence

- Developmental pressures could reduce available habitat and create competition for space with other marine invertebrates;
- Changes in ocean conditions (ocean acidification) may threaten PBFs.

Conclusion: Critical habitat is most at risk in areas of extensive overlap with BLM lands. However, the 300 m PULA buffer, as well as SOPs and conservation measures, along with the limited extent of BLM land within proximity to the designated critical habitat will mitigate that risk. We determine that BLM is able to insure that its action is not likely to destroy or adversely modify this species' critical habitat. This determination takes into consideration the status and baseline conditions as well as concerns associated with cumulative effects.

12 CONCLUSION

It is NMFS's conference and biological opinion that BLM is able to insure that their vegetation management program is not likely to jeopardize the continued existence of the following species under NMFS's jurisdiction: Chum salmon, Columbia River ESU (*Oncorhynchus keta*); Chinook salmon (*Oncorhynchus tshawytscha*), Puget Sound ESU, Lower Columbia River ESU, Snake River spring/summer-run ESU, California coastal ESU, Central Valley spring-run ESU, Snake River fall-run ESU, Upper Columbia River spring-run ESU, Sacramento River winter-run ESU, Upper Willamette River ESU; Coho salmon (*Oncorhynchus kisutch*), Central California Coast ESU, Lower Columbia River ESU, Southern Oregon/Northern California Coast ESU, Oregon Coast ESU; Steelhead (*Oncorhynchus mykiss*), South-Central California Coast DPS, Central California Coast DPS, Southern California DPS, Lower Columbia River DPS, Puget Sound DPS, Northern California DPS, Middle Columbia River DPS, Snake River Basin DPS, Upper Columbia River DPS, Upper Willamette River DPS, California Central Valley DPS; Eulachon, Southern DPS (*Thaleichthys pacificus*), Black Abalone (*Haliotis cracherodii*), Sunflower Sea Star (proposed) (*Pycnopodia helianthoides*); Sockeye, Snake River ESU (*Oncorhynchus nerka*), and Green Sturgeon, Southern DPS (*Acipenser medirostris*).

Similarly, it is NMFS's biological opinion that BLM is able to insure this proposed action is not likely to destroy or adversely modify the following designated critical habitat of those species: Chum salmon, Columbia River ESU (*Oncorhynchus keta*); Chinook salmon (*Oncorhynchus tshawytscha*), Puget Sound ESU, Lower Columbia River ESU, Snake River spring/summer-run ESU, California coastal ESU, Central Valley spring-run ESU, Snake River fall-run ESU, Upper Columbia River spring-run ESU, Sacramento River winter-run ESU, Upper Willamette River ESU; Coho salmon (*Oncorhynchus kisutch*), Central California Coast ESU, Lower Columbia River ESU, Southern Oregon/Northern California Coast ESU, Oregon Coast ESU; Steelhead (*Oncorhynchus mykiss*), South-Central California Coast DPS, Central California Coast DPS, Southern California DPS, Lower Columbia River DPS, Puget Sound DPS, Northern California DPS, Middle Columbia River DPS, Snake River Basin DPS, Upper Columbia River DPS, Upper Willamette River DPS, California Central Valley DPS; Eulachon, Southern DPS (*Thaleichthys pacificu*s), Black Abalone (*Haliotis cracherodii*); Sockeye, Snake River ESU (*Oncorhynchus nerka)*, and Green Sturgeon, Southern DPS (*Acipenser medirostris*).

We reached this conclusion upon reviewing the current status of the ESA-listed and proposed species and designated and proposed critical habitat, the environmental baseline within the action area, the effects of the action and cumulative effects.

It is NMFS's determination that the action is not likely to adversely affect the following ESA-listed species: Sei whale (*Balaenoptera borealis*), North Pacific Right Whale (*Eubalaena japonica*), Fin whale (*Balaenoptera physalus*), Bowhead whale (*Balaena mysticetus*), Blue whale (*Balaenoptera musculus*), Sperm whale (*Balaenoptera borealis*), beluga whale, Cook Inlet DPS (*Delphinapterus leucas*), Humpback Whale (*Megaptera novaeangliae*) Western North Pacific DPS, Mexico DPS, and Central America DPS; Killer whale, Southern resident DPS (*Orcinus orca*); Guadalupe fur seal

(*Arctocephalus townsendi*); Steller sea lion, Western DPS (*Eumetopias jubatus*); Bearded Seal, Beringia DPS (*Erignathus barbatus*); Ringed Seal, Arctic subspecies (*Phoca (pusa) hispida*); Green sea turtle, East Pacific DPS (*Chelonia mydas*); Leatherback sea turtle (*Dermochelys coriacea*); Loggerhead sea turtle, North Pacific DPS (*Caretta caretta*); Olive ridley sea turtle (*Lepidochelys olivacea*) Pacific Coast of Mexico breeding populations, all other populations; Scalloped Hammerhead Shark, Eastern Pacific DPS (*Sphyrna lewini*); Bocaccio, Puget Sound-Georgia Basin DPS (*Sebastes paucispinis*); Yellow Eye Rockfish, Puget Sound-Georgia Basin DPS (*Sebastes ruberrimus*); Sockeye salmon, Ozette Lake DPS (*Oncorhynchus nerka*); Hood Canal summer-run DPS (*Oncorhynchus keta*); and White abalone (*Haliotis sorenseni*).

13 INCIDENTAL TAKE STATEMENT

Section 7(b)(4) of the ESA requires that when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA, either as proposed by the action agency or modified by a RPA, and the action may incidentally take individuals of ESA-listed species, NMFS will issue a statement that specifies the impact of any incidental taking of endangered or threatened species, or an ITS. To minimize such impacts, NMFS provides RPMs and terms and conditions that must be complied with by the Federal agency or any applicant in order to be exempt from the prohibitions against "take" of ESA-listed species specified in section 9 of the ESA. RPMs are measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take." (50 C.F.R. §402.02).

Section 9(a)(1) of the ESA prohibits the taking of endangered species without a specific permit or exemption. Protective regulations adopted pursuant to section 4(d) of the ESA extend the prohibition to threatened species. 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 (50 CFR §222.102). We interpret "harass" as meaning to create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (Wieting 2016). Harm is further defined by NMFS as an act which actually kills or injures fish or wildlife, and may to include significant habitat modification or degradation that results in death or injury to ESA-listed species by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 C.F.R. §222.102). NMFS has not defined "harass" under ESA regulations. On May 1, 2023, NMFS adopted, as final, the previous interim guidance on the term "harass," defining it as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering."

Incidental take is defined 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 C.F.R. §402.02). Section 7(b)(4) and section 7(o)(2) of the ESA, as well as in regulation at 50 C.F.R. §402.14(i)(5) 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.

This conference and biological opinion has assessed the effects of the action and determined incidental take of proposed species is reasonably certain to occur. However, there are no take prohibitions under section 9 or 4(d) until proposed species are listed under the ESA as endangered (or threatened with a 4d rule). The incidental take statement provided with this conference opinion does not become effective after the listing is final unless BLM requests to adopt the conference opinion as a biological opinion and NMFS, after ensuring the effects of the action are no different than identified here, responds in the affirmative (50 C.F.R. §402.10(d)).

13.1 Amount or Extent of Take

Section 7 regulations require NMFS to specify the impact of any incidental take of endangered or threatened species; that is, the amount or extent, of such incidental taking on the species (50 C.F.R. § 402.14(i)(1)(i)). The amount of take represents the number of individuals that are expected to be taken by the action. When it is not possible or practicable to specify the amount or extent of take, a surrogate may be used if we: describe the causal link between the surrogate and take of the listed species, explain why it is not practical to express the amount or extent of anticipated take or to monitor take-related impacts in terms of individuals of the listed species, and set a clear standard for determining when the level of anticipated take has been exceeded. 50 C.F.R. §402.14(h)(i)(1)(i).

For this opinion, NMFS anticipates the direct and indirect effects that would occur from BLM's vegetation management program. Herbicide runoff and drift, increased sedimentation, mechanical disturbance, and temporary loss of riparian vegetation are all likely to occur within species habitats. The likelihood of these occurring in aquatic habitats is especially high when rainfall immediately follows herbicide applications, or if wind conditions exacerbate inputs from drift. The range of responses to the stressors of the proposed action on ESA-listed species may include killing or injuring individuals directly, and starvation and impaired growth through reductions in prey. These results are not the purpose of the proposed action. Therefore, incidental take of ESA-listed species is reasonably certain to occur.

Given the variability of real-life conditions, the broad nature and scope of the proposed action, and the wide-ranging distributions of individuals of ESA-listed species, the best scientific and commercial data available are not sufficient to enable NMFS to directly estimate a specific amount of incidental take associated with the proposed action for each listed species that may be exposed and respond to this exposure. NMFS identified multiple uncertainties associated with the proposed action. Areas of uncertainty include:

- Limited use and exposure data on stressors of the proposed action for uses of these pesticides;
- Minimal information on exposure and toxicity for pesticide formulations, adjuvants, and other/inert ingredients within registered formulations;
- Minimal information on tank mixtures and associated exposure estimates;
- Limited data on toxicity of environmental mixtures;
- Temporal and spatial variability of individuals; and
- Uncertainty about stressors in the nearshore estuarine and marine habitats.

Additionally, NMFS recognizes there are multiple impediments that reduce the likelihood of detecting take of ESA-listed species from this type of action. Vyas (1999) concluded that most wildlife mortality is unaccounted for as only a small fraction is likely observed, reported, and confirmed. Data show that most effects on wildlife are not observed, the majority of incidents

observed are not reported, only a portion of those that are reported are investigated and, of those investigated, confirmation of pesticides is challenging given a lack of resources for such investigations and the need to immediately secure samples for analysis prior to chemical dissipation. The likelihood of detecting impacts becomes even more difficult in species that are not abundant. Sublethal effects such as reduced reproduction are nearly impossible to detect without rigorous environmental monitoring. Additionally, there are generally no mandates requiring investigation or reporting of pesticide incidents. The exception is that pesticide registrants are required to report ecological incidents to EPA under FIFRA 6(a)(2). EPA maintains an incident database (the EIIS) to document reported incidents. The EIIS uses criteria to categorize incidents as "major" or "minor" depending on the scale of effect observed. Additionally, the EIIS also characterizes the likelihood that the incident was caused by a particular pesticide using defined criteria (https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/guidance-using-incident-data-evaluating-listed-and#eiis). For these reasons, NMFS uses surrogates for the allowable extent of take of listed species, as described below within each of the species groupings.

Anadromous fish

NMFS identifies, as a surrogate for the anticipated extent of take of anadromous and marine fish, the ability of this proposed action to proceed without any fish mortality within the action area attributed to BLM's vegetation treatment activities. Note that "any fish mortality" is a higher threshold than might be assumed on first reading. This threshold is appropriate as a surrogate for take given the qualifiers described below, as well as the discussion on observing ecological incidents outlined in the previous section. Because of the difficulty of detecting mortality or other adverse effects on ESA-listed species of fish, individuals killed do not have to be ESA-listed species in order for their death to be considered a relevant surrogate for take. In addition, mortalities of other species of fish provide an acceptable surrogate because they are causally linked to effects on the ESA-listed fish species in the same habitat. For example, salmonids are relatively sensitive to pesticides compared to other species of fish so, if there are kills of other anadromous or freshwater fishes attributed to use of these stressors, it is likely that salmonids have also died, even if no dead salmonids can be located.

Because fish mortalities can easily go unobserved or unaccounted for, we consider an exceedance of take to have occurred when either of the following occurs:

1. Any fish mortality is reported to EPA, and attributed by EPA to BLM's use of herbicides (in their vegetation management program) according to EPA's guidelines for evaluating ecological incident data (https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/guidance-using-incident-data-evaluating-listed-and#eiis). Incidental take consists of incidents (as defined in 40 CFR 159.184) involving fish mortalities that are considered attributable to one of the authorized herbicides and when available information suggests a certainty index of "probable" or "highly probable" as defined in EPA's guidance for using incident data (EPA October 13, 2011; https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/guidance-using-incident-data-evaluating-listed-and#guidance).

2. Any fish mortality is observed by BLM staff during vegetation treatment activities or during post-treatment monitoring and when the available information suggests that it is probable or highly probable that the mortality is attributable to BLM vegetation treatment activities. As described in the 2023 PEIS, the BLM will use the BLM Assessment, Inventory, and Monitoring Strategy as a monitoring framework; this is described further in the 2016 PEIS (BLM 2016b, p. 2-9). The 2007 PEIS (BLM 2007b, pp. 2-35 to 2-39) provides an additional discussion of monitoring of vegetation treatments, including BLM guidance, procedures for implementation, monitoring methods, and dissemination of results.

Marine Invertebrates

NMFS identifies, as a surrogate for the allowable extent of take of black abalone and sunflower sea star (proposed), the ability of this action to proceed without any mortality or adverse reproductive effects to echinoderms (e.g. starfish, sea urchin) or marine mollusks within the action area attributed to BLM's vegetation treatment activities. Note that "any mortality or adverse reproductive effects" is a higher threshold than might be assumed on first reading. This threshold is appropriate as a surrogate for take given the qualifiers described below, as well as the discussion on observing ecological incidents outlined in the previous section. Mortality or adverse reproductive effects on other species of echinoderms or marine mollusks provide an acceptable surrogate because they are causally linked to similar effects on the ESA-listed species. For example, species that are taxonomically similar tend to have similar toxicological sensitivities to pesticides. Therefore, if there are mortalities or adverse reproductive effects on other species of echinoderms or marine mollusks, it is likely that black abalone and sunflower sea star have also been adversely affected, even if these effects were not observed and reported.

Similar to the situation with fish, because of the difficulty of detecting adverse effects on ESA-listed or proposed species of marine invertebrates, we consider an exceedance of take to have occurred when either of the following occurs:

1. Any echinoderm or marine mollusk mortality or adverse reproductive effect is reported to EPA and attributed to BLM's use of herbicides (in their vegetation management program) according to EPA's guidelines for evaluating ecological incident data (https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/guidance-using-incident-data-evaluating-listed-and#eiis). Incidental take consists of incidents (as defined in 40 CFR 159.184) involving reproductive effects, and both "minor" and "major" incidents, involving echinoderms or marine mollusks that are considered attributable to one of the authorized herbicides and when the available information suggests a certainty index of "probable" or "highly probable" as defined in EPA's guidance for using incident data (EPA October 13, 2011; https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/guidance-using-incident-data-evaluating-listed-and#guidance).
2. Any echinoderm or marine mollusk mortality is observed by BLM staff during vegetation treatment activities or during post-treatment monitoring and when the available information suggests that it is probable or highly probable that the mortality is attributable to BLM

vegetation treatment activities. As described in the 2023 PEIS, the BLM will use the BLM Assessment, Inventory, and Monitoring Strategy as a monitoring framework; this is described further in the 2016 PEIS (BLM 2016b, p. 2-9). The 2007 PEIS (BLM 2007b, pp. 2-35 to 2-39) provides an additional discussion of monitoring of vegetation treatments, including BLM guidance, procedures for implementation, monitoring methods, and dissemination of results.

For marine mollusks, only incidents reported along the West coast, south of Point Arena, California will be considered relevant. For echinoderms, any incident reported along the West coast, including Alaska, will be considered relevant.

13.2 Reasonable and Prudent Measures

Reasonable and prudent measures, along with the terms and conditions that implement them, cannot alter the basic design, location, scope, duration, or timing of the action, may involve only minor changes, and may include measures implemented inside or outside of the action area that avoid, reduce, or offset the impact of incidental take (50 C.F.R. §402.14(i)(2)).

NMFS believes the RPM described below are necessary and appropriate to minimize the impacts of incidental take on threatened and endangered species:

- Minimize the transport of herbicides into the habitats of ESA-listed (or proposed) species within NMFS's jurisdiction in Washington, Oregon, Idaho, California, and Alaska.

13.3 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, and any 4(d) rule that extends the protections of section 9 to threatened species, the Federal action agency must comply with the following terms and conditions. These include the take minimization, monitoring and reporting measures required by the section 7 regulations (50 C.F.R. §402.14(i)). The following terms and conditions implement the reasonable and prudent measure above. To be exempt from the prohibitions of section 9 of the ESA, BLM must adhere to the following:

When conducting vegetation treatment activities within watersheds containing habitats of ESA-listed (or proposed) species within NMFS's jurisdiction in Washington, Oregon, Idaho, California, and Alaska:

a. Do not make pesticide applications when soil is saturated, or when a storm event likely to produce runoff from the treated area is forecasted (by NOAA/National Weather Service, or other similar forecasting service) to occur within 48 hours following application;
b. Do not make pesticide applications when wind is blowing towards aquatic habitats. If this scenario cannot be avoided, implement one or more of the following to prevent drift: a) decrease boom height; b) increase distance from aquatic habitats; c) increase droplet size; d) implement spray reduction technology (e.g. hooded sprayer, spot treatment); or, e) ensure the presence of a physical wind-break between the site of application and the aquatic habitat.

The wind-break must not contain gaps. Boom height must be lower than the wind-break height.

14 CONSERVATION RECOMMENDATIONS

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

- Develop materials for BLM field offices to better depict the locations of NMFS's species ranges as well as the PULA.
- Develop a means to more effectively gather information on BLM site-level activities that fall under this programmatic consultation.

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

15 REINITIATION NOTICE

This concludes formal consultation for the Permits Division proposed issuance of Permit No. 17304-03. As 50 CFR 402.16 states, reinitiation of formal consultation is required, and shall be requested by the Federal agency, where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action that may affect ESA-listed species or designated critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an effect to the ESA-listed species or designated critical habitat that was not considered in this opinion, or (4) a new species is ESA-listed or designated critical habitat designated that may be affected by the action.

16 MAGNUSON STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT RESPONSE

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity," and includes the physical, biological, and chemical properties that are used by fish (50 C.F.R. §600.10). 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 may result from actions occurring within or outside EFH, and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 C.F.R. §600.810). Section 305(b) of the MSA also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH (50 C.F.R. §600.905(b)).

16.1 Essential Fish Habitat Affected by the Project

The proposed action and action area for this consultation are described in Sections 3, 4, and 5 of this document, and this EFH consultation only covers part of the BLM's herbicide program, by excluding those BLM-owned lands in the southeast continental U.S. Should the BLM wish to provide a supplemental EFH assessment, those lands could be added to this programmatic consultation.

BLM identified affected and potentially affected EFH designated by two fishery management councils and implemented by NMFS' West Coast and Alaska Regional Offices, in Chapter 6 of the EFH Assessment. Those designations are subject to change through the councils' process as described by an amendment published in the Federal Register. Current designations are listed below.

Affected EFH and associated HAPCs are designated by the Pacific Fishery Management Council, and are identified and described in the following fishery management plans or amendments to fishery management plans:

- Coastal Pelagic Species Fishery Management Plan[1]
- Groundfish Fishery Management Plan[2]

[1] https://www.pcouncil.org/documents/2019/08/cps-fmp-efh-section.pdf
[2] https://www.pcouncil.org/actions/amendment-28-pacific-coast-groundfish-essential-fish-habitat-rockfish-conservation-area-modifications-and-magnuson-act-discretionary-closures/

    - Seagrass HAPC
    - Estuaries HAPC
    - Rocky Reefs HAPC
- Salmon Fishery Management Plan[3]
    - Complex Channels and Floodplain Habitats HAPC
    - Thermal Refugia HAPC
    - Spawning Habitat HAPC
    - Estuaries HAPC
    - Marine and Estuarine Submerged Aquatic Vegetation HAPC

Affected EFH and associated HAPCs are designated by the North Pacific Fishery Management Council,[4] and are identified and is described in the following fishery plans or amendments to fishery management plans:

- Gulf of Alaska Groundfish Fishery Management Plan[5]
- Bering Sea / Aleutian Islands Groundfish Fishery Management Plan[6]
- Scallop Fishery Management Plan[7]
- Bering Sea / Aleutian Islands Crab Fishery Management Plan[8]
- Salmon Fishery Management Plan[9]

It remains the obligation of BLM to be aware of changes to EFH designations where their activities take place; BLM's list of EFH designations for affected managed species should be updated annually (e.g., as part of an annual programmatic consultation review). In addition, please be aware of two helpful documents for future reference when preparing EFH assessments:

- Impacts to Essential Fish Habitat from Non-Fishing Activities in Alaska: EFH 5-year review from 2018-2023[10]
- Nonfishing Impacts on Essential Fish Habitat[11]

16.2 Adverse Effects on Essential Fish Habitat

The adverse effects of herbicide treatments on EFH are analogous to those summarized by Table 148, and the effects of the action are described in chapters 8 and 9 of this biological opinion. Similar to the analysis of effects for ESA-listed species and their critical habitat, adverse effects on EFH are likely to occur from BLM's vegetation management program. Herbicide runoff and drift,

[3] https://www.pcouncil.org/documents/2019/08/salmon-efh-appendix-a.pdf
[4] https://www.npfmc.org/
[5] https://www.npfmc.org/wp-content/PDFdocuments/fmp/GOA/GOAfmpAppendix.pdf
[6] https://www.npfmc.org/wp-content/PDFdocuments/fmp/BSAI/BSAIfmpAppendix.pdf
[7] https://www.npfmc.org/wp-content/uploads/ScallopFMP.pdf
[8] https://www.npfmc.org/wp-content/PDFdocuments/fmp/CrabFMP.pdf
[9] https://www.npfmc.org/wp-content/PDFdocuments/fmp/Salmon/SalmonFMPAppendix.pdf
[10] https://repository.library.noaa.gov/view/noaa/50445
[11] https://repository.library.noaa.gov/view/noaa/48083

increased sedimentation, mechanical disturbance, and temporary loss of riparian vegetation are all likely adverse effects on EFH. Depending on a number of environmental variables, many of these chemical constituents persist in the environment. The likelihood for these inputs on EFH is especially high when rainfall immediately follows herbicide applications, or if wind conditions exacerbate inputs from drift. The range of responses to the stressors of the action on EFH may include killing or injuring (injury includes prolonged sublethal impacts) of individuals directly, or by reductions in prey leading to starvation and impaired growth.

Salmon

Most public lands are inland and far from estuarine, coastal, and marine habitats. As such, the proposed herbicide treatments would be administered primarily in inland aquatic habitats, with no activities occurring either in estuarine or marine environments. Therefore, primarily freshwater life history stages would be potentially affected by the proposed treatments.

Five salmon species were considered in the BLM's EFH assessment: chinook, coho, and pink salmon for the Pacific Coast; and chinook, coho, chum, pink, and sockeye for Alaska. Some of the ESA-listed salmon species are also managed under the MSA and are included in FMPs that have designated EFH. Additionally, some designated critical habitat overlaps with designated EFH for salmon. Because of the overlap between ESA-listed species, designated critical habitat and EFH, we are reasonably certain the effects analysis is relevant to the effects of the proposed action on EFH for salmon that are located on the west coast and Alaska.

While the ESA analysis of effects in Chapters 8 and 9 is relevant to EFH designated in the two salmon FMPs, it should be noted that inland areas are also HAPCs for salmon along the west coast: Complex Channels and Floodplain Habitats HAPC, Thermal Refugia HAPC, Spawning Habitat HAPC, Estuaries HAPC, Marine and Estuarine Submerged Aquatic Vegetation HAPC.

In addition, during Alaska's summer season, headwater tributaries in uplands are often not visible from the air, as they are concealed under riparian sedges and high grasses. Young of the year salmonids (fry and parr) often seek rearing, refuge, and foraging opportunities in these tributaries. These early life stages and their prey are most vulnerable to exposure to these chemical constituents here. Furthermore, headwater tributaries have lower water volumes reducing dilution capacity. This combination of environmental influences could significantly increase mortality and sublethal injury potential.

The proposed BLM herbicide treatments in inland areas may adversely affect EFH for Salmon designated in Alaska and along the west coast, even though minimum widths of 100 feet for aerial, 25 feet for vehicle, and 10 feet for hand spray applications would be implemented for non-aquatic herbicides.

Groundfish, Coastal Pelagic Species, Crab, and Scallop

Twenty-nine Pacific Coast and 34 Alaskan groundfish species or groups were reviewed in the BLM's EFH assessment. Groundfish are fish such as rockfish, sablefish, flatfish, and Pacific

whiting, which are often (but not exclusively) found on or near the ocean floor or other structures. There are five Pacific Coast pelagic species (Pacific sardine, Pacific mackerel, northern anchovy, jack mackerel, and market squid). Pelagic fish are found in open marine water near the surface and are not associated with substrate. BLM's EFH assessment also reviews five Alaska crab species (blue king crab, golden king crab, red king crab, snow crab, and Tanner crab) and four Alaska scallop species (pink, rock, spiny, and weathervane).

There could be distinct adverse effects on EFH and/or HAPCs for groundfish, coastal pelagic species, crab, and scallop, especially pertaining to potential coastal or estuarine applications, which are proposed to be rare. Groundfish, coastal pelagic species, crab, and scallop have life stages that would be potentially adversely affected by herbicide applications along the coast and in estuaries.

However, the BLM is explicit that they would not treat known aquatic vegetation in estuarine or coastal waters, nor do they propose to treat lands on the North Slope and lands adjacent to the coast in Alaska, or along the west coast. If treatments did occur adjacent to marine and coastal habitats, they would be limited to onshore spot or other small-scale treatments (limited in size to a few acres or less), and the effects would be temporary as herbicides diluted by freshwater are further diluted when reaching an estuary or marine habitat. In addition, coastal herbicide treatments would not directly impact vegetation favored by groundfish, coastal pelagic species, crab, and scallop

16.3 Essential Fish Habitat Conservation Recommendations

The proposed treatment program, with conservation measures implemented, may have adverse effects on managed species or their essential fish habitats. The BLM proposes to follow conservation measures and SOPs identified as PDCs in section 3.3 of this opinion. Some impacts to EFH have already been minimized as part of the proposed action because of the implementation of those conservation measures and SOPs developed by the BLM (also listed as PDCs in this document), and some impacts cannot be minimized.

The following EFH conservation recommendations are necessary to further avoid, minimize, mitigate, or otherwise offset the adverse effects on EFH from implementation of program activities as described in Section 3 of this opinion. We appreciate your consideration of our conservation recommendations.

EFH Conservation Recommendation 1

- In addition to the conservation measures identified in Section 6.16 of the EFH assessment, and the SOPs identified in the 2007, 2016, and 2023 PEIS (Appendix B); the BLM should implement the following conservation measures that are modified from those listed on page 5-73 the 2007 Biological Assessment[12] for proposed herbicide treatments in areas that are

[12] https://eplanning.blm.gov/public_projects/nepa/70300/94255/113753/Final_Biological_Assessment__(June_2007).pdf

designated as essential fish habitat, where it does not already overlap with threatened and endangered aquatic species ranges or designated critical habitat.

- Maintain equipment used for transportation, storage, or application of chemicals in a leak proof condition.
- Do not store or mix herbicides, or conduct post-application cleaning within riparian areas.
- Ensure that trained personnel monitor weather conditions at spray times during application.
- Strictly enforce all herbicide labels.
- Do not broadcast spray within 100 feet of open water when wind velocity exceeds 5 mph.
- Do not broadcast spray when wind velocity exceeds 10 mph.
- Do not spray if precipitation is occurring or is imminent (within 24 hours).
- Do not spray if air turbulence is sufficient to affect the normal spray pattern.
- Do not broadcast spray herbicides in riparian areas that are designated EFH. Appropriate buffer distances should be determined at the local level to ensure that overhanging vegetation that provides habitat for managed species is not removed from the site.
- Do not use diquat, fluridone, terrestrial formulations of glyphosate, or triclopyr BEE, to treat EFH.
- Avoid using glyphosate formulations that include R-11 in the future, and either avoid using any formulations with POEA, or seek to use the formulation with the lowest amount of POEA available, to reduce risks to EFH.
- Follow all instructions and SOPs to avoid spill and direct spray scenarios into aquatic habitats. Special care should be followed when transporting and applying 2,4-D, bromacil, clopyralid, diuron, glyphosate, hexazinone, imazapyr, metsulfuron methyl, picloram, tebuthiuron, and triclopyr
- Do not broadcast spray diuron, glyphosate, picloram, or triclopyr BEE in upland habitats adjacent to EFH under conditions that would likely result in off-site drift.
- In watersheds with designated EFH, do not apply bromacil, diuron, tebuthiuron, or triclopyr BEE in upland habitats within ½ mile upslope of EFH under conditions that would likely result in surface runoff.

EFH Conservation Recommendation 2

- If aerial herbicide application is considered in upland regions of Alaska during the summer, BLM should map headwater tributaries at a finer scale using helicopter or foot surveys and further identify avoidance areas.

16.4 Response Requirement

As required by Section 305(b)(4)(B) of the MSA, BLM must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Please send that response to the Office of Habitat Conservation at nmfs.hq.hc.efhconsult@noaa.gov. 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, minimizing, mitigating, or otherwise 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)].

16.5 Reinitiation

BLM 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(1)]. If the active ingredients are determined to be more harmful than previously anticipated, the BLM should reinitiate consultation with NMFS to reconsider the application procedures and use of these herbicides.

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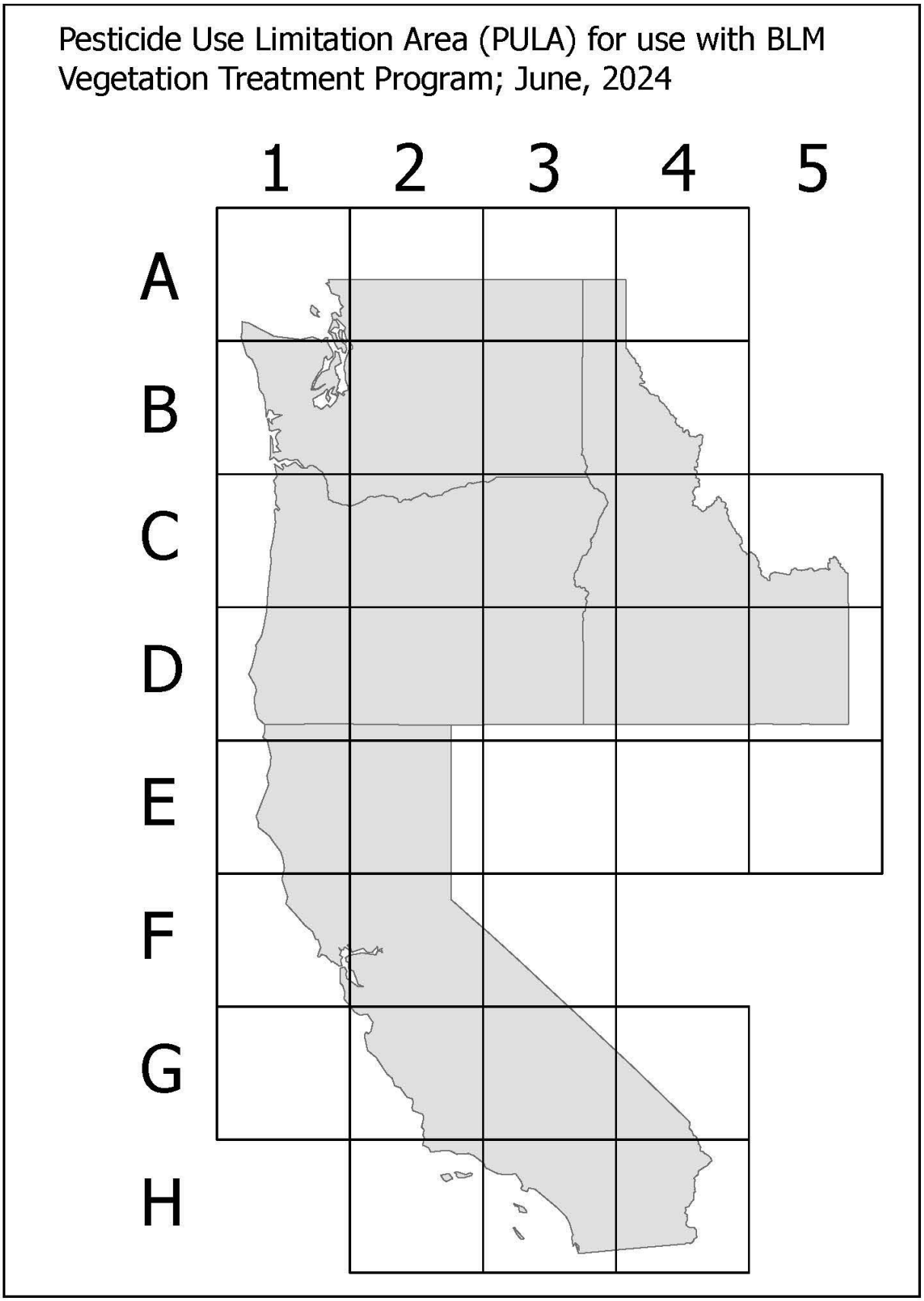
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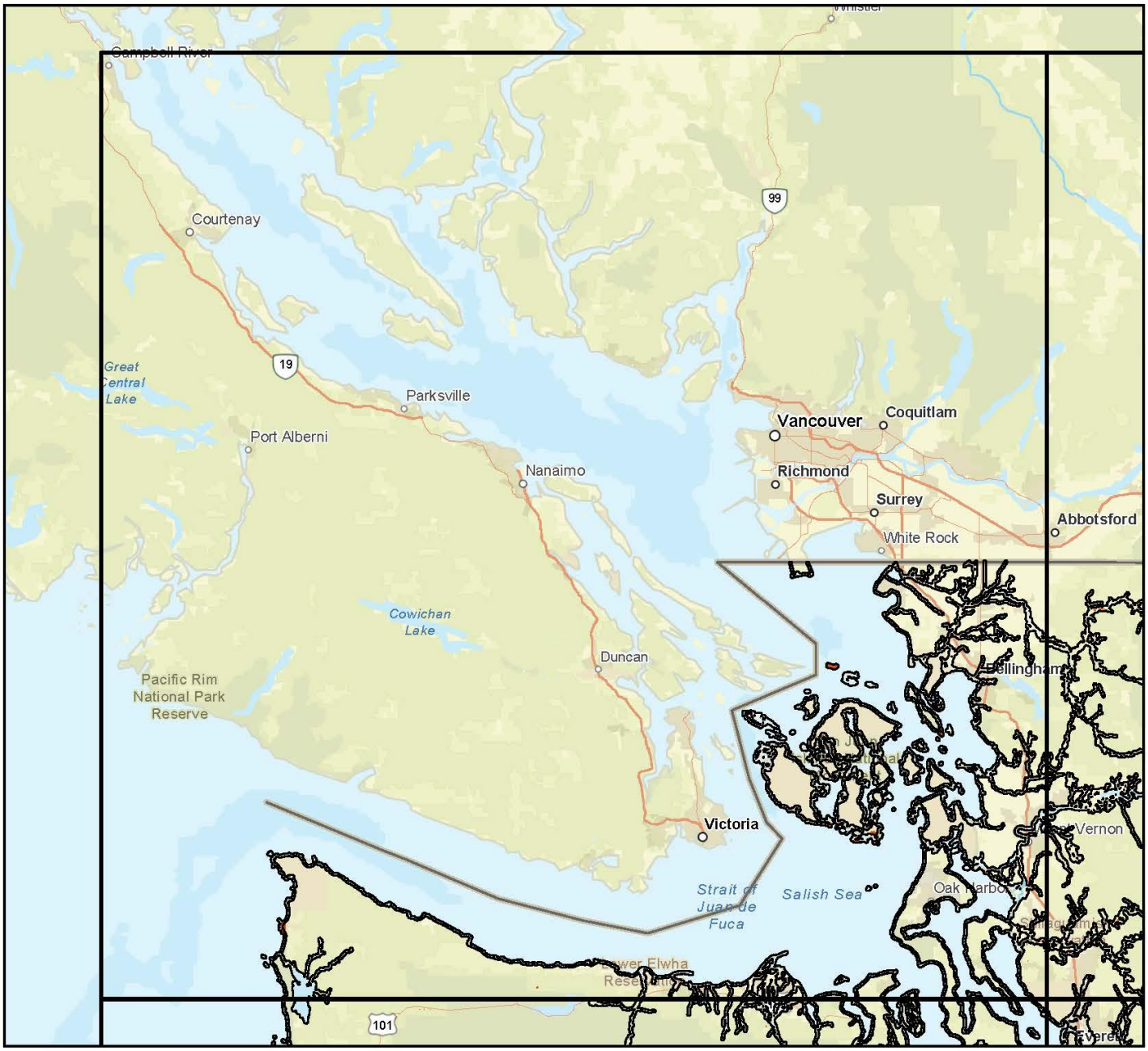
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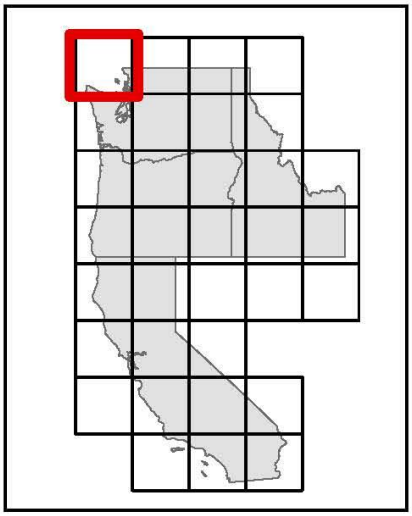
Appendix A. Pesticide Use Limitation Area Maps

The PULA was created by NMFS in the context of the ESA section 7 consultations on FIFRA registration actions. The PULA has been used in FIFRA consultations to target mitigations more meaningfully for the species. Although the PULA was designed for pesticide applications, the parameters used to set the buffer distance (chemical and physical properties of particle movement via runoff and drift) are generally relevant to other types of land-based contaminants. For example, when considering the potential for runoff of sediments and the transport of particles via drift.

The PULA does not represent the complete distribution of ESA-listed species, rather it represents those areas that are most important to the survival and recovery of the species. The spatial data layers can be provided to BLM upon request. The PULA is also available to view in an interactive we app on EPA's Bulletin's Live Two! website https://www.epa.gov/endangered-species/bulletins-live-two-view-bulletins. If viewing on Bulletins, note that other PULAs not relevant to this consultation will also be visible.


Pesticide Use Limitation Area (PULA) for use with BLM Vegetation Treatment Program; June, 2024
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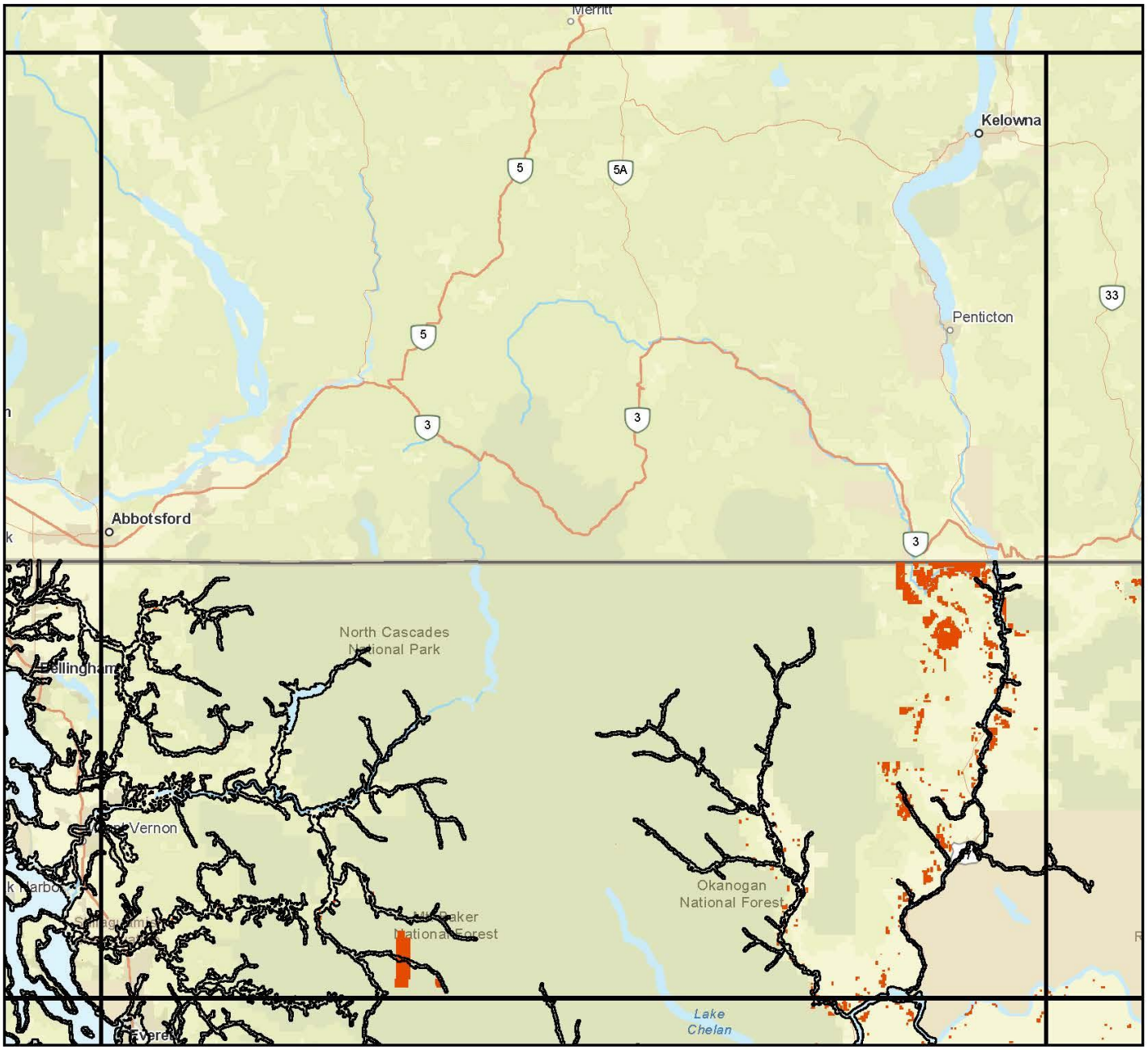
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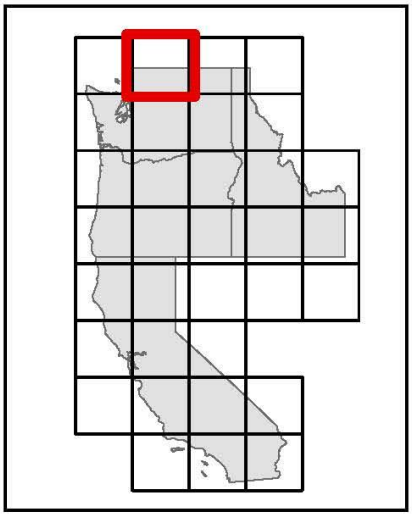
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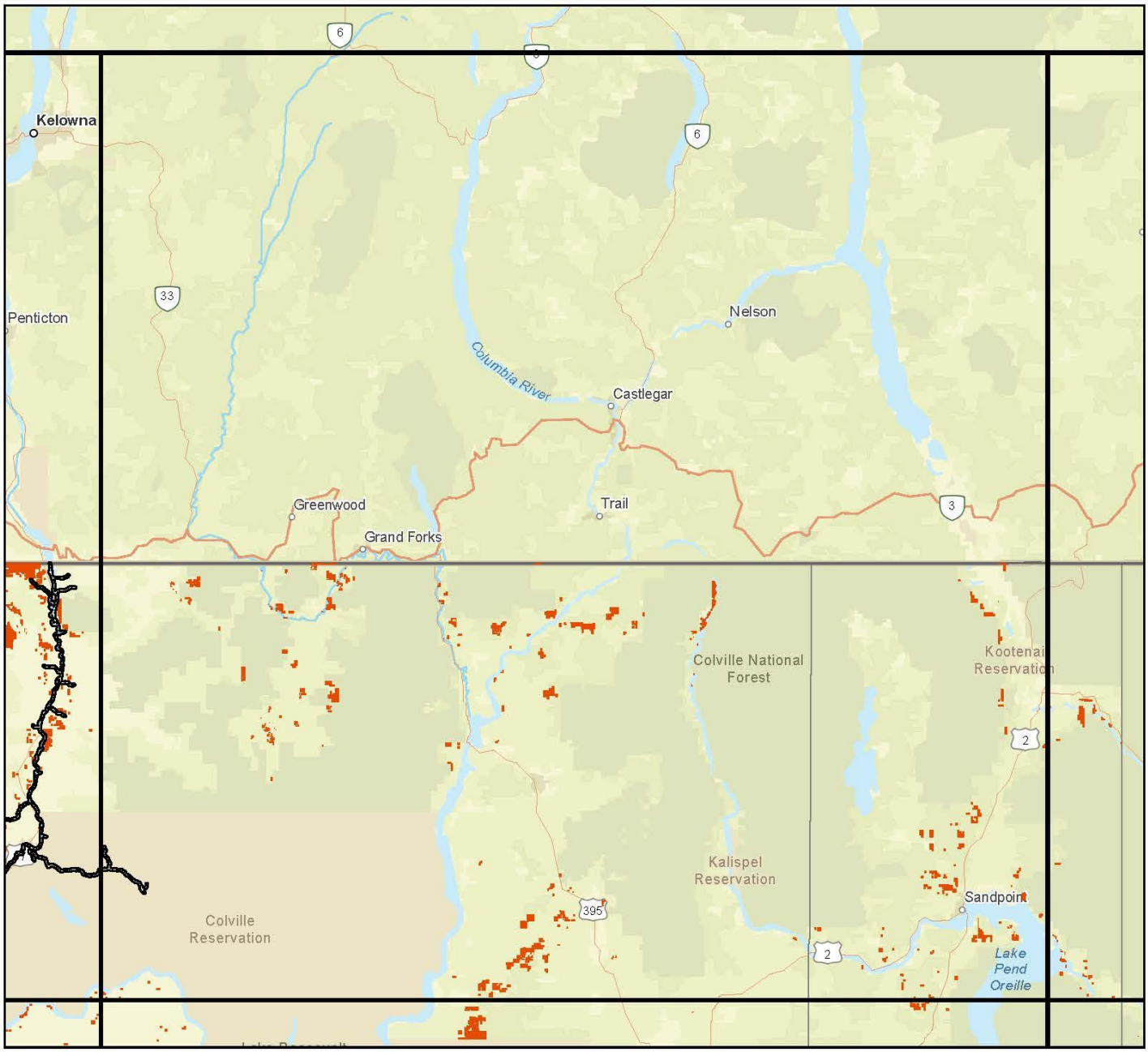
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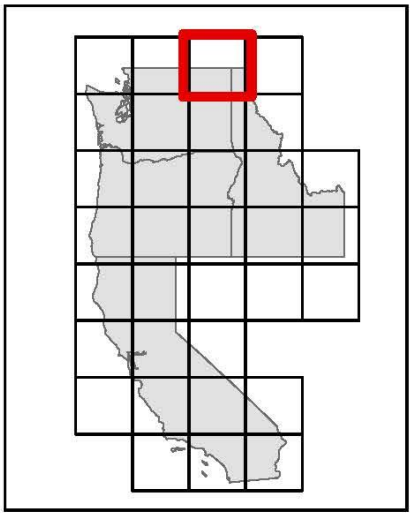
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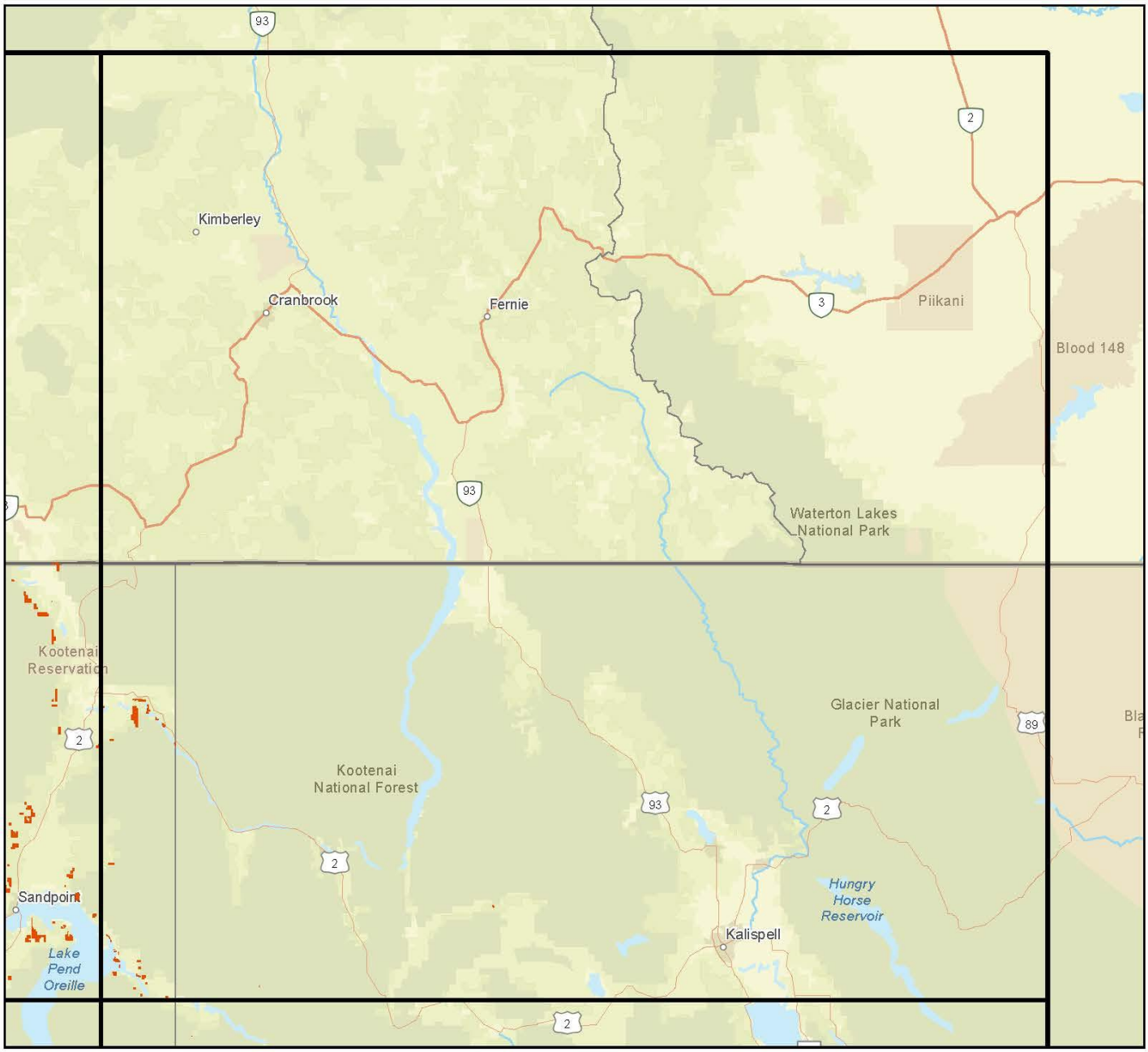
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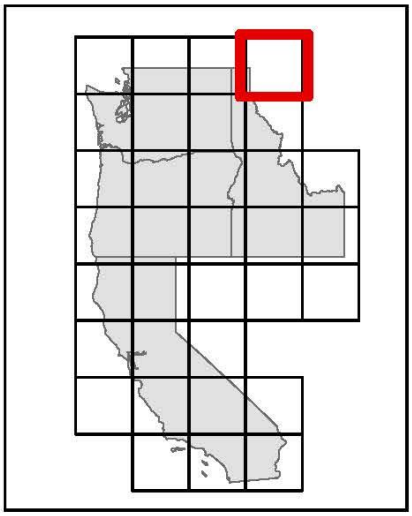
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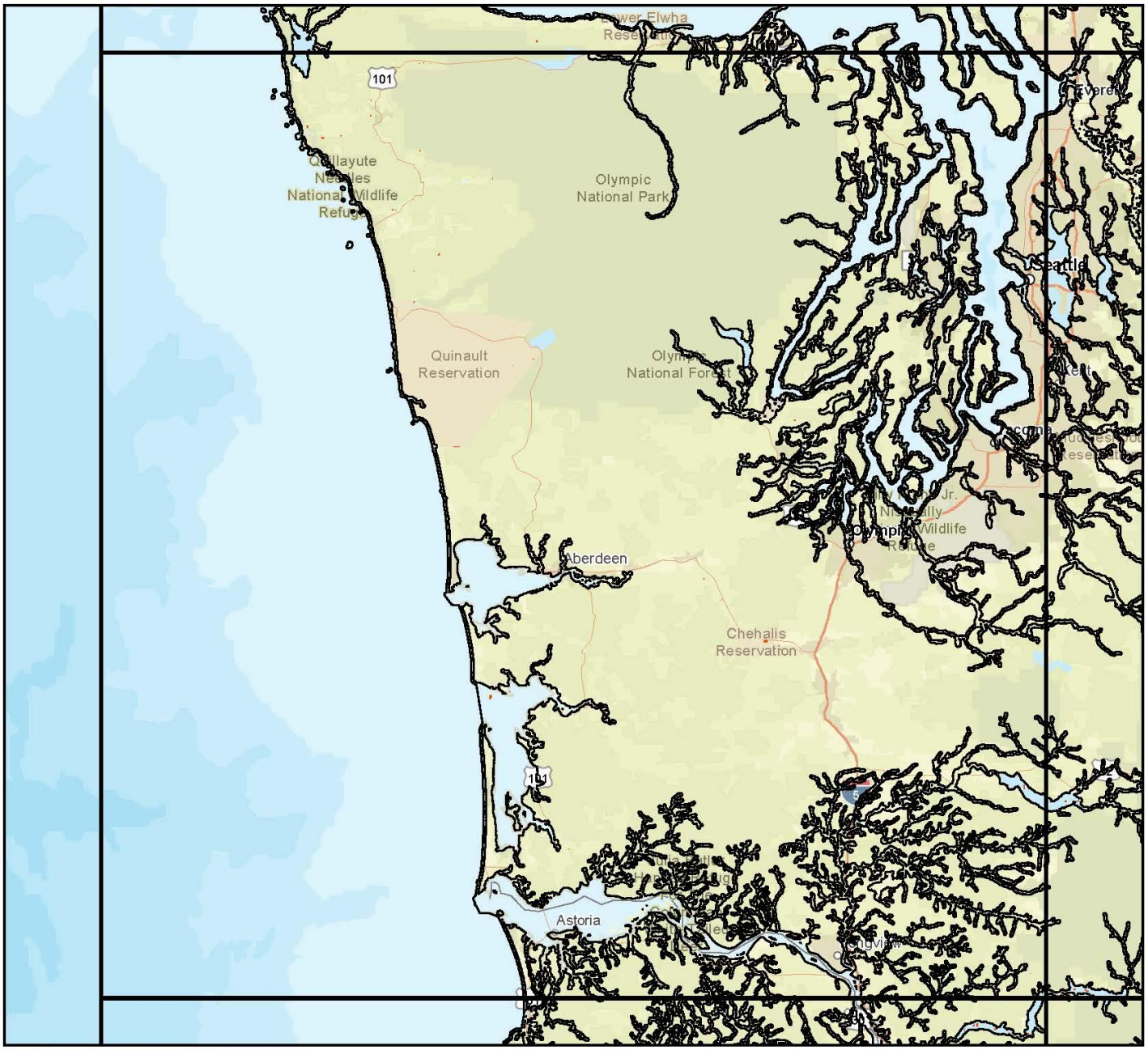
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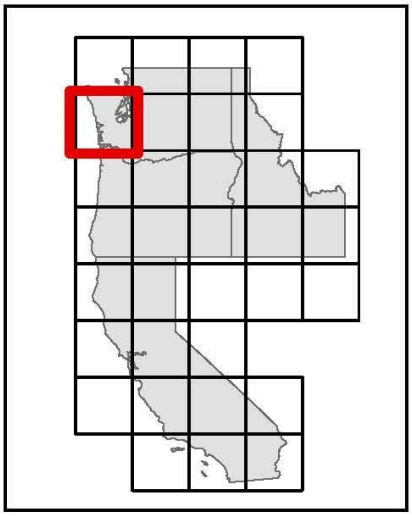
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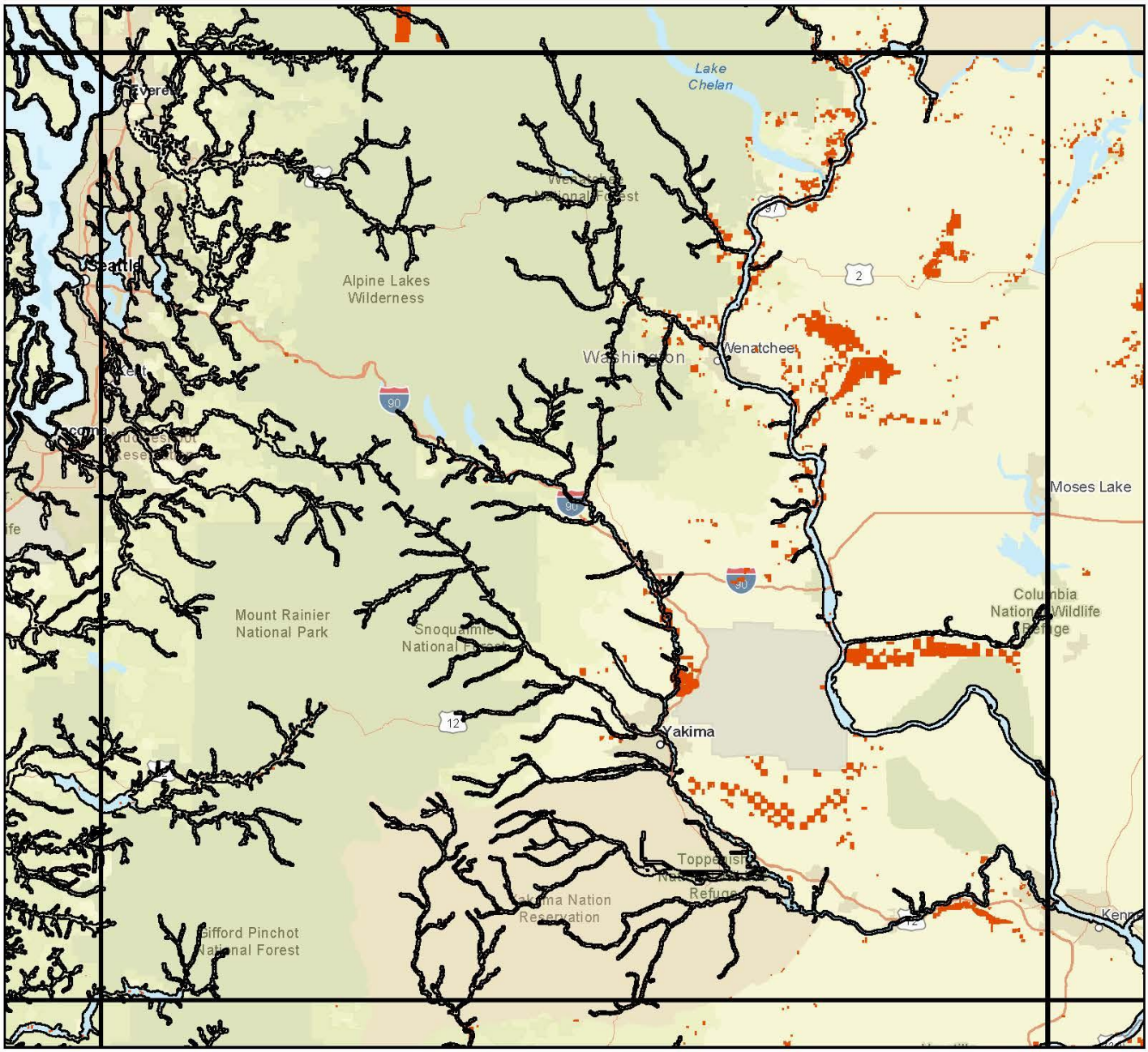
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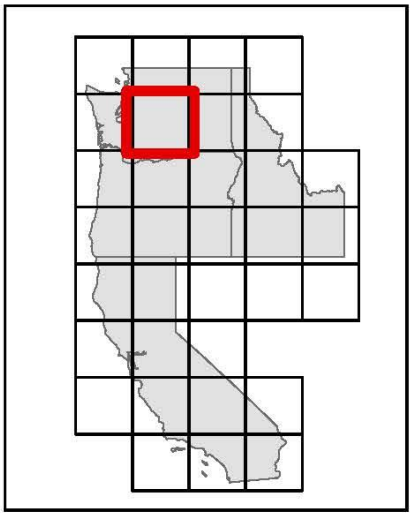
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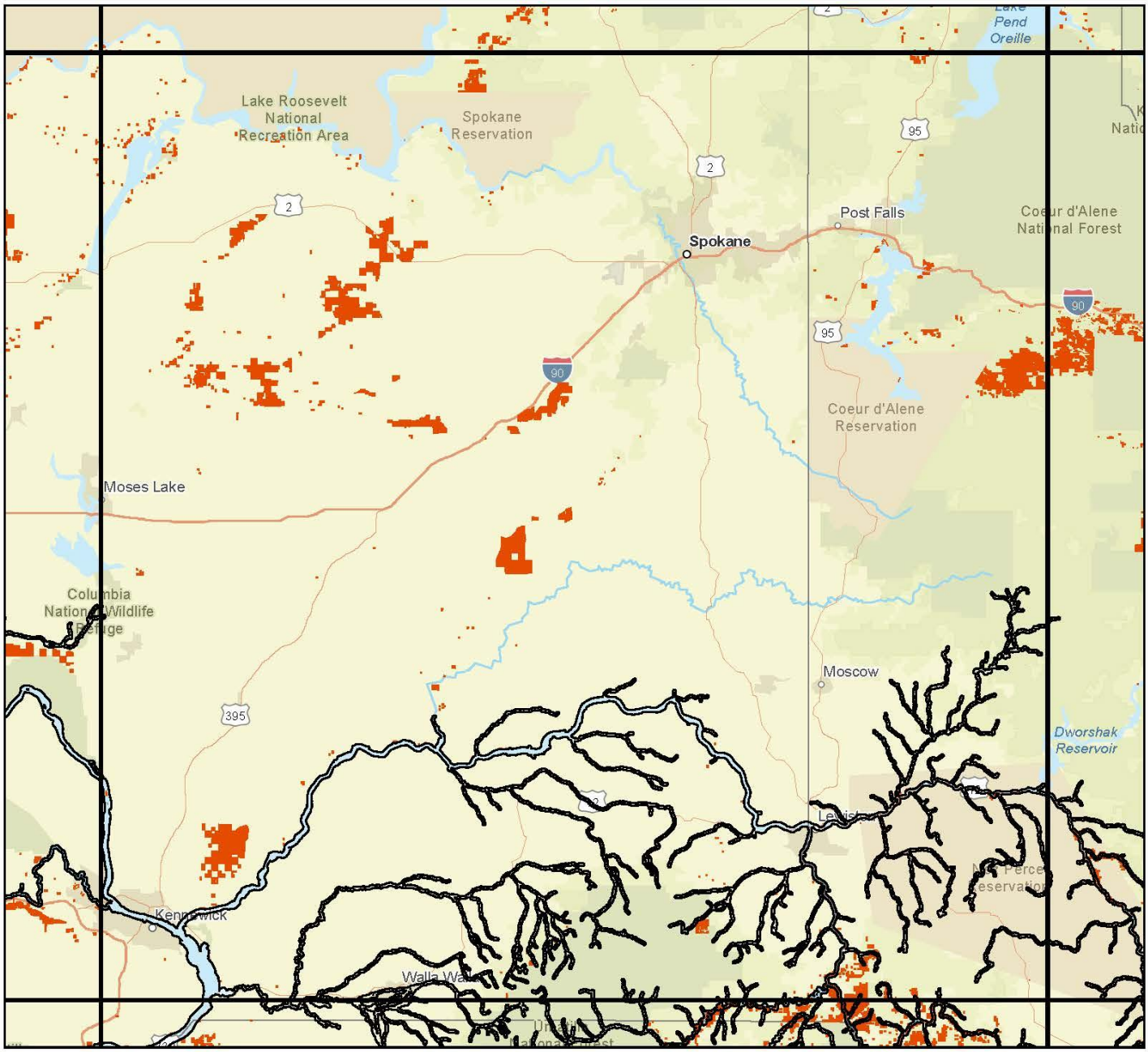
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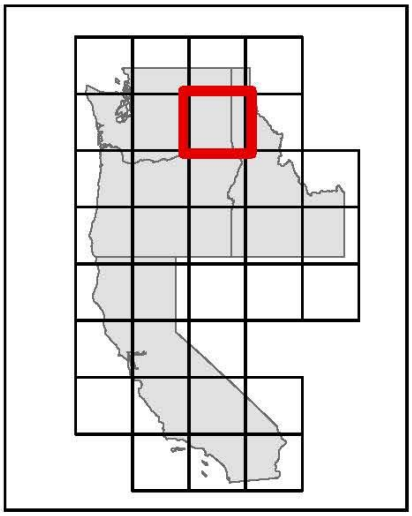
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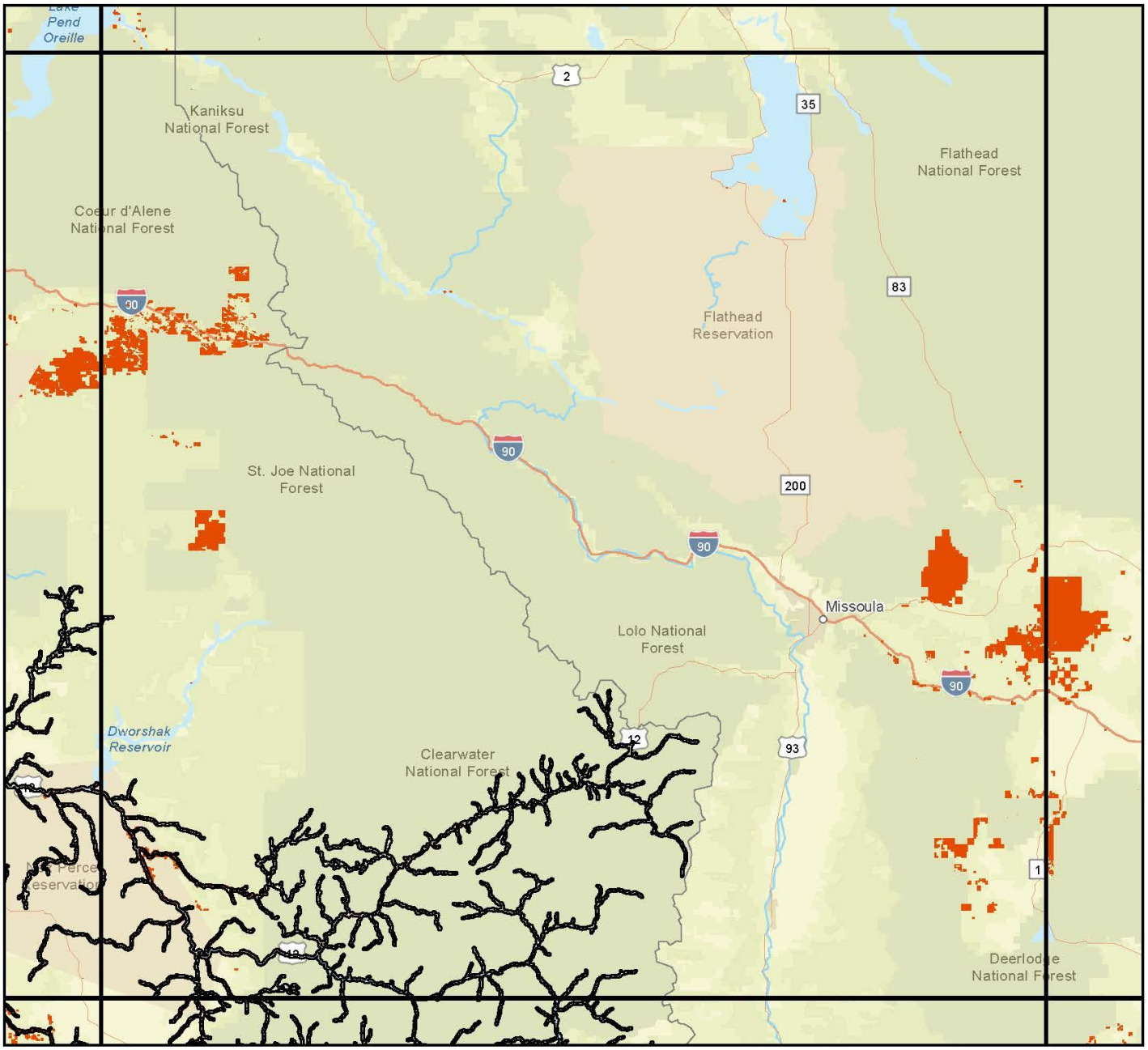
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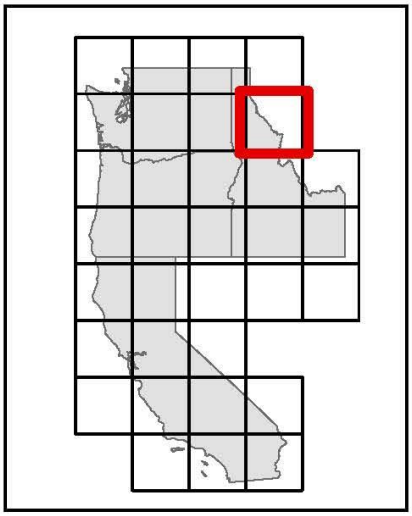
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BLM Lands

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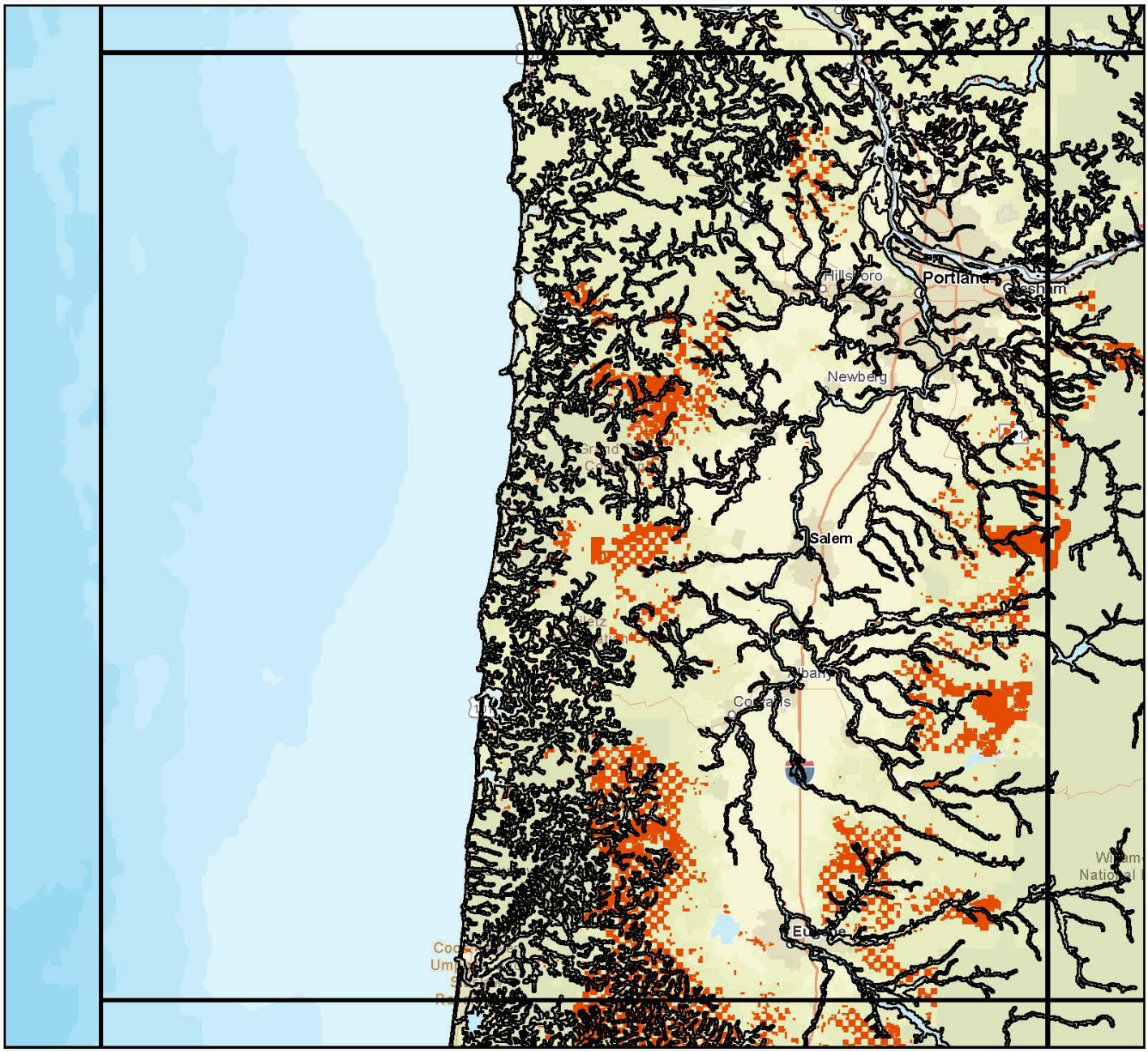
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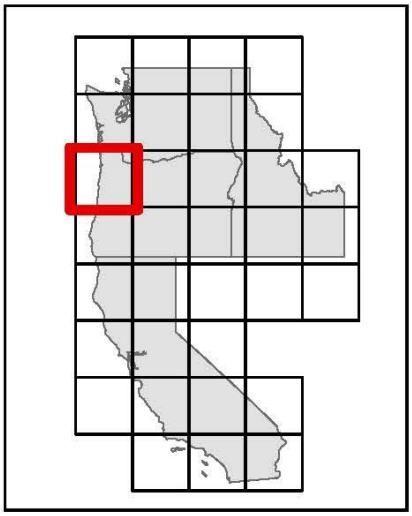
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BLM Lands

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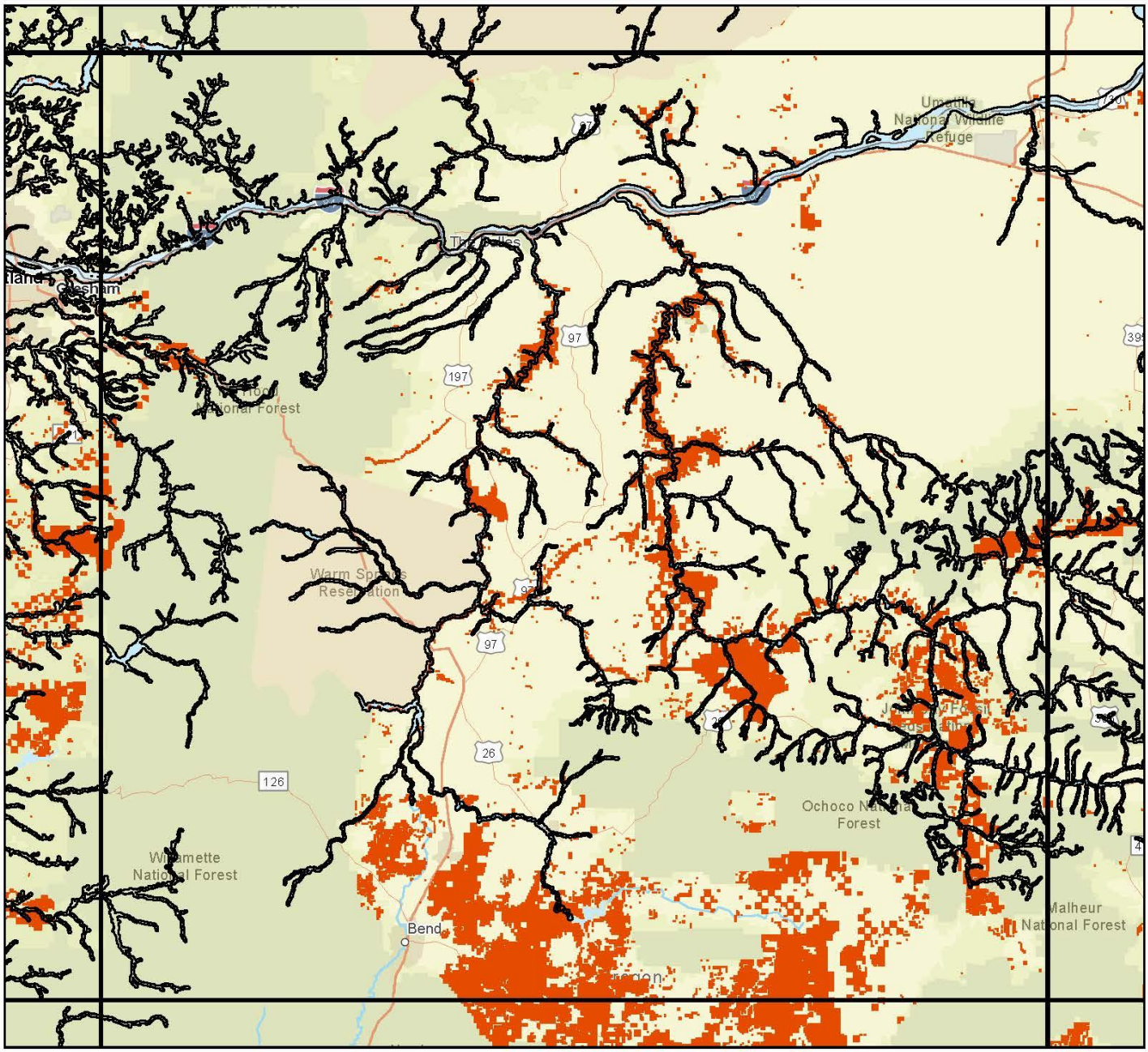
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Vegetation Treatment Program

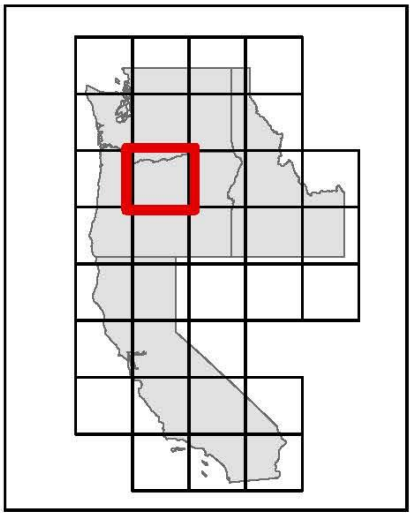
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BLM Lands

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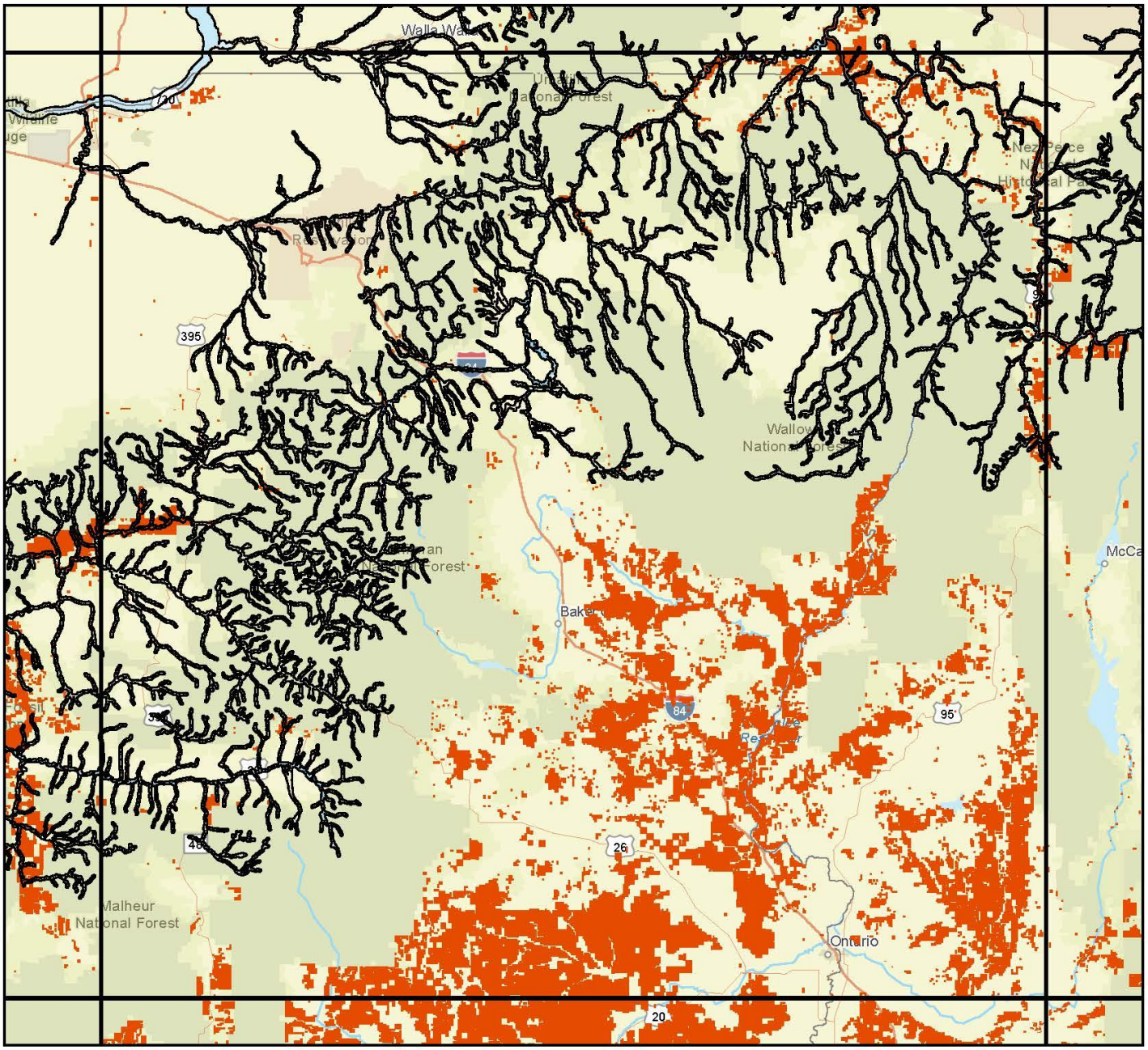
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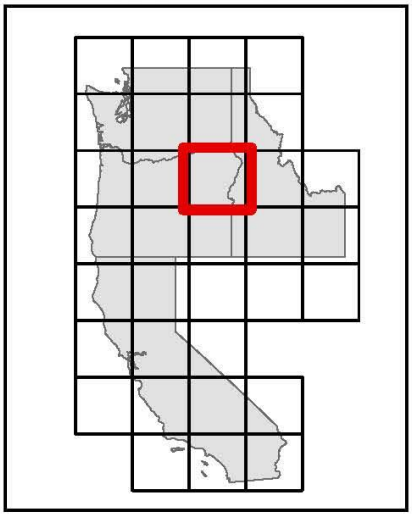
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BLM Lands

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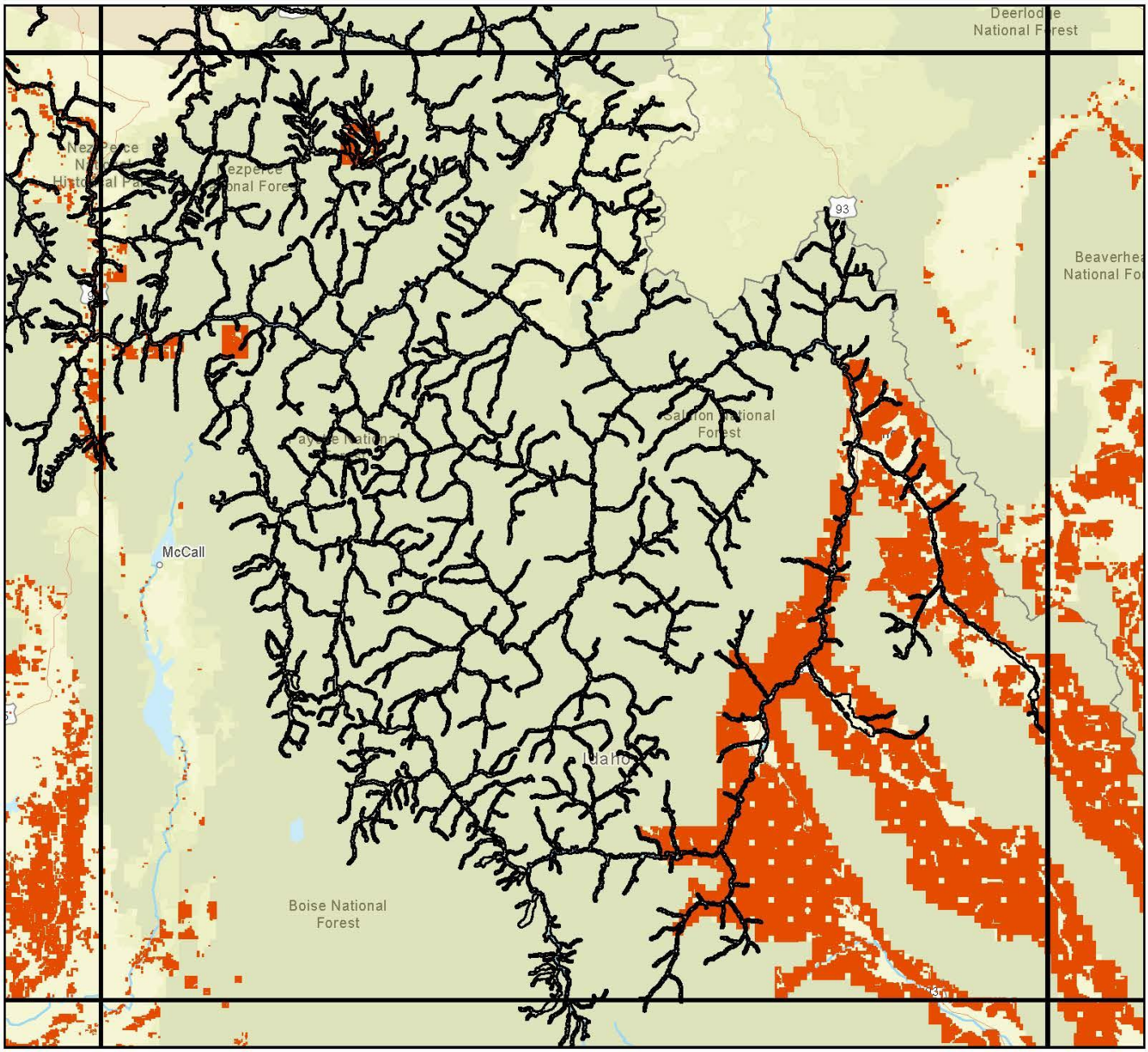
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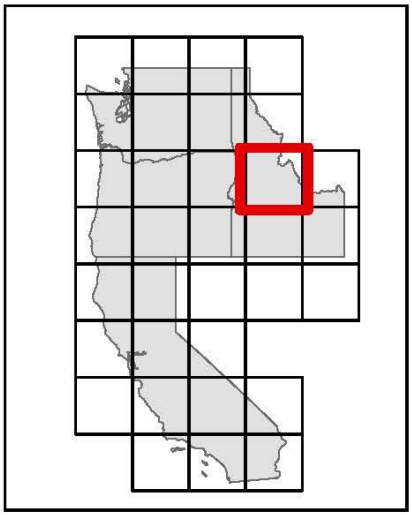
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BLM Lands

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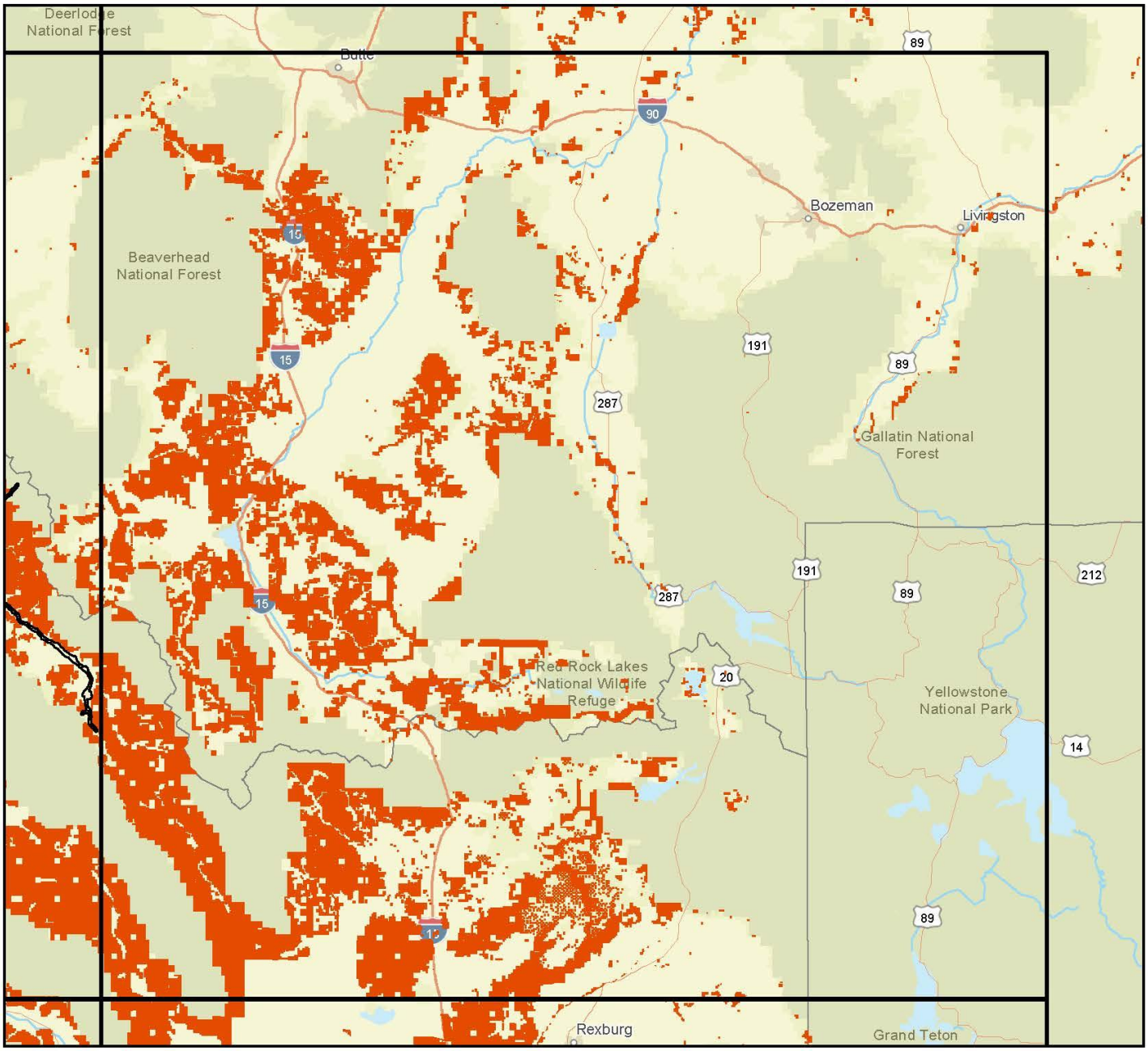
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for use with BLM
Vegetation Treatment Program

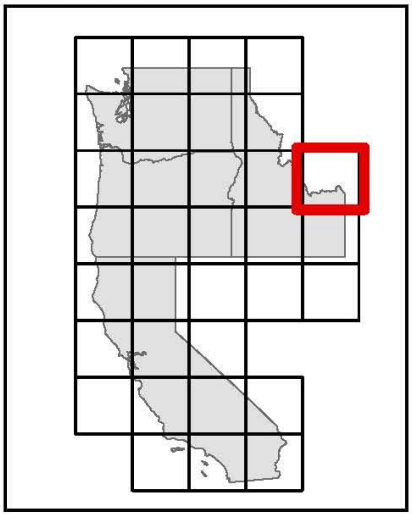
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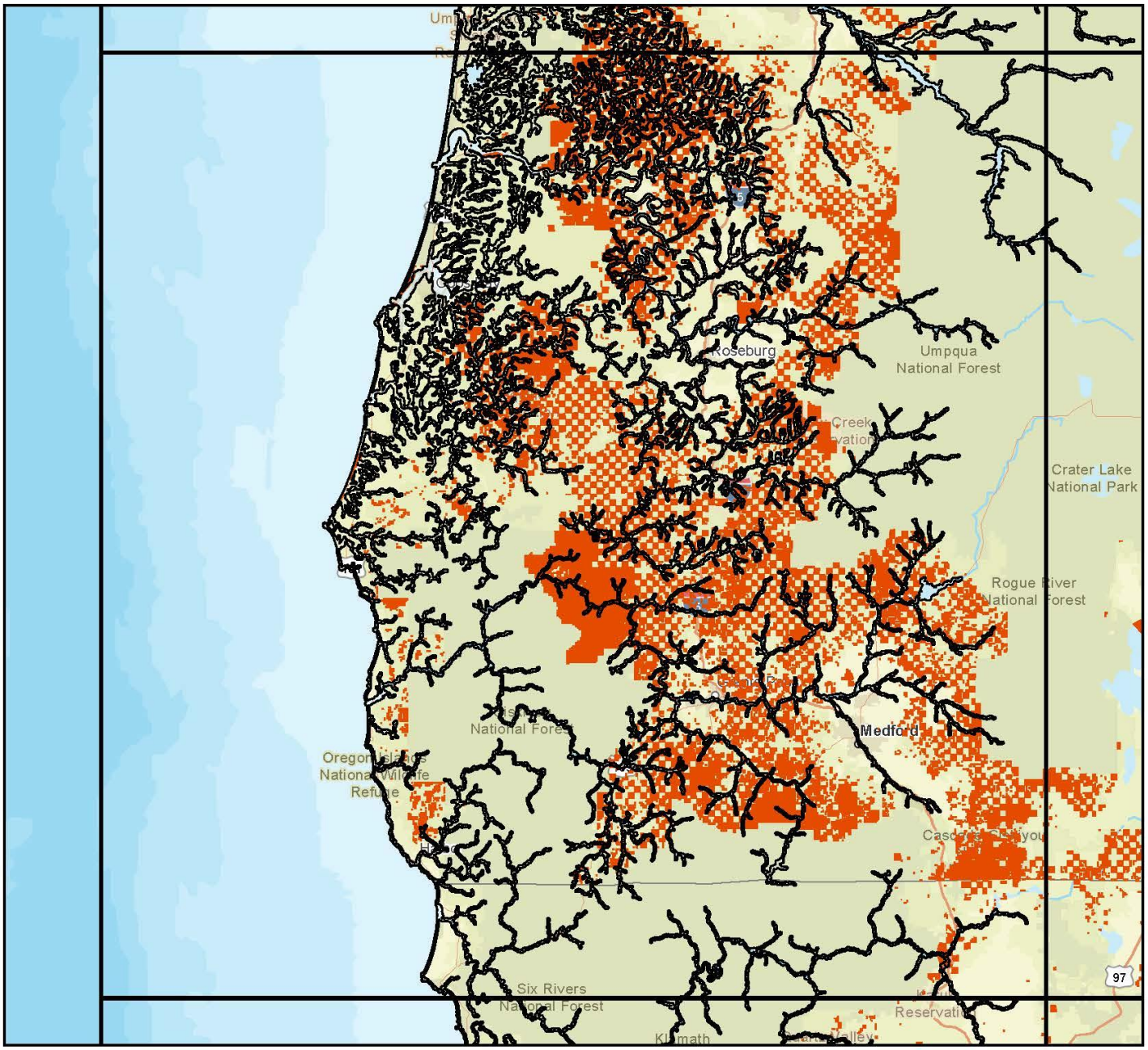
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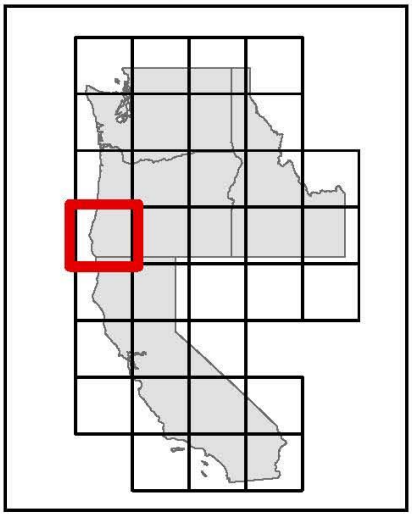
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BLM Lands

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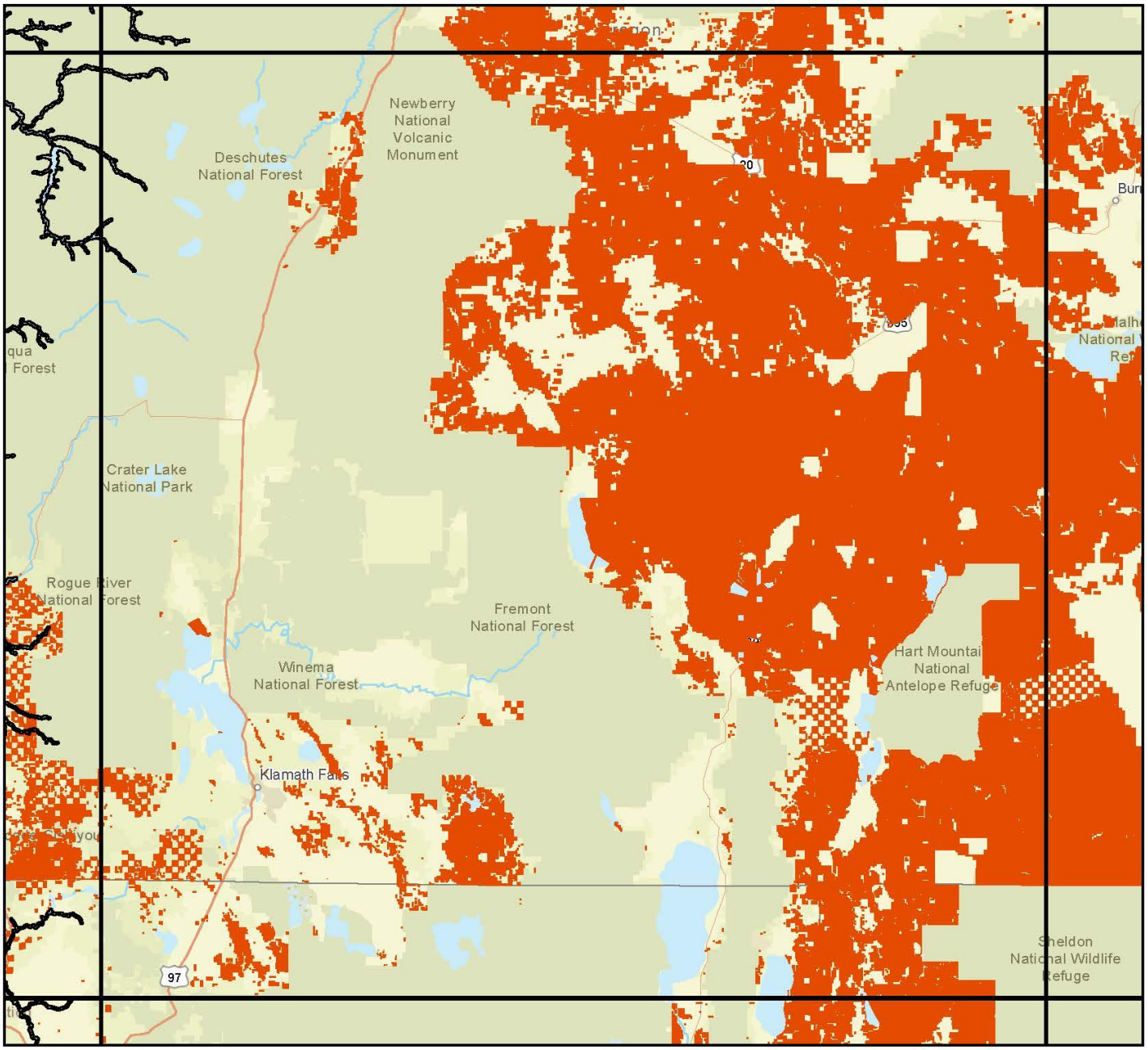
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Vegetation Treatment Program

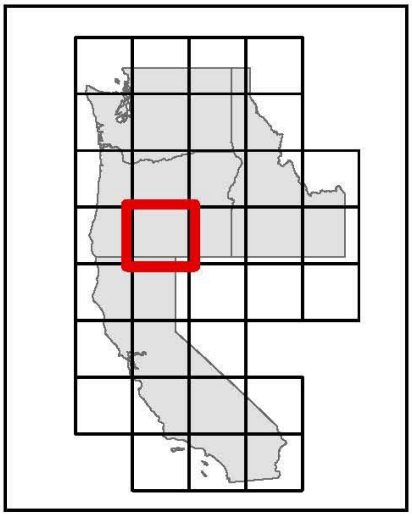
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PULA

BLM Lands

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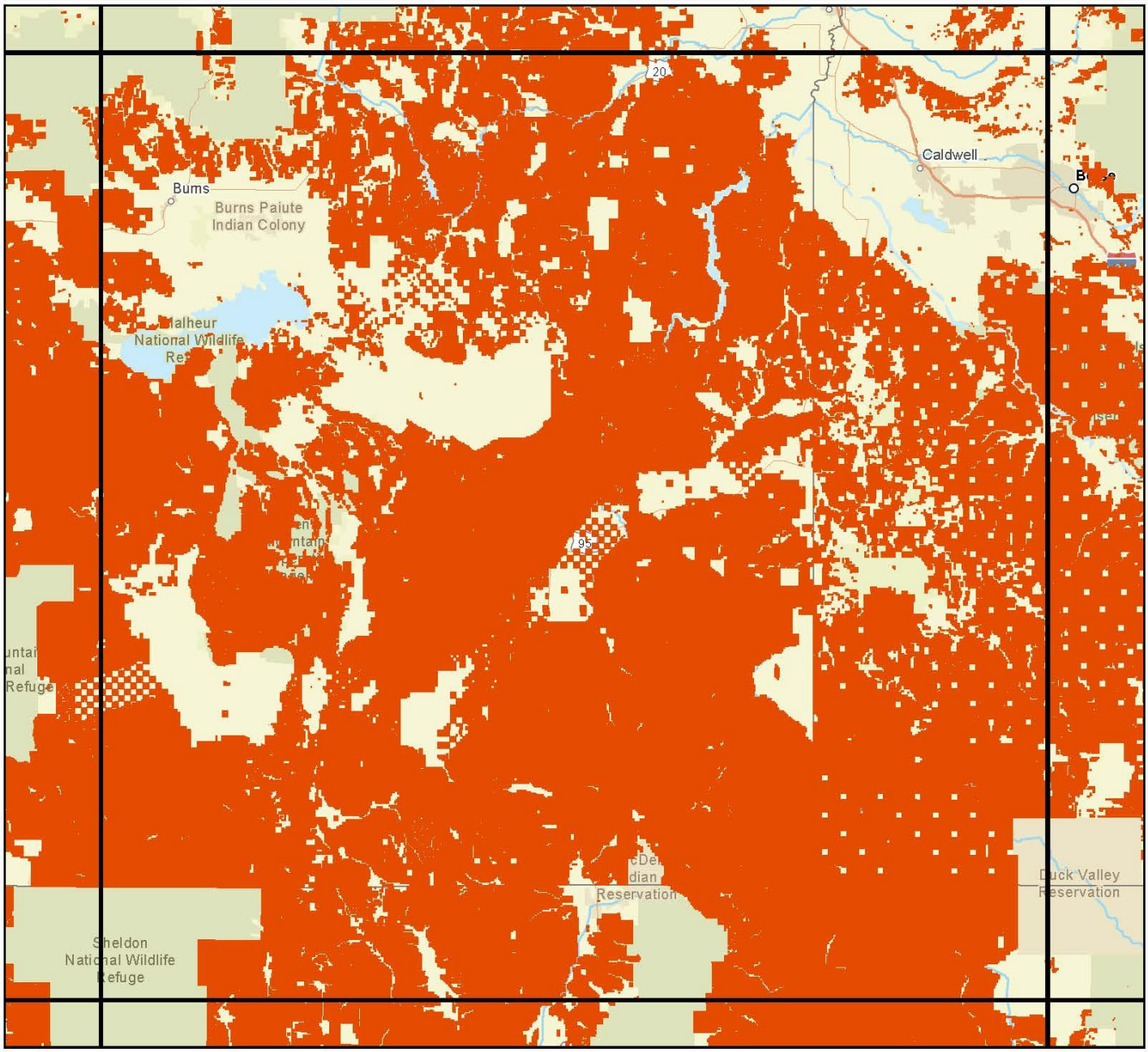
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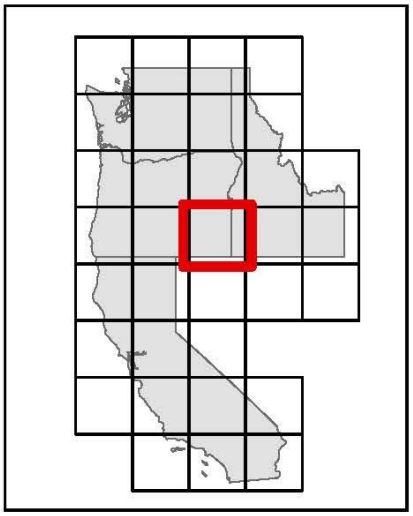
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BLM Lands

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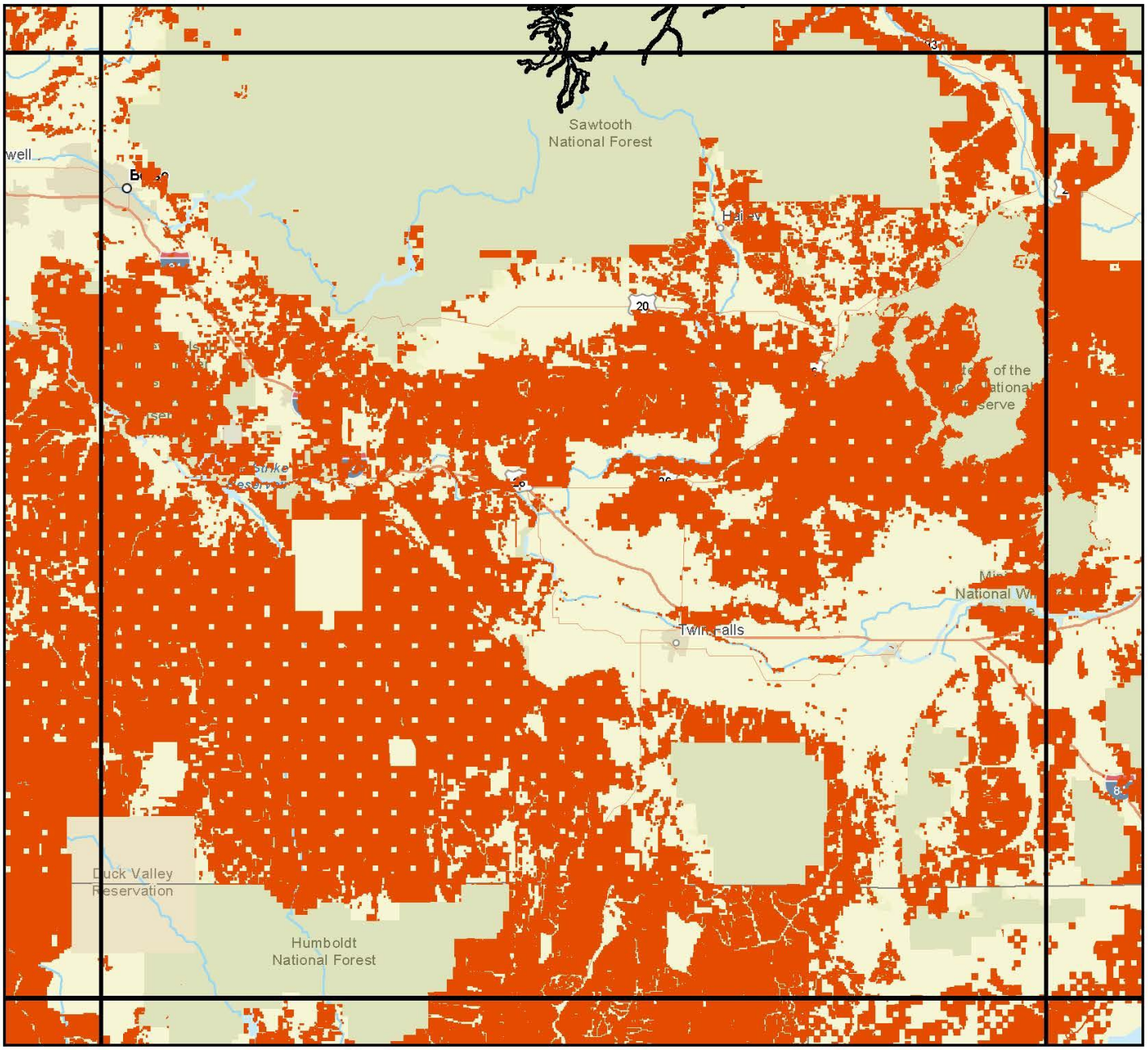
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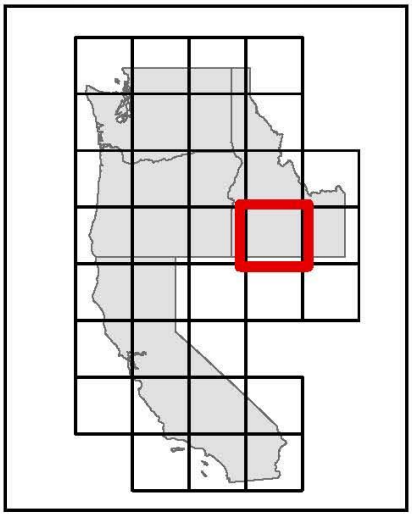
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BLM Lands

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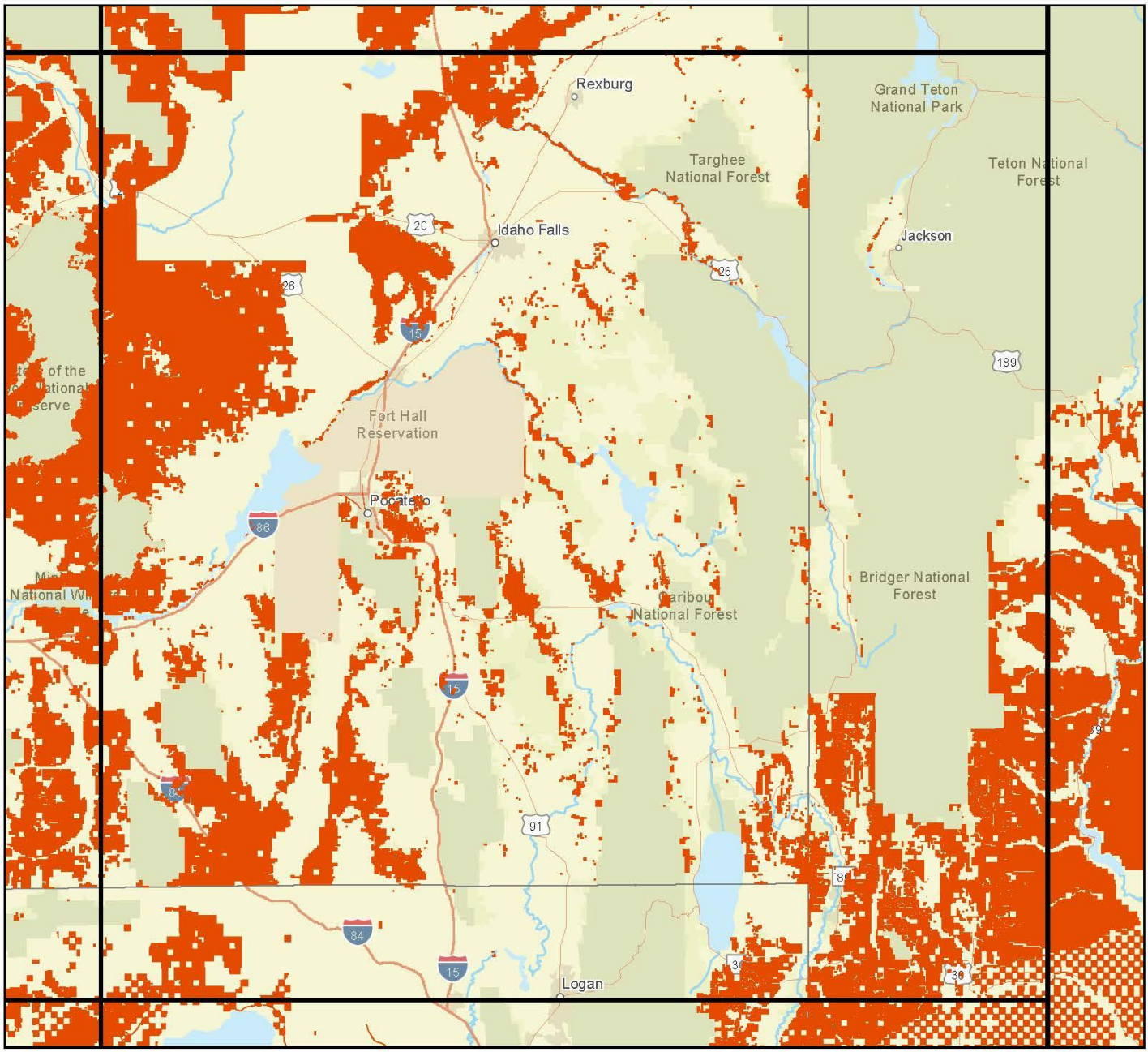
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for use with BLM
Vegetation Treatment Program

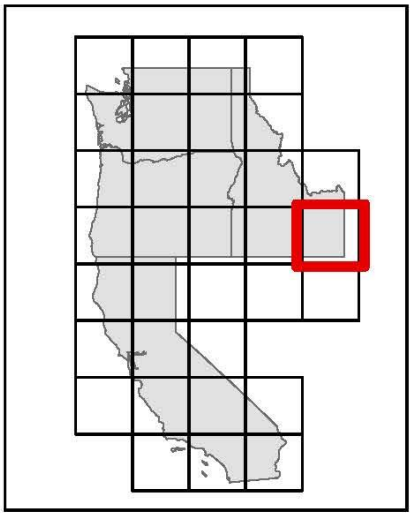
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BLM Lands

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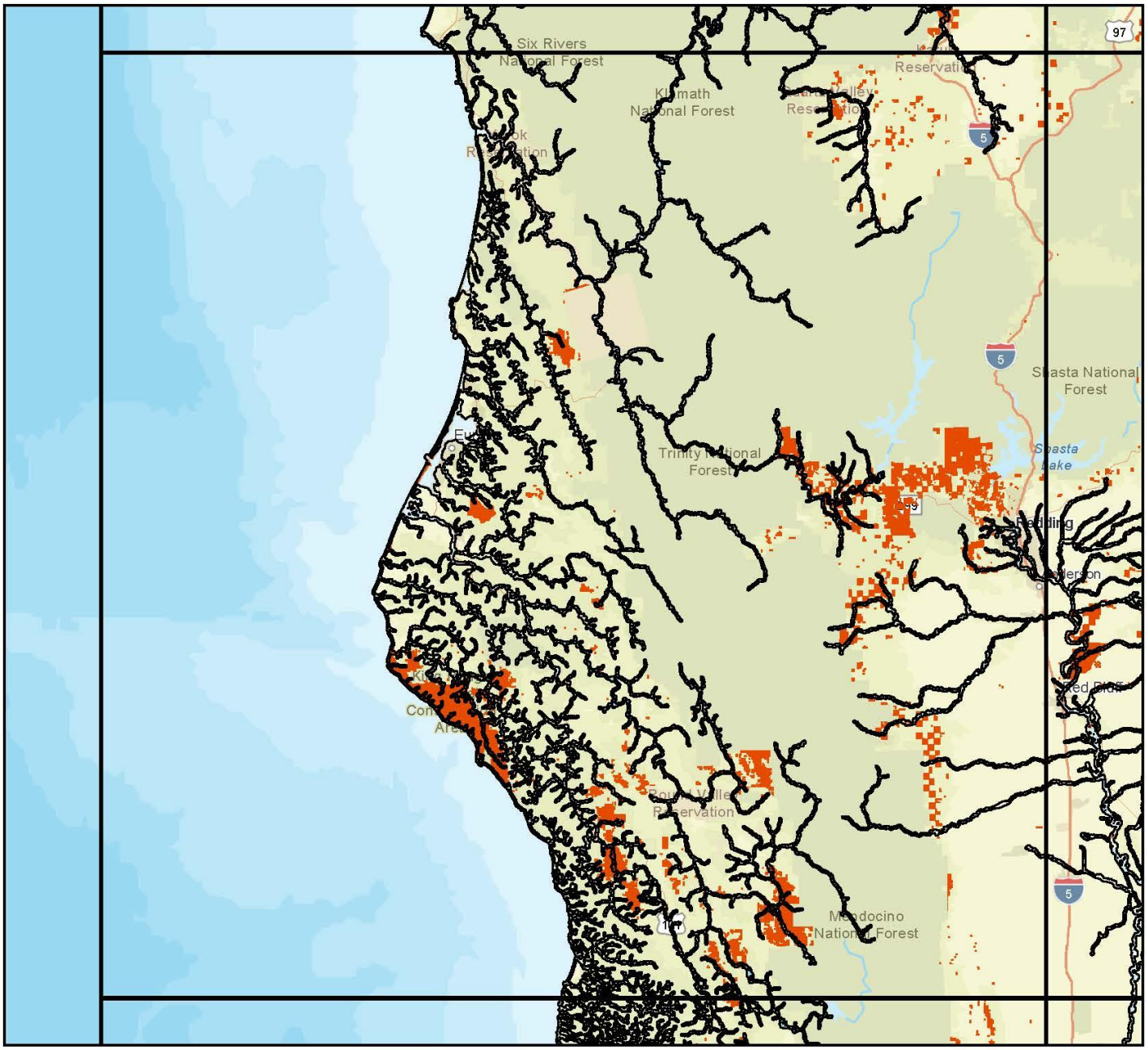
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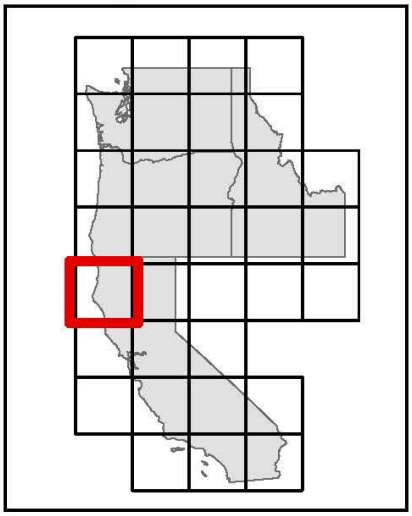
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BLM Lands

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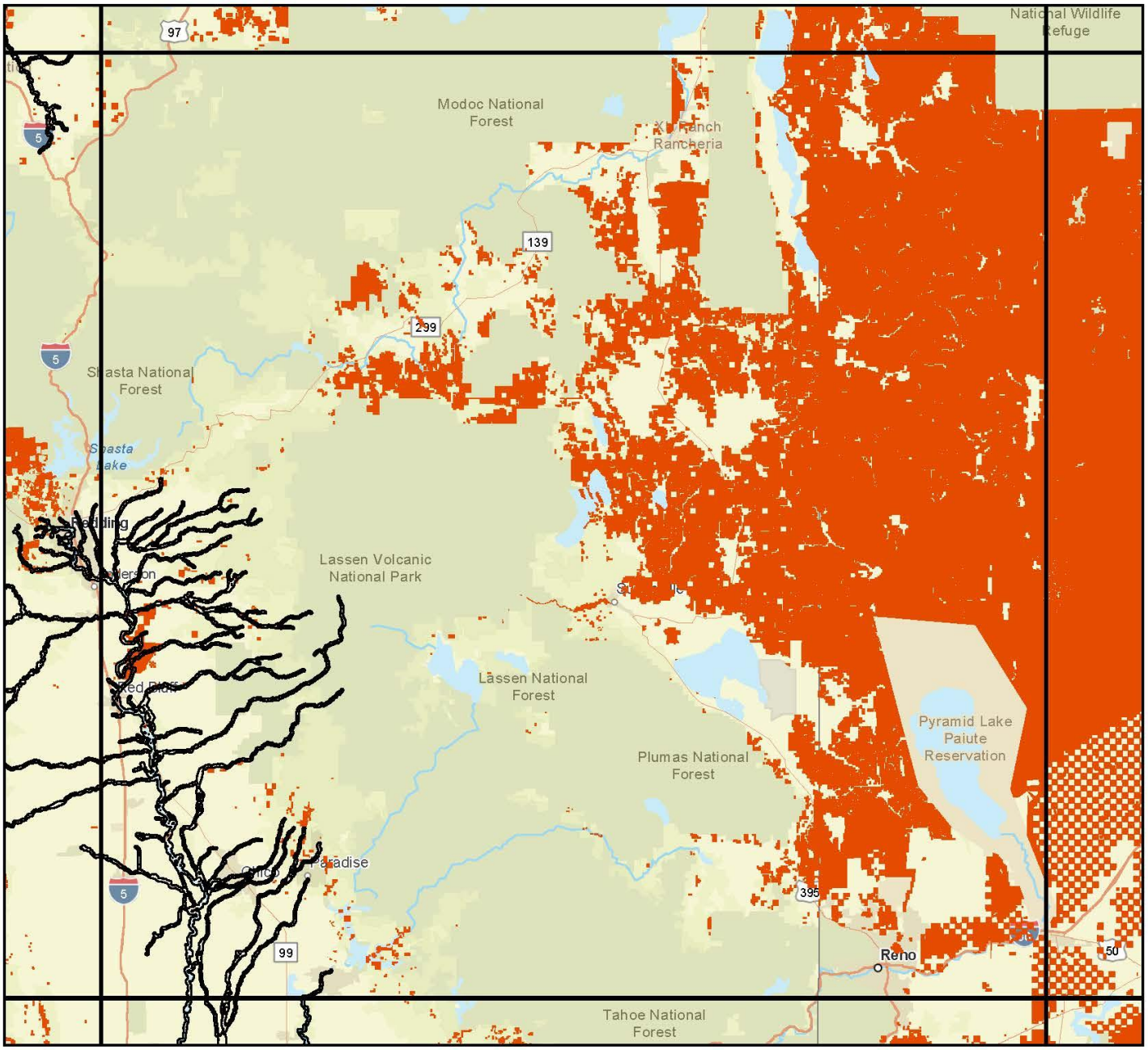
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for use with BLM
Vegetation Treatment Program

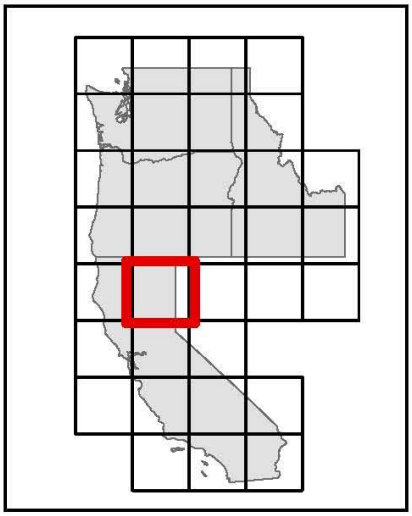
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PULA

BLM Lands

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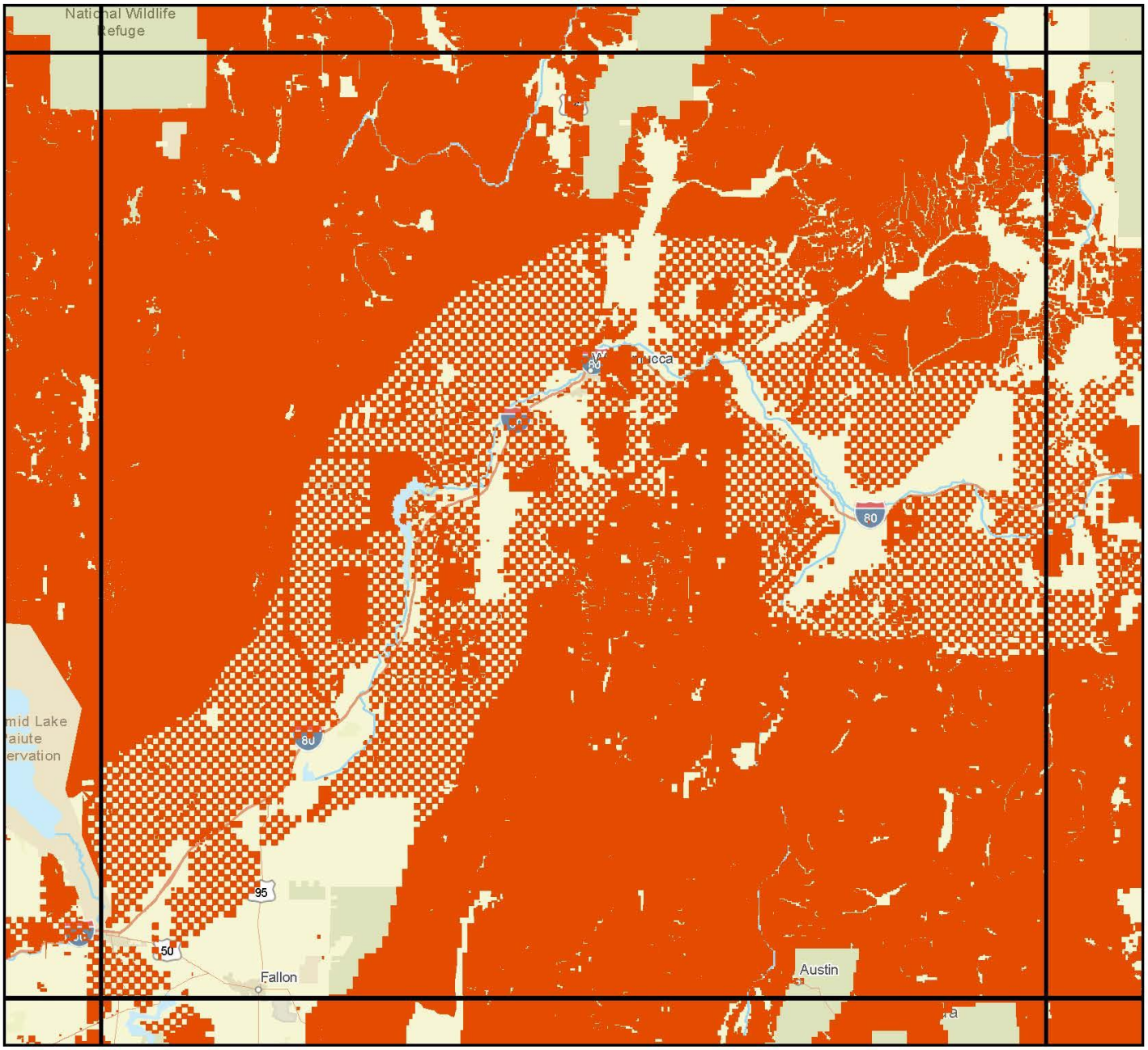
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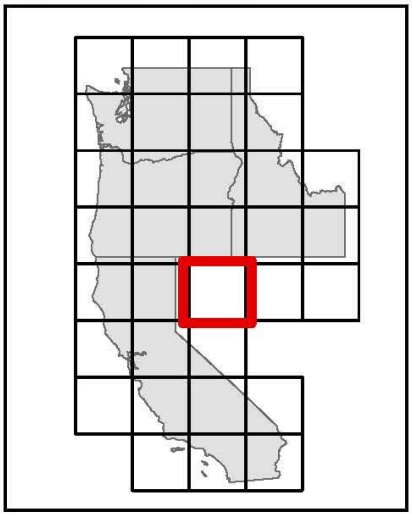
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BLM Lands

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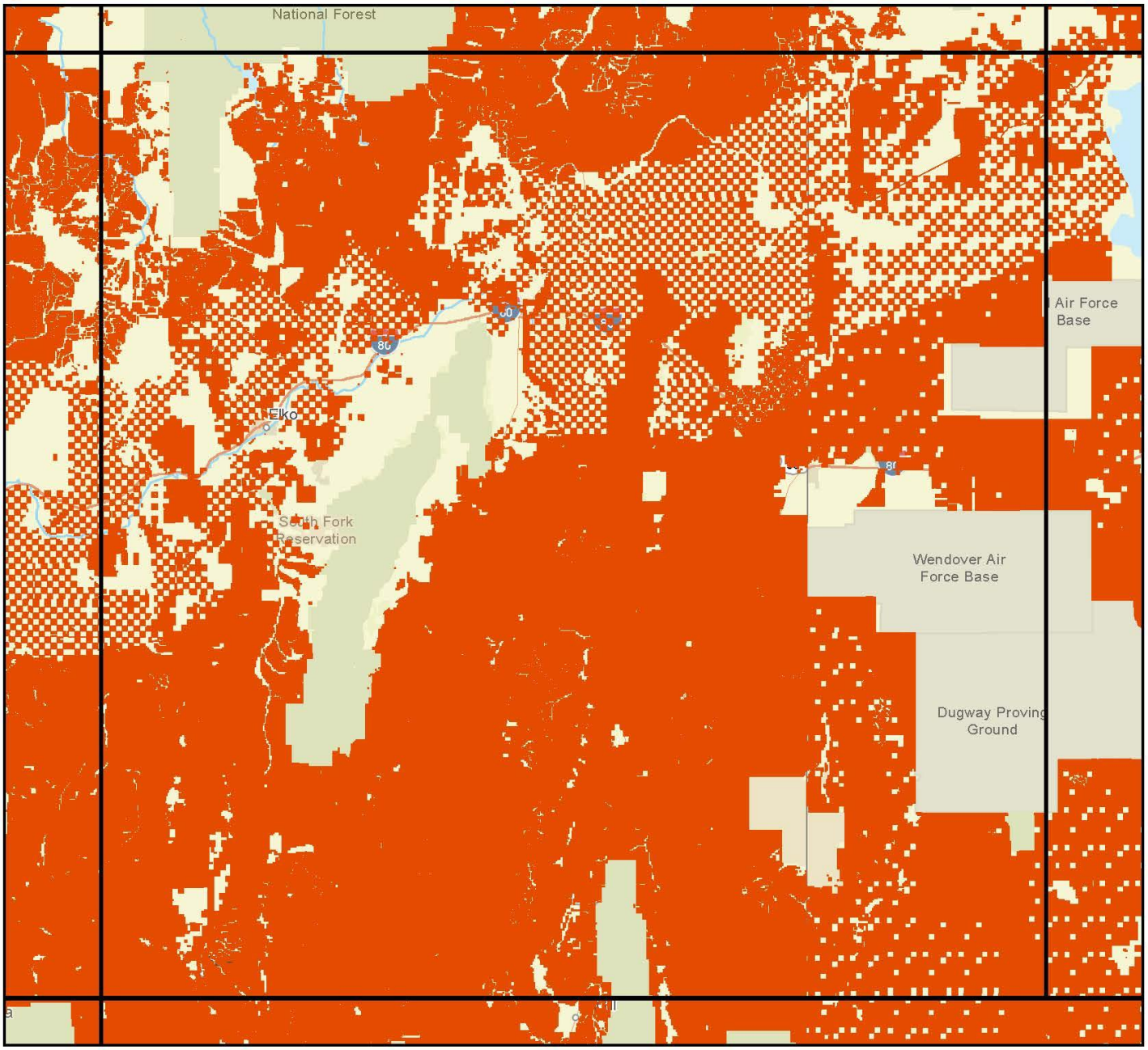
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for use with BLM
Vegetation Treatment Program

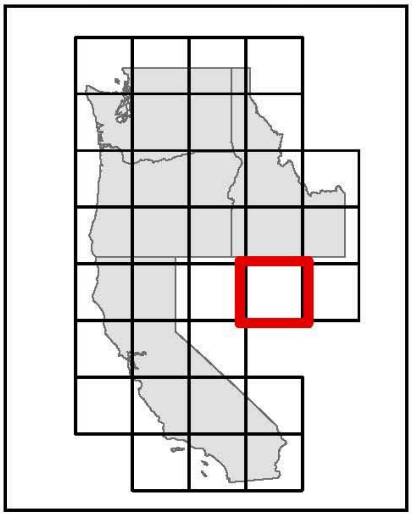
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BLM Lands

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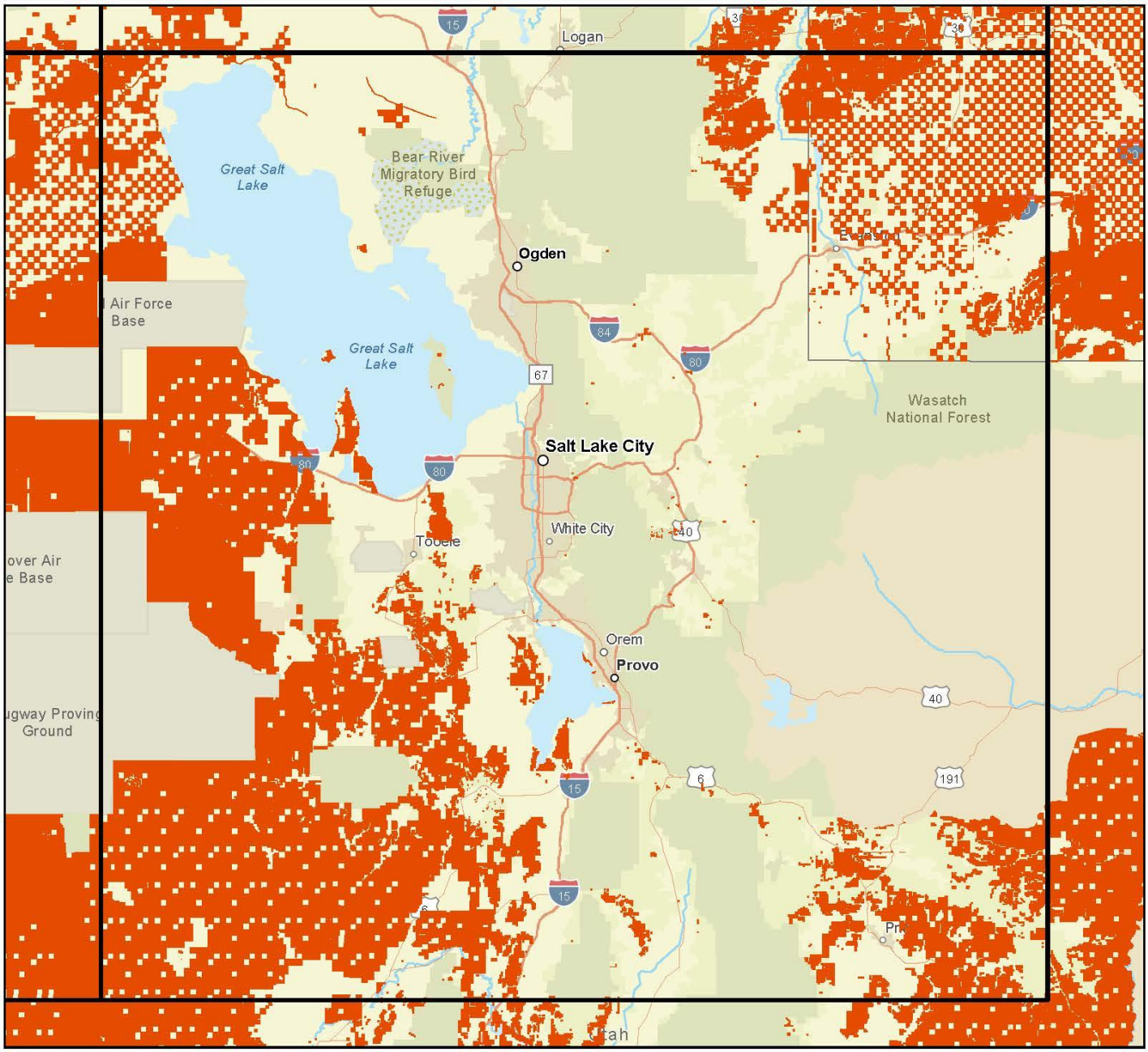
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Vegetation Treatment Program

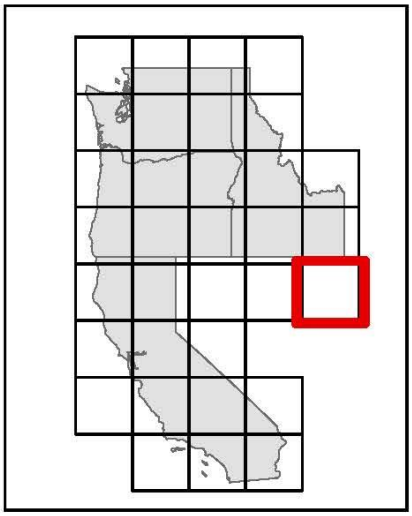
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BLM Lands

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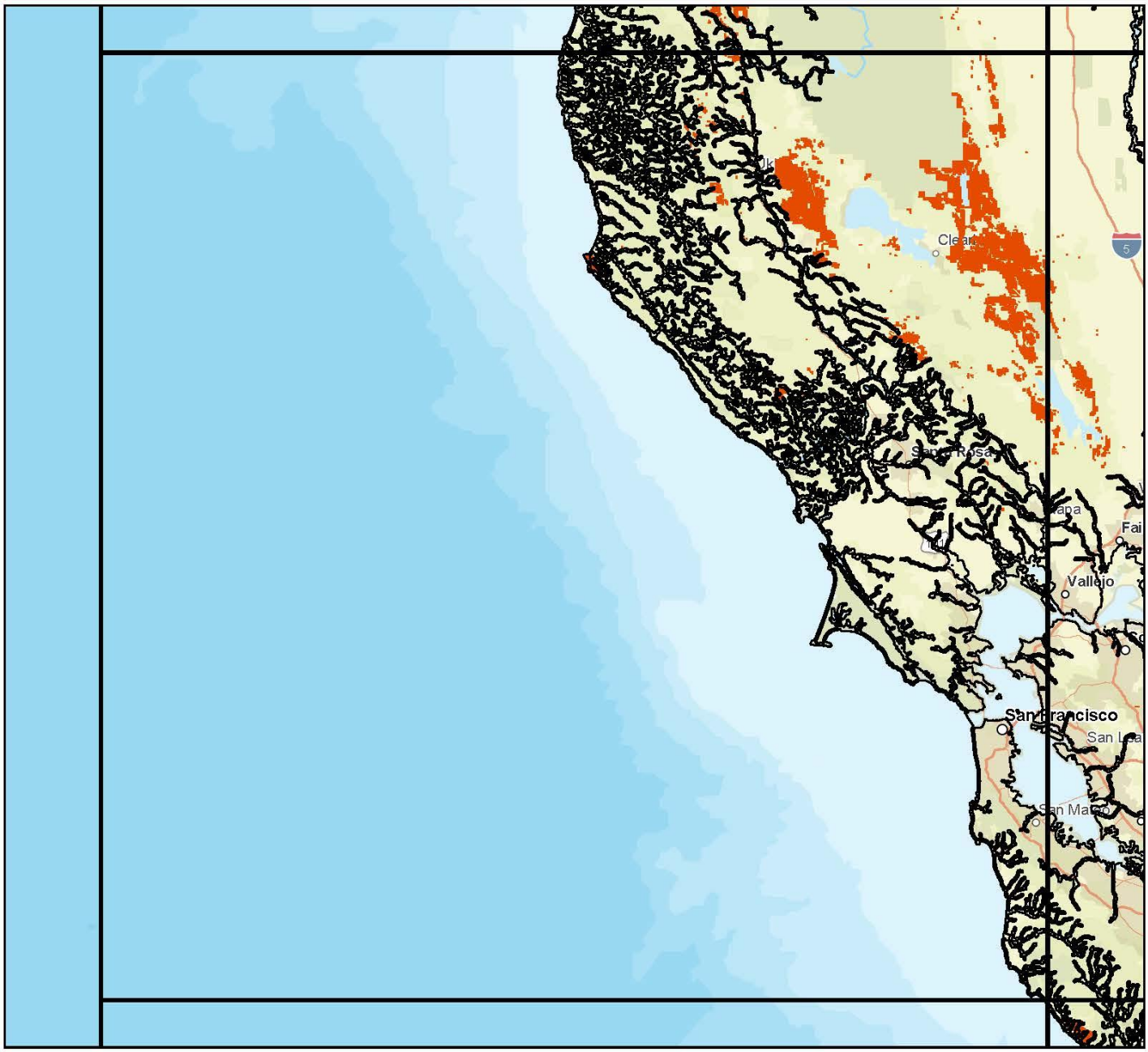
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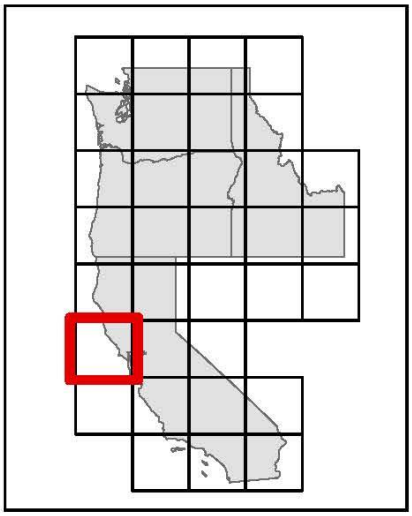
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BLM Lands

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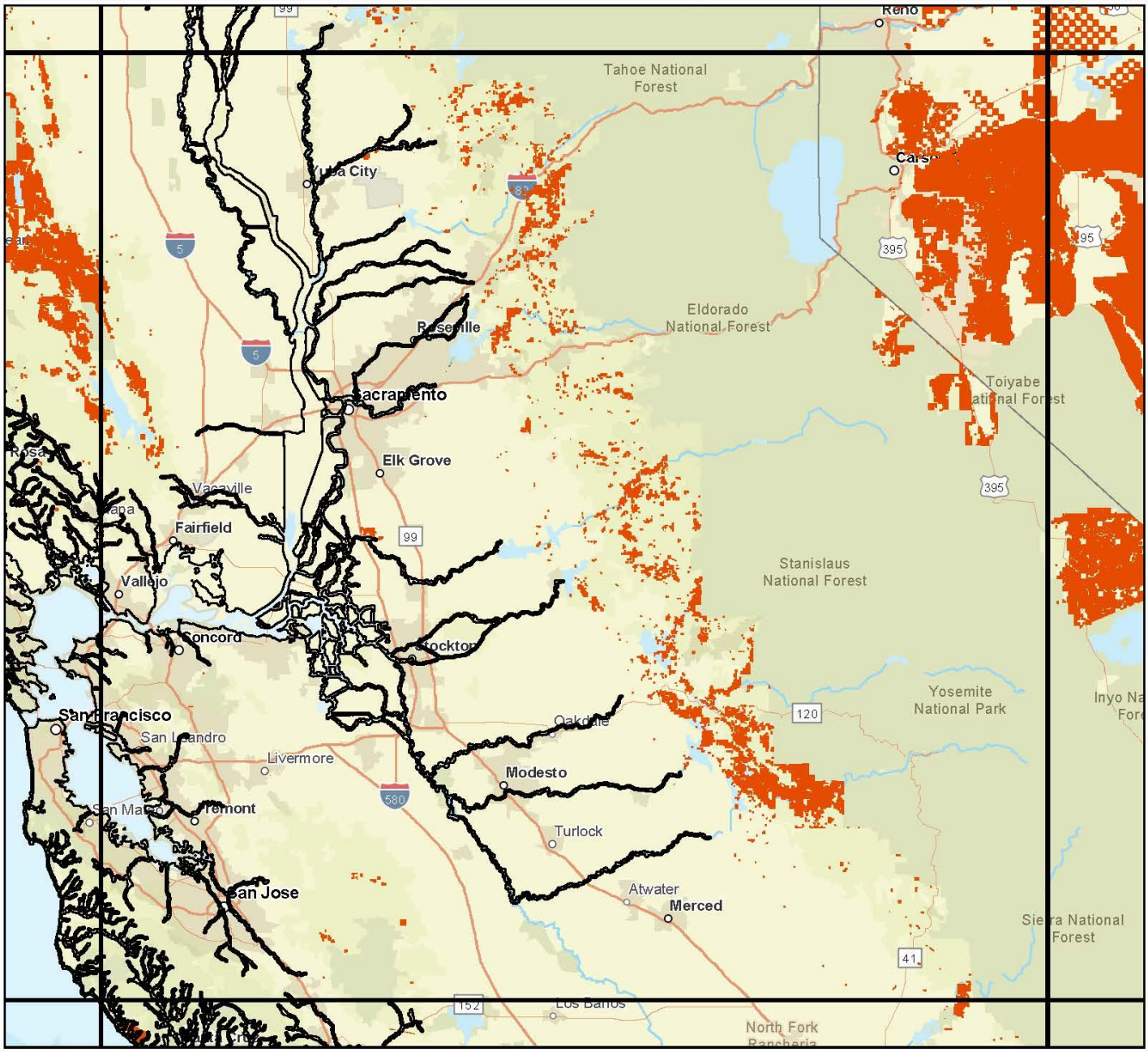
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Vegetation Treatment Program

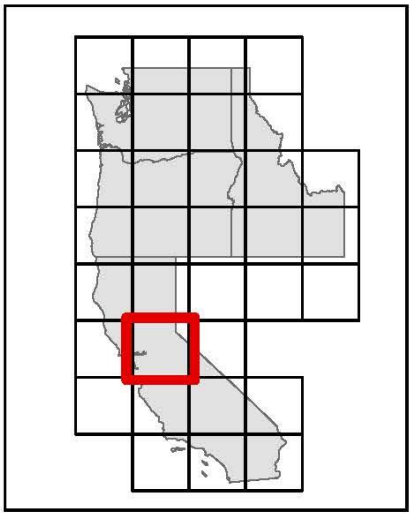
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PULA

BLM Lands

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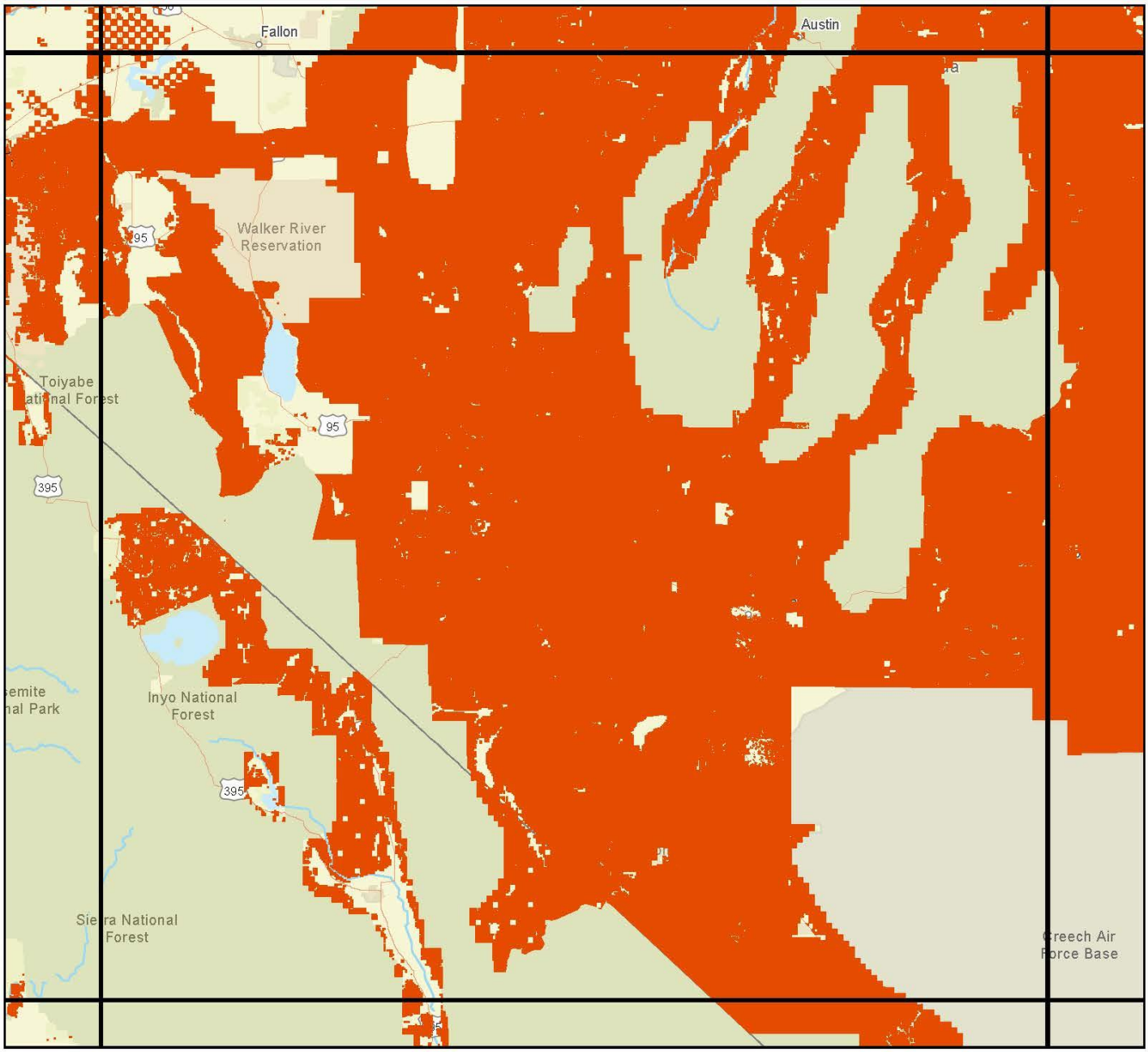
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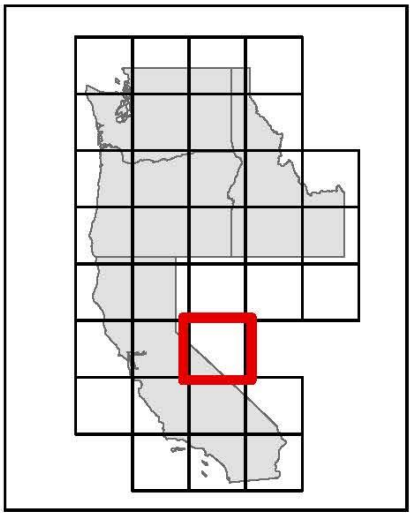
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PULA

BLM Lands

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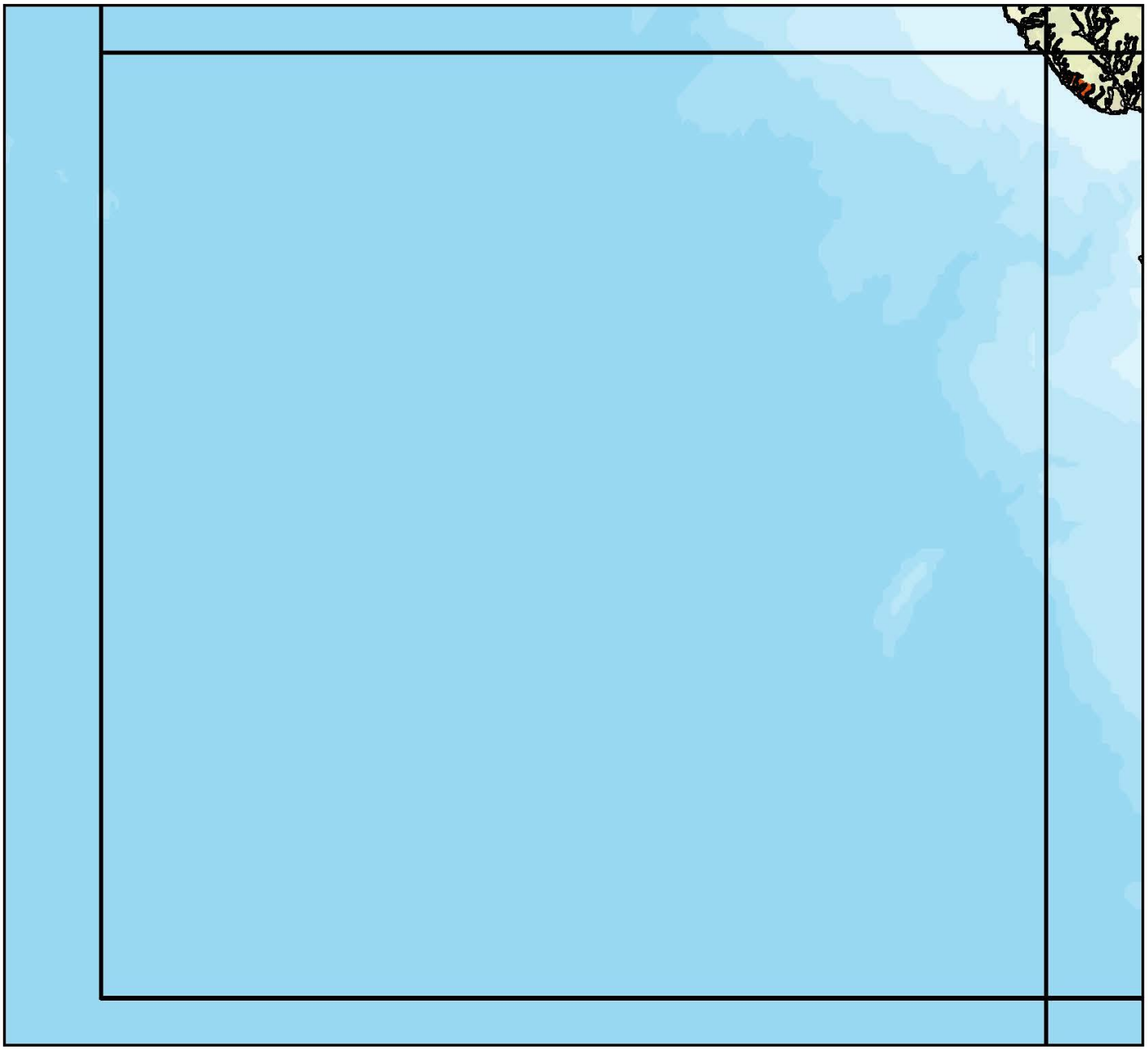
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Vegetation Treatment Program

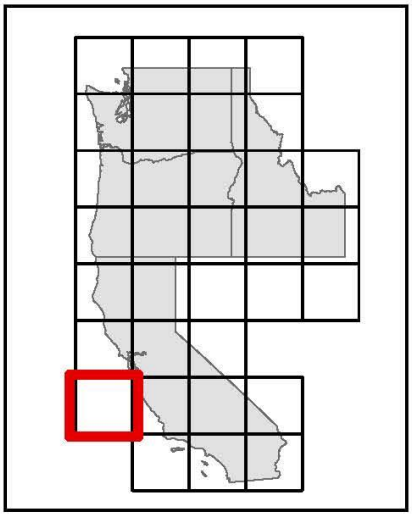
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BLM Lands

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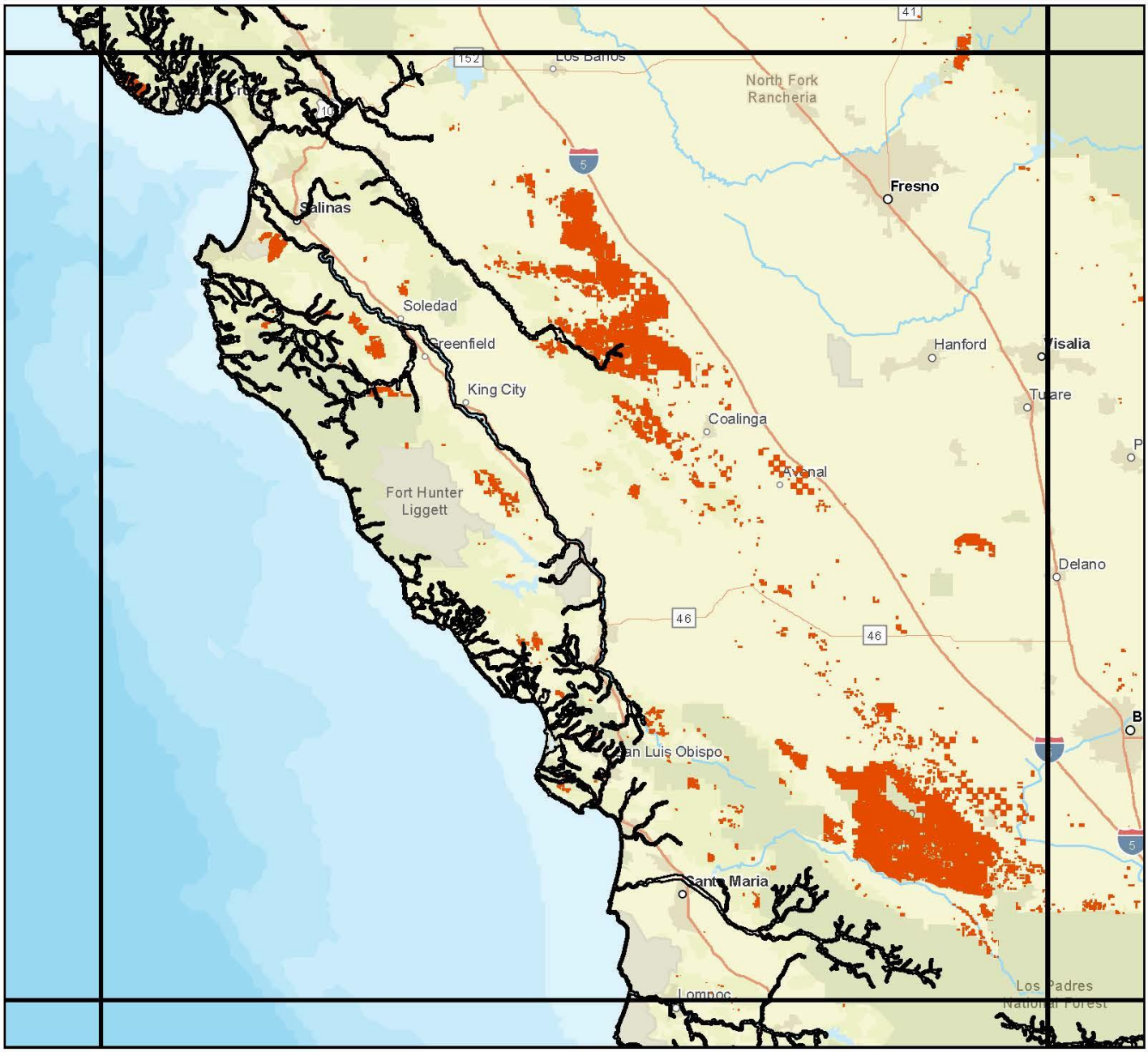
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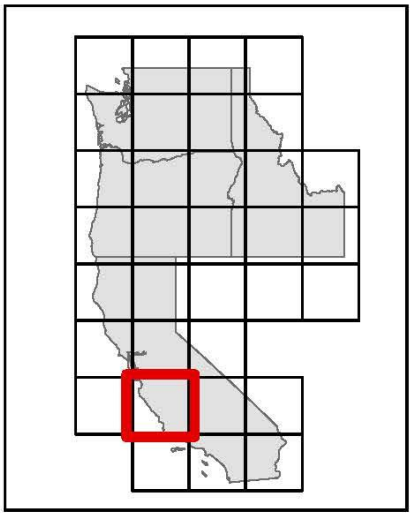
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PULA

BLM Lands

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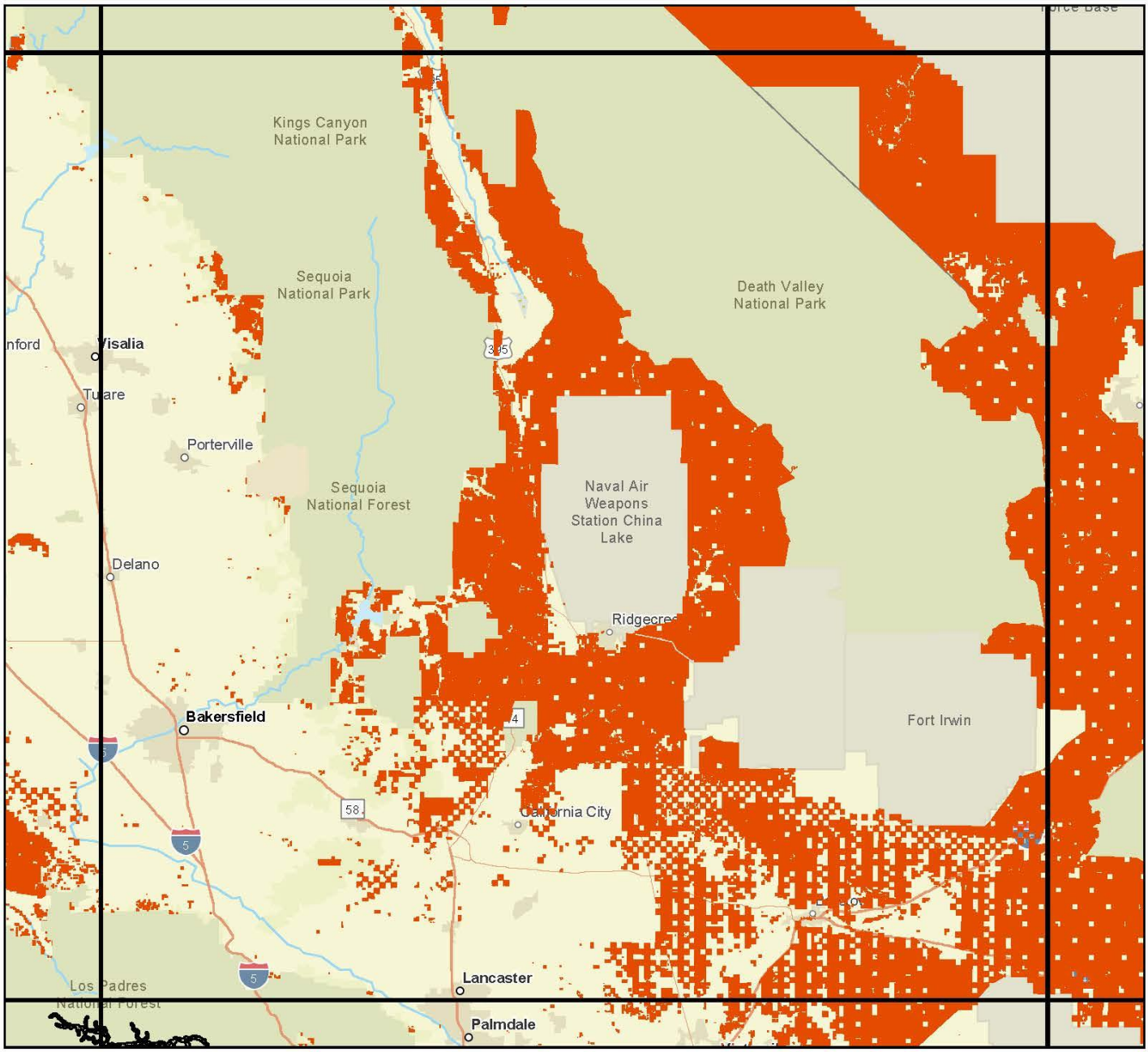
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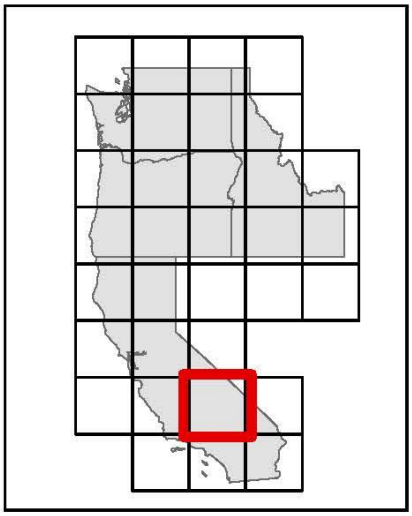
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BLM Lands

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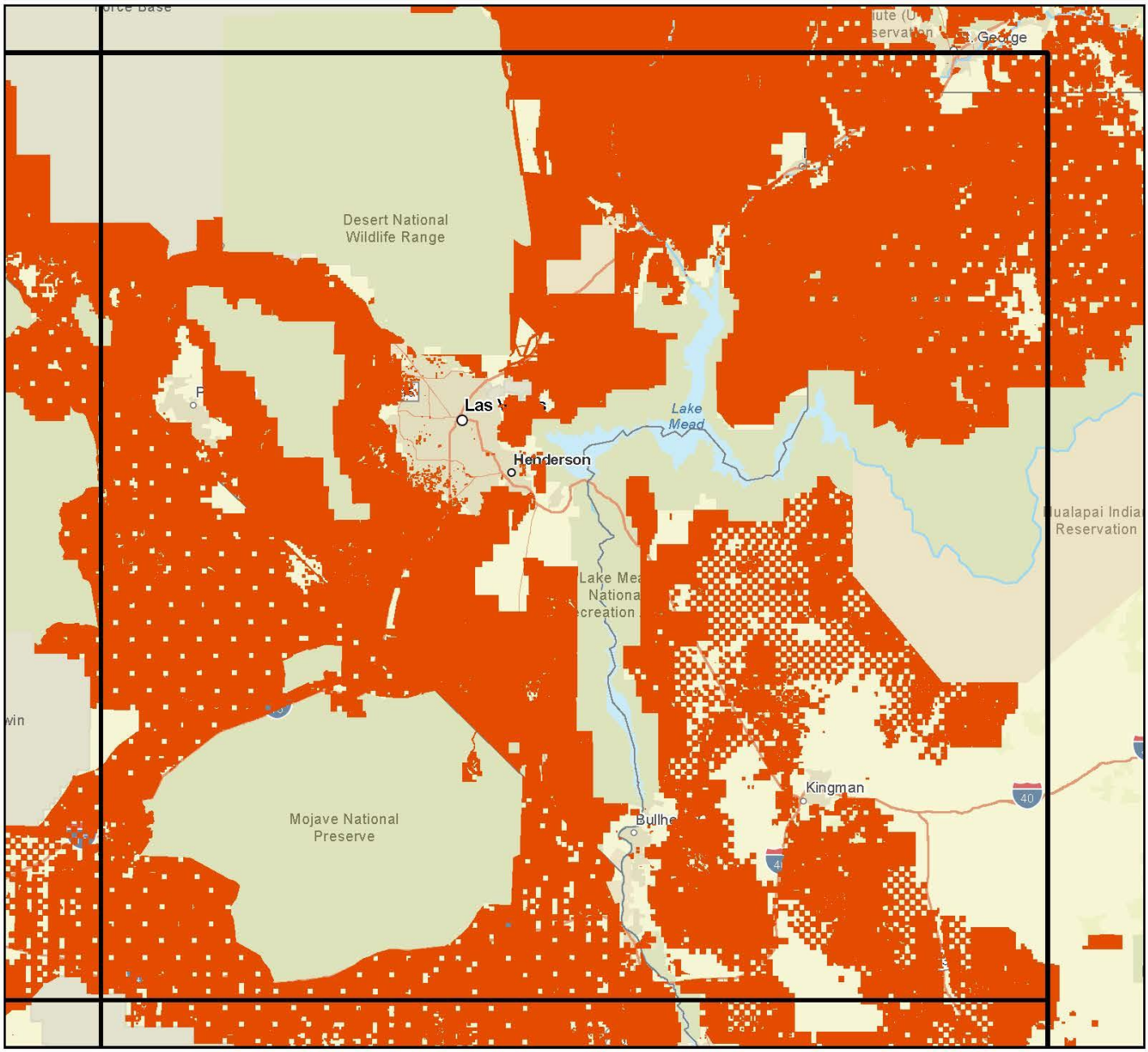
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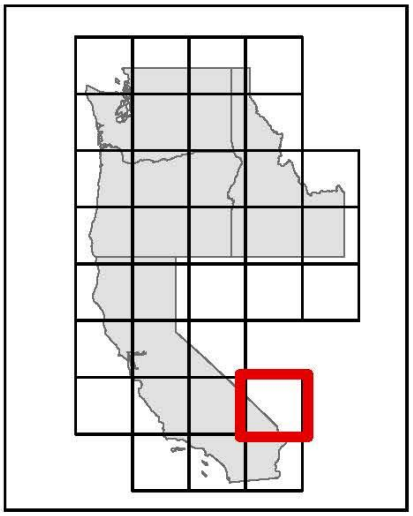
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PULA

BLM Lands

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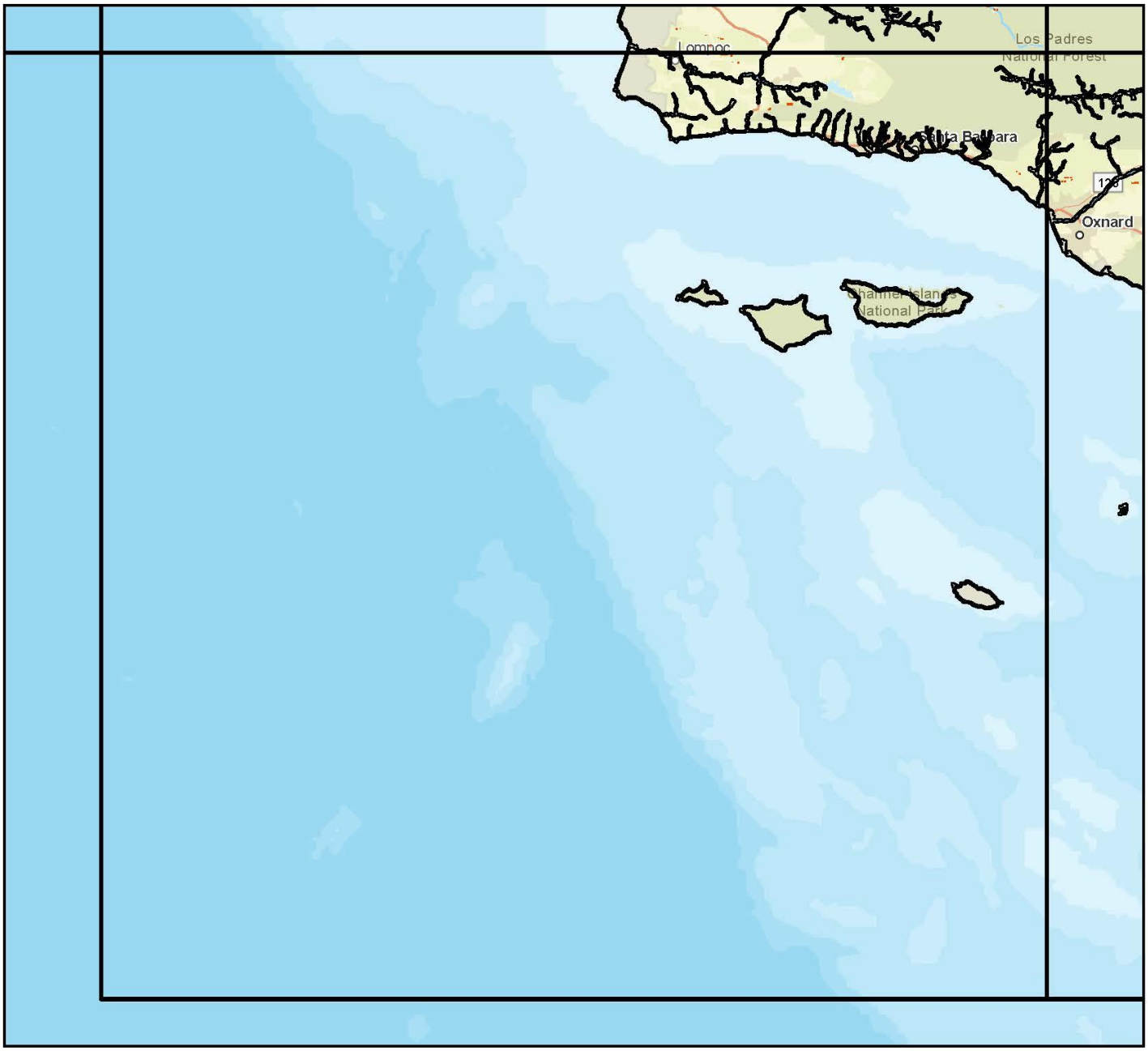
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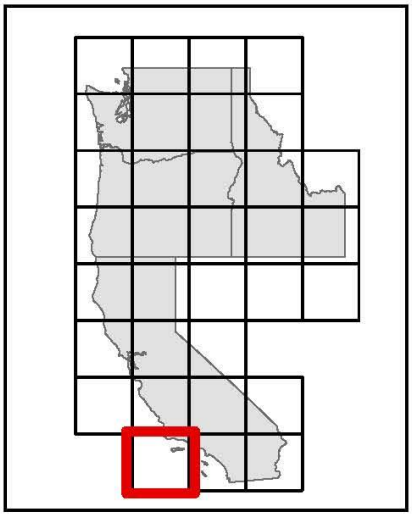
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BLM Lands

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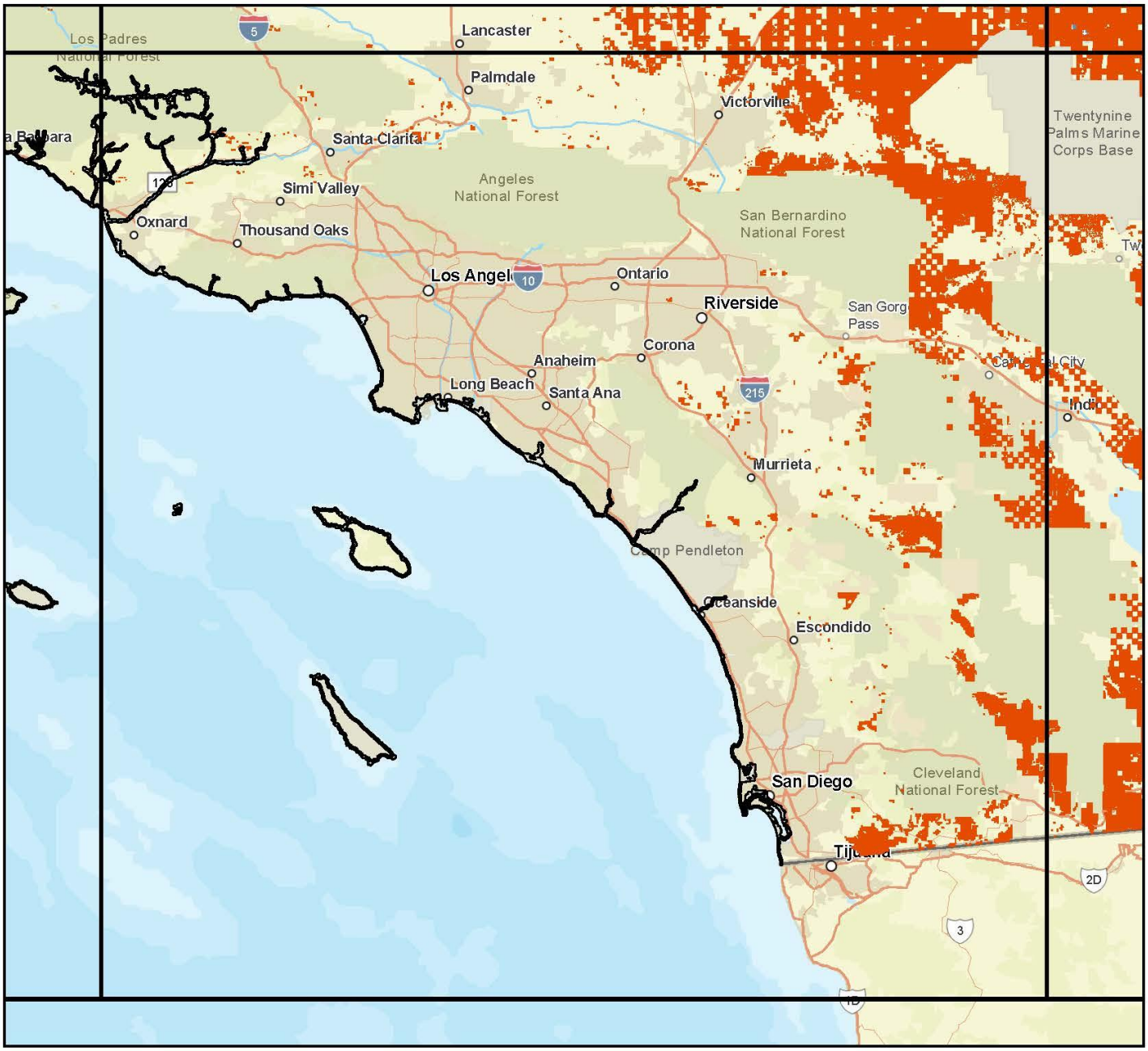
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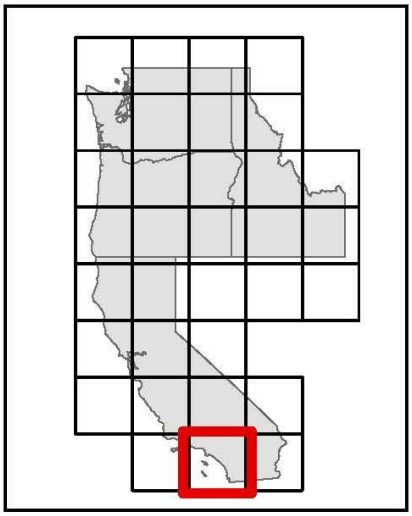
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BLM Lands

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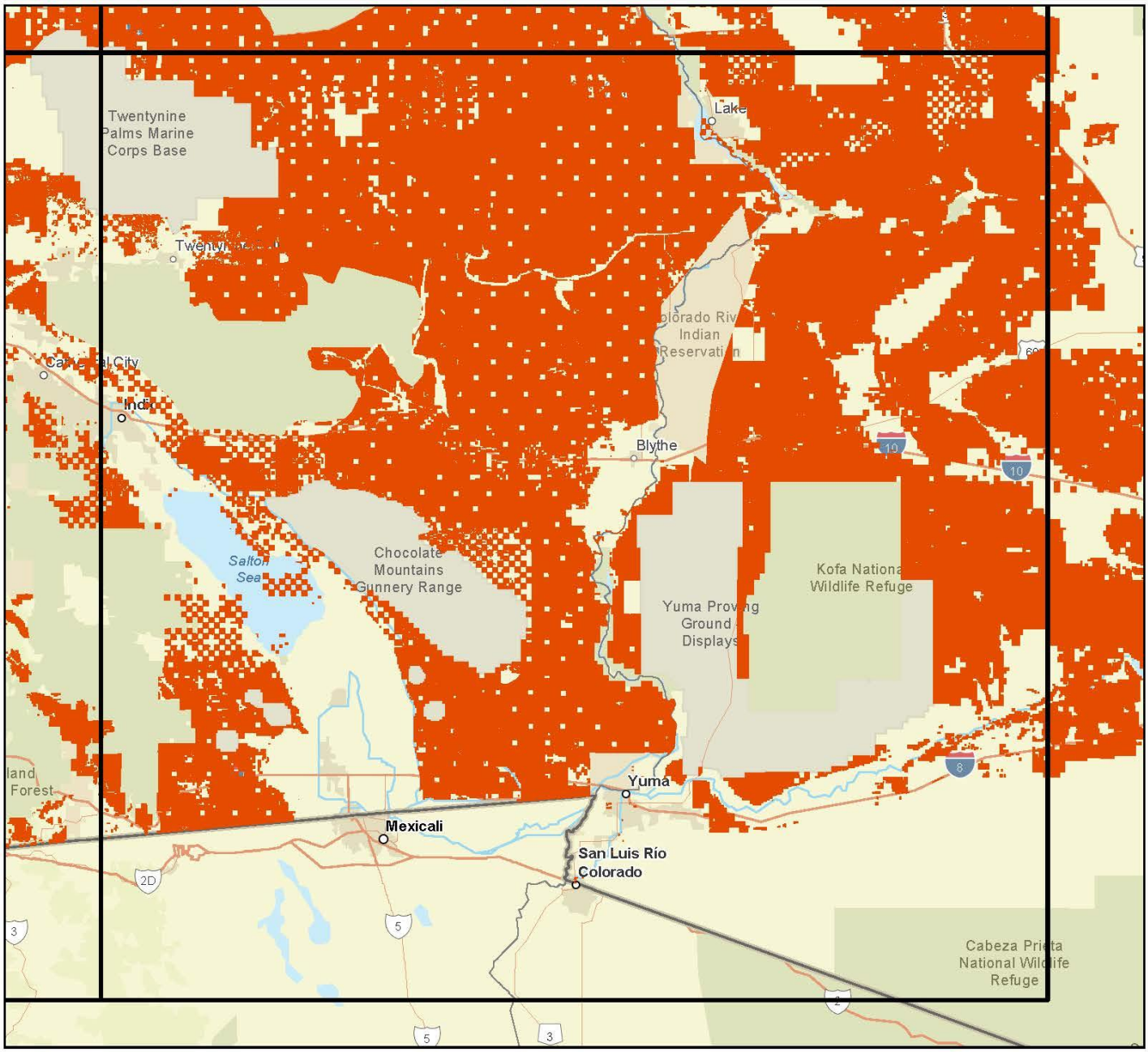
Pesticide Use Limitation Area (PULA) for use with BLM Vegetation Treatment Program

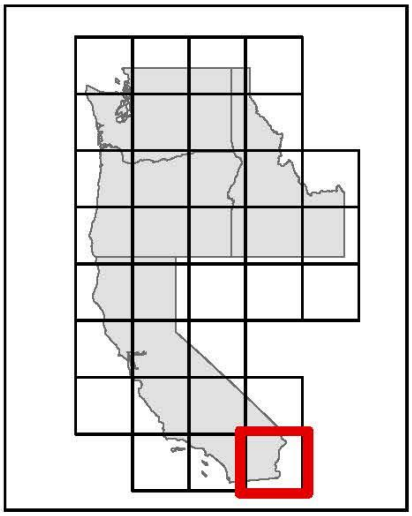
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Pesticide Use Limitation Area (PULA) for use with BLM Vegetation Treatment Program

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Appendix B. STANDARD OPERATING PROCEDURES

The following appendix describes measures to prevent the introduction and spread of noxious and invasive weeds (**Table A-1**) and standard operating procedures (SOPs) for applying herbicides (**Table A-2**). The 2007 PEIS describes further the importance, priorities, and processes associated with prevention, early detection, and rapid response (BLM 2007b, p. 2-23 to 2-25).

As described in the 2007 PEIS (BLM 2007b, p. 2-22 to 2-23), SOPs would be followed by the BLM under all alternatives to ensure that risks to human health and the environment from herbicide treatment actions would be kept to a minimum. Standard operating procedures are the management controls and performance standards required for vegetation management treatments. These practices are intended to protect and enhance natural resources that could be affected by future vegetation treatments. For instance, following specifications on an herbicide's label may require spray at a certain droplet size which is intended to prevent offsite spread. Drift prevention may also be accomplished by the use of adjuvants or tank mixes.

Table B-1
Prevention
Measures

BLM Activity	Prevention Measure
Project Planning	• Incorporate prevention measures into project layout and design, alternative evaluation, and project decisions to prevent the introduction or spread of weeds. • Determine prevention and maintenance needs, including the use of herbicides, at the onset of project planning. • Use modeling tools (e.g., EPA's Pesticide Use Limitation Areas), as appropriate and available, during project planning to avoid impacts on resources. • Before ground-disturbing activities begin, inventory weed infestations and prioritize areas for treatment in project operating areas and along access routes. • Remove sources of weed seed and propagules to prevent the spread of existing weeds and new weed infestations. • Pre-treat high-risk sites for weed establishment and spread before implementing projects. • Post weed awareness messages and prevention practices at strategic locations such as trailheads, roads, boat launches, and public land kiosks. • Inform the public about weed free hay, straw, and gravel requirements in applicable states. • Coordinate project activities with nearby herbicide applications to maximize the cost-effectiveness of weed treatments. • Consider adjustments in the existing grazing permit, needed to maintain desirable vegetation on the treatment site. • Identify and implement any temporary domestic livestock grazing and/or supplemental feeding restrictions needed to enhance desirable vegetation recovery following treatment. • Provide educational materials at trailheads and other wilderness entry points to educate the public on the need to prevent the spread of weeds. • Encourage backcountry pack and saddle stock users to feed their livestock only certified weed-free feed for several days before entering a wilderness area.

BLM Activity	Prevention Measure

Project Development	• Minimize soil disturbance to the extent practical, consistent with project objectives.
	• To prevent weed germination and establishment, retain native vegetation in and around project activity areas and keep soil disturbance to a minimum, consistent with project objectives.
	• Locate and use weed-free project staging areas. Avoid or minimize all types of travel through weed-infested areas, or restrict travel to periods when the spread of seeds or propagules is least likely.
	• Prevent the introduction and spread of weeds caused by moving weed-infested sand, gravel, borrow, and fill material.
	• Inspect material sources on site, and ensure that they are weed-free before use and transport. Treat weed-infested sources to eradicate weed seed and plant parts, and strip and stockpile contaminated material before any use of pit material.
	• Survey the area where material from treated weed-infested sources is used for at least three years after project completion to ensure that any weeds transported to the site are promptly detected and controlled.
	• Prevent weed establishment by not driving through weed-infested areas.
	• Inspect and document weed establishment at access roads, cleaning sites, and all disturbed areas; control infestations to prevent spread within the project area.
	• For operations in waterbodies, when moving equipment or personnel through waterbodies on the way to the project site or before transporting watercraft and aquatic gear (i.e., hip boots, waders, and bait containers) to the authorized use area, permittee shall:
	  • Remove any aquatic plants, animals, and mud attached to watercraft and equipment,
	  • Drain water from boat, motor, bilge, live wells, and bait containers, and
	  • Spray all watercraft and equipment with high pressure water or dry for at least five days

Project Development *(cont.)*	• Avoid acquiring water for dust abatement where access to the water is through weed-infested sites. • Identify sites where equipment can be cleaned. Clean equipment before entering public lands. • Clean all equipment before leaving the project site if operating in areas infested with weeds. • Inspect and treat weeds that establish at equipment cleaning sites. • Ensure that rental equipment is free of weed seed. • Inspect, remove, and properly dispose of weed seed and plant parts found on workers' clothing and equipment. Proper disposal entails bagging the seeds and plant parts and incinerating them. • Use certified weed-free feed for horses and pack animals. • Develop monitoring and evaluation plans to record and identify treatment effectiveness and non-target effects

BLM Activity	Prevention Measure
Revegetation	• Include weed prevention measures, including project inspection and documentation, in operation and reclamation plans. • Retain bonds until reclamation requirements, including weed treatments, are completed, based on inspection and documentation. • To prevent conditions favoring weed establishment, re-establish vegetation on bare ground caused by project disturbance as soon as possible using either natural recovery or artificial techniques. Revegetate disturbed sites with native species if there is no reasonable expectation of natural regeneration. • Maintain stockpiled, un-infested material in a weed-free condition. • Revegetate disturbed soil (except travel ways on surfaced projects) in a manner that optimizes plant establishment for each specific project site. For each project, define what constitutes disturbed soil and objectives for plant cover revegetation. Revegetation may include topsoil replacement, planting, seeding, fertilization, liming, and weed-free mulching, as necessary. • Where practical, stockpile weed-seed-free topsoil and replace it on disturbed areas (e.g., road embankments or landings). • Inspect seed and straw mulch to be used for site rehabilitation (for wattles, straw bales, dams, etc.) and certify that they are free of weed seed and propagules. • Inspect and document all limited term ground-disturbing operations in noxious weed infested areas for at least three growing seasons following completion of the project. • Use native material where appropriate and feasible. Use certified weed-free or weed-seed-free hay or straw where certified materials are required and/or are reasonably available. • Provide briefings that identify operational practices to reduce weed spread (for example, avoiding known weed infestation areas when locating fire lines). • Evaluate options, including closure, to regulate the flow of traffic on sites where desired vegetation needs to be established. Sites could include road and trail ROW, and other areas of disturbed soils.

Table B-2
Standard Operating Procedures for Applying Herbicides

Resource Element	Standard Operating Procedure
Guidance Documents	BLM Handbook H-9011-1 (*Chemical Pest Control*); and manuals 1112 (*Safety*), 9011 (*Chemical Pest Control*), 9012 (*Expenditure of Rangeland Insect Pest Control Funds*), 9015 (*Integrated Weed Management)*, 9220 (*Integrated Pest Management*), and 1740-2 (*Integrated Vegetation Management*)
General	**General standard operating procedures would be used for all projects; standard operating procedures for other resource elements would be used as appropriate.**
	Follow product label for use and storage. **Storage, Contingency, and Record Keeping** • Prepare spill contingency plan in advance of treatment. • Keep copy of Safety Data Sheets (SDSs) at work sites. SDSs are available for review at http://www.cdms.net/. • Keep records of each application, including the AI, formulation, application rate, date, time, and location. • Conduct mixing and loading operations in an area where an accidental spill would not contaminate an aquatic body. **Herbicide Treatment Planning** • Use only BLM-approved herbicides. Some state or local restrictions may apply. • Use only licensed herbicide applicators. • Pesticide use proposals are required for all herbicide treatments on BLM public lands. • Review, understand, and conform to all aspects of the herbicide label for each specific herbicide used. • Consult the herbicide label when planning revegetation to ensure that subsequent vegetation would not be injured following application of the herbicide. • Select herbicides and adjuvants that are least damaging to environment while providing the desired results. • Where habitat is present, conduct pre-treatment surveys for sensitive habitat and special status species within or adjacent to proposed treatment areas. • Consider site characteristics, environmental conditions, application equipment, and herbicide characteristics in order to minimize damage to resources, such as non-target vegetation or water resources. • Minimize the size of application areas, when feasible. • Consider surrounding land use (including visual resources and socioeconomic conditions) before assigning aerial spraying as a treatment method and avoid aerial spraying near agricultural or densely populated areas. • Notify adjacent landowners prior to treatment. • Post treated areas and specify reentry or rest times, if appropriate. • Observe restricted entry intervals specified by the herbicide label. • Apply the least amount of herbicide needed to achieve the desired result. • Avoid accidental direct spray and spill conditions to minimize risks to resources. • Avoid aerial spraying during periods of adverse weather conditions (snow or rain imminent, fog, or air turbulence). • Consider the effects of wind, humidity, temperature inversions, and heavy rainfall on herbicide effectiveness and risks.

Resource Element	Standard Operating Procedure
General *(cont.)*	**Minimizing Herbicide Drift** • Only apply herbicides when winds are <10 mph (<6 mph for aerial applications) or if no serious rainfall event is imminent. Some state/local or label restrictions may apply. • Use drift control agents, drift reduction agents, and low volatile formulations to reduce drift hazards. • Use appropriate application equipment/method near water bodies if the potential for off-site drift exists. • Establish herbicide-free buffer zones to ensure that drift will not affect crops or nearby residents/landowners. • Keep records of each application, including the AI, formulation, application rate, date, time, and location. • Avoid accidental direct spray and spill conditions to minimize risks to resources. • Consider surrounding land uses before aerial spraying. • Avoid aerial spraying during periods of adverse weather conditions (snow or rain imminent, fog, or air turbulence). • Make helicopter applications at a target airspeed of 40 to 50 miles per hour (mph), and at about 30 to 45 ft above ground. • Turn off applied treatments at the completion of spray runs and during turns to start another spray run.
Air Quality See Manual 7000 (*Soil, Water, and Air Management*)	• Select proper application equipment (e.g., spray equipment that produces 200- to 800-micron diameter droplets [spray droplets of 100 microns and less are most prone to drift]). • Select proper application methods (e.g., set maximum spray heights, use appropriate buffer distances between spray sites and non-target resources).
Soil See Manual 7000 (*Soil, Water, and Air Management*)	• Minimize treatments in areas where herbicide runoff is likely, such as steep slopes when heavy rainfall is expected. • Minimize use of herbicides that have high soil mobility, particularly in areas where soil properties increase the potential for mobility. • Do not apply granular herbicides on slopes of more than 15%, or as specified in the label, where there is the possibility of runoff carrying the granules into non-target areas.
Water Resources See Manual 7000 (*Soil, Water, and Air Management*)	• Select herbicide products to minimize impacts to water. This is especially important for application scenarios that involve risk from AIs in a particular herbicide, as predicted by risk assessments. • Use local historical weather data to choose the month of treatment. Considering the phenology of the target species, schedule treatments based on the condition of the water body and existing water quality conditions. • Plan to treat between weather fronts (calms) and at appropriate time of day to avoid high winds that increase water movements, and to avoid potential stormwater runoff and water turbidity. • Review hydrogeologic maps of proposed treatment areas .Note depths to groundwater and areas of shallow groundwater and areas of surface water and groundwater interaction. Minimize treating areas with high risk for groundwater contamination.. • Do not rinse spray tanks in or near water bodies. Do not broadcast pellets where there is danger of contaminating water supplies. • Maintain buffers between treatment areas and water bodies. Buffer widths should be developed based on herbicide- and site-specific criteria to minimize impacts to water bodies. • Apply measures to prevent sedimentation into surface water from treatment areas.

Resource Element	Standard Operating Procedure
Wetlands and Riparian Areas	• Use a selective herbicide and a wick or backpack sprayer. • Use appropriate herbicide-free buffer zones for herbicides not labeled for aquatic use based on risk assessment guidance, with minimum widths of 100 ft for aerial, 25 ft for vehicle, and 10 ft for hand spray applications.
Vegetation See Handbook H-4410-1 (*National Range Handbook*), and manuals 5000 (*Forest Management*) and 9015 (*Integrated Weed Management*)	• Identify if the vegetation has acquired resistance to any AI and select herbicides to reduce potential for resistance.

Pollinators	• Time vegetation treatments to take place when foraging pollinators are least active both seasonally and daily.
	• Design vegetation treatment projects so that nectar and pollen sources for important pollinators and resources are treated in patches rather than in one single treatment.
	• Maintain herbicide free buffer zones around patches of important pollinator nectar and pollen sources.
	• Maintain herbicide free buffer zones around patches of important pollinator nesting habitat and hibernacula.
	• Make special note of pollinators that have single host plant species, and minimize herbicide spraying on those plants (if invasive species) and in their habitats.
	• Use the least hazardous formulation to pollinators available
	  • Dust, wettable powders, and microencapsulated formulations are most hazardous to bees because they are similar in size to pollen and can stick to hairs on a bee's body.
	  • Granulated formulations are generally the least hazardous to bees.

Fish and Other Aquatic Organisms See manuals 6500 (*Wildlife and Fisheries Management*) and 6780 (*Habitat Management Plans*)	• Use appropriate buffer zones based on label and risk assessment guidance. • Minimize treatments near fish-bearing water bodies during periods when fish are in life stages most sensitive to the herbicide(s) used, and use spot rather than broadcast or aerial treatments. • For treatment of aquatic vegetation, 1) treat only that portion of the aquatic system necessary to achieve acceptable vegetation management; 2) use the appropriate application method to minimize the potential for injury to desirable vegetation and aquatic organisms; and 3) follow water use restrictions presented on the herbicide label.
Wildlife See manuals 6500 (*Wildlife and Fisheries Management*) and 6780 (*Habitat Management Plans*)	• Use herbicides of low toxicity to wildlife, where feasible. • Use spot applications or low-boom broadcast operations where possible to limit the probability of contaminating non-target food and water sources, especially non-target vegetation over areas larger than the treatment area. • Use timing restrictions (e.g., do not treat during critical wildlife breeding or staging periods) to minimize impacts to wildlife.
Threatened, Endangered, and Sensitive Species See Manual 6840 (*Special Status Species*)	• Use a selective herbicide and a wick or backpack sprayer to minimize risks to special status plants. • Avoid treating vegetation during time-sensitive periods (e.g., nesting and migration, sensitive life stages) for special status species in area to be treated.

Resource Element	Standard Operating Procedure
Livestock See Handbook H-4120-1 (*Grazing Management*)	• Whenever possible and whenever needed, schedule treatments when livestock are not present in the treatment area. Design treatments to take advantage of normal livestock grazing rest periods, when possible. • As directed by the herbicide label, remove livestock from treatment sites prior to herbicide application, where applicable. • Use herbicides of low toxicity to livestock, where feasible. • Notify permittees of the project to improve coordination and avoid potential conflicts and safety concerns during implementation of the treatment. • Notify permittees of livestock grazing, feeding, or slaughter restrictions, if necessary. • Provide alternative forage sites for livestock, if possible.
Wild Horses and Burros	• Apply SOPs as listed above for wildlife.
Cultural Resources and Paleontological Resources See handbooks H-8120-1 (*Guidelines for Conducting Tribal Consultation*) and H-8270-1 (*General Procedural Guidance for Paleontological Resource Management*), and manuals 8100 (*The Foundations for Managing Cultural Resources*), 8270 (*Paleontological Resource Management*), and 1780 (*Tribal Relations*) See also: *Programmatic Agreement among the Bureau of Land Management, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers Regarding the Manner in Which BLM Will Meet Its Responsibilities Under the National Historic Preservation Act.*	• Follow standard procedures for compliance with Section 106 of the National Historic Preservation Act as implemented through the *Programmatic Agreement among the Bureau of Land Management, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers Regarding the Manner in Which BLM Will Meet Its Responsibilities Under the National Historic Preservation Act* and state protocols or36 CFR Part 800, including necessary consultations with State Historic Preservation Officers and interested tribes. • Follow BLM Handbook H-8270-1 (*General Procedural Guidance for Paleontological Resource Management*) to determine known Condition I and Condition 2 paleontological areas, or collect information through inventory to establish Condition one and Condition 2 areas, determine resource types at risk from the proposed treatment, and develop appropriate measures to minimize or mitigate adverse impacts. • Consult with tribes to locate any areas of vegetation that are of significance to the tribe and that might be affected by herbicide treatments. • Work with tribes to minimize impacts to these resources. • Follow guidance under Human Health and Safety in areas that may be visited by Native peoples after treatments. • Consult with Native American tribes and Alaska Native groups to locate any areas of vegetation that are of significance to the tribe and that might be affected by herbicide treatments.

Visual Resources See handbooks H-8410-1 (*Visual Resource Inventory*) and H-8431-1 (*Visual Resource Contrast Rating*), and manual 8400 (*Visual Resource Management*)	• If the area is a Class I or II visual resource, ensure that the change to the characteristic landscape is low and does not attract attention (Class I), or if seen, does not attract the attention of the casual viewer (Class II). • Lessen visual impacts by: 1) designing projects to blend in with topographic forms; 2) leaving some low-growing trees or planting some low-growing tree seedlings adjacent to the treatment area to screen short-term effects; and 3) revegetating the site following treatment. • When restoring treated areas, design activities to repeat the form, line, color, and texture of the natural landscape character conditions to meet established Visual Resource Management (VRM) objectives.

Resource Element	Standard Operating Procedure
Wilderness and Other Special Areas See handbooks H-8550-1 (*Management of Wilderness Study Areas (WSAs)*), and H-8560-1 (*Management of Designated Wilderness Study Areas*), and Manual 8351 (*Wild and Scenic Rivers*)	• Use the "minimum tool" to treat noxious and invasive vegetation, relying primarily on use of ground-based tools, including backpack pumps, hand sprayers, and pumps mounted on pack and saddle stock. • Use chemicals only when they are the minimum method necessary to control weeds that are spreading within the wilderness or threaten lands outside the wilderness. • Give preference to herbicides that have the least impact on non-target species and the wilderness environment. • Implement herbicide treatments during periods of low human use, where feasible.
Recreation See Handbook H-1601-1 (*Land Use Planning Handbook, Appendix C*)	• Schedule treatments to avoid peak recreational use times, while taking into account the optimum management period for the targeted species. • Use herbicides during periods of low human use, where feasible.
Rights-of-way	• Coordinate vegetation management activities where joint or multiple use of a ROW exists. • Notify other public land users within or adjacent to the ROW proposed for treatment.
Human Health and Safety See Manual M-1703 (*Hazard Management and Resource Restoration*).	• Establish a buffer between treatment areas and human residences based on guidance given in the HHRA, with a minimum buffer of ¼ mile for aerial applications and 100 ft for ground applications, unless a written waiver is granted. • Use protective equipment as directed by the herbicide label. • Provide public notification in newspapers or other media where the potential exists for public exposure. • Notify local emergency personnel of proposed treatments. • Notify local emergency response agencies of herbicides stored on-site. • Contain and clean up spills and request help as needed. • Secure containers during transport. • Dispose of unwanted herbicides, contaminated materials, and pesticide containers promptly and correctly. • Clean vehicles and equipment to prevent further contamination by chemicals. • Consult with Native American tribes and Alaska Native groups to locate any areas of vegetation that are of significance to the tribe or areas that are important for natural materials and food gathering and that might be affected by herbicide treatments.

Appendix C. PHYSICAL OR BIOLOGICAL FEATURES

Table 139. Physical or biological features essential for the conservation of the species for NMFS ESA-listed species under consultation.

Species	FR Notice Date	Physical or Biological Features Essential for the Conservation of the Species
Black Abalone *Haliotis cracherodii*	76 FR 66806 10/27/2011	• Rocky substrate: Rocky benches, crevices, large boulders • Food resources: Bacterial and diatom films, algae • Juvenile settlement habitat: Rocky habitat with coralline algae and/or crevices, cryptic biogenic structures • Suitable water quality • Suitable nearshore circulation patterns
White Abalone *Haliotis sorenseni*	66 FR 29046 05/29/2001	NO DESIGNATED CRITICAL HABITAT. A designation was deemed not prudent because it was expected to increase risk of poaching

Species	FR Notice Date	Physical or Biological Features Essential for the Conservation of the Species
Green Turtle *Chelonia mydas* East Pacific DPS	Proposed 88 FR 46572 07/19/2023	The following generalized features are essential to the conservation of at least one DPS: • Reproductive essential feature - Mean high water line to 20 m depth of sufficiently dark and unobstructed waters adjacent to nesting beaches. • Migratory essential feature - Mean high water line to a particular depth/distance (varies by DPS) of sufficiently unobstructed corridors for transit of reproductive individuals between benthic foraging/resting areas and reproductive areas. • Benthic foraging/resting essential features - Mean high water line to 20 m depth of underwater refugia and food resources of sufficient condition, distribution, diversity, abundance, and density. • Surface-pelagic foraging/resting essential features – Oceanographic features/currents which result in concentrated components of the Sargassum-dominated drift community and currents which carry turtles to Sargassum-dominated drift communities, with sufficient food resources and refugia in at least 10 m water depth.
Leatherback Turtle *Dermochelys coriacea*	44 FR 17710 03/23/1979 77 FR 4170 01/26/2012	• Occurrence of prey species, primarily Scyphomedusae of the order Semaeostomeae (Chrysaora, Aurelia, Phacellophora, and Cyanea) of sufficient condition, distribution, diversity, and abundance to support individual as well as population growth, reproduction, and development • Migratory pathway conditions to allow for safe and timely passage and access to/from/within high use foraging areas
Killer Whale *Orcinus orca* Southern Resident DPS	86 FR 41668 08/02/2021	• Water quality to support growth and development; • Prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth; and • Passage conditions to allow for migration, resting, and foraging.
Steller Sea Lion *Eumetopias jubatus*	58 FR 45269	Terrestrial, air, and aquatic areas that support: • Reproduction

Species	FR Notice Date	Physical or Biological Features Essential for the Conservation of the Species
(Eastern DPS delisted, but CH still in effect; see 78 FR 66139)	8/27/1993	• Foraging • Rest • Refuge
Green Sturgeon *Acipenser medirostris* Southern DPS	74 FR 52300 10/9/2009	Freshwater areas • Food resources. Abundant prey items for larval, juvenile, subadult, and adult life stages. • Substrate type or size (i.e., structural features of substrates) • Water flow. A flow regime (i.e., the magnitude, frequency, duration, seasonality, and rate-of-change of fresh water discharge over time) necessary for normal behavior, growth, and survival of all life stages. • Water quality. Water quality, including temperature, salinity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages. • Migratory corridor. A migratory pathway necessary for the safe and timely passage of Southern DPS fish within riverine habitats and between riverine and estuarine habitats (e.g., an unobstructed river or dammed river that still allows for safe and timely passage). • Water depth. Deep (≥5 m) holding pools for both upstream and downstream holding of adult or subadult fish, with adequate water quality and flow to maintain the physiological needs of the holding adult or subadult fish. • Sediment quality. Sediment quality (i.e., chemical characteristics) necessary for normal behavior, growth, and viability of all life stages.
Green Sturgeon *Acipenser medirostris* Southern DPS (continued)	74 FR 52300 10/9/2009	Estuarine areas • Food resources. Abundant prey items within estuarine habitats and substrates for juvenile, subadult, and adult life stages. • Water flow. Within bays and estuaries adjacent to the Sacramento River (i.e., the Sacramento-San Joaquin Delta and the Suisun, San Pablo, and San Francisco bays), sufficient flow into the bay and estuary to allow adults to successfully orient to the incoming flow and migrate upstream to spawning grounds. • Water quality. Water quality, including temperature, salinity, oxygen content, and other

Species	FR Notice Date	Physical or Biological Features Essential for the Conservation of the Species
		chemical characteristics, necessary for normal behavior, growth, and viability of all life stages. • Migratory corridor. A migratory pathway necessary for the safe and timely passage of Southern DPS fish within estuarine habitats and between estuarine and riverine or marine habitats. • Water depth. A diversity of depths necessary for shelter, foraging, and migration of juvenile, subadult, and adult life stages. Sediment quality. Sediment quality (i.e., chemical characteristics) necessary for normal behavior, growth, and viability of all life stages. This includes sediments free of elevated levels of contaminants
Green Sturgeon *Acipenser medirostris* Southern DPS (continued)	74 FR 52300 10/9/2009	Coastal Marine Areas • Migratory corridor. A migratory pathway necessary for the safe and timely passage of Southern DPS fish within marine and between estuarine and marine habitats. • Water quality. Coastal marine waters with adequate DO levels and acceptably low levels of contaminants (e.g., pesticides, PAHs, heavy metals that may disrupt the normal behavior, growth, and viability of subadult and adult green sturgeon). • Food resources. Abundant prey items for subadults and adults, which may include benthic invertebrates and fish.
Eulachon *Thaleichthys pacificus* Southern DPS	76 FR 65323 10/20/2011	Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation, and with migratory access for adults and juveniles. • Flow: A flow regime (i.e., the magnitude, frequency, duration, seasonality, and rate-of-change of freshwater discharge over time) that supports spawning, and survival of all life stages. • Water Quality: Water quality suitable for spawning and viability of all eulachon life stages. Sublethal concentrations of contaminants affect the survival of aquatic species by increasing stress, predisposing

Species	FR Notice Date	Physical or Biological Features Essential for the Conservation of the Species
Eulachon *Thaleichthys pacificus* Southern DPS (continued)	76 FR 65323 10/20/2011	organisms to disease, delaying development, and disrupting physiological processes, including reproduction. • Water Temperature: Suitable water temperatures, within natural ranges, in eulachon spawning reaches. • Substrate: Spawning substrates for eulachon egg deposition and development. Freshwater and estuarine migration corridors associated with spawning and incubation sites that are free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted. • Migratory Corridor: Safe and unobstructed migratory pathways for eulachon adults to pass from the ocean through estuarine areas to riverine habitats in order to spawn, and for larval eulachon to access rearing habitats within the estuaries and juvenile and adults to access habitats in the ocean. • Flow: A flow regime (i.e., the magnitude, frequency, duration, seasonality, and rate-of-change of freshwater discharge over time) that supports spawning migration and outmigration of larval eulachon from spawning sites. • Water Quality: Water quality suitable for survival and migration of spawning adults and larval eulachon. • Water Temperature: Water temperature suitable for survival and migration. • Food: Prey resources to support larval eulachon survival. Nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival. • Food: Prey items, in a concentration that supports foraging leading to adequate growth and reproductive development for juveniles and adults in the marine environment. • Water Quality: Water quality suitable for adequate growth and reproductive development.

Species	FR Notice Date	Physical or Biological Features Essential for the Conservation of the Species
Puget Sound / Georgia Basin Rockfish: • Yelloweye *Sebastes ruberrimus* • Boccacio *Sebastes paucispinis*	79 FR 68041 11/13/2014	Adult bocaccio and adult/juvenile yelloweye rockfish. Benthic habitats and sites deeper than 30 m (98 ft) that possess or are adjacent to areas of complex bathymetry consisting of rock and or highly rugose habitat. Site attributes: • Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities, • water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities, and • the type and amount of structure and rugosity that supports feeding opportunities and predator avoidance. Juvenile boccacio. Juvenile settlement habitats located in the nearshore with substrates such as sand, rock and/or cobble compositions that support kelp. Site attributes: • Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities; and • water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities.
West Coast Salmon: Chum Salmon (*O. keta)* • Columbia River ESU • Hood Canal summer-run ESU Sockeye Salmon (*O. nerka)* • Ozette Lake ESU • Snake River ESU Chinook Salmon (*O. tshawytscha)* • Lower Columbia River ESU • Puget Sound ESU • Upper Columbia River spring-run ESU • Upper Willamette River ESU	70 FR 52629 09/02/2005 70 FR 52630 09/02/2005 58 FR 68543 12/28/1993	Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development; Freshwater rearing sites with: • Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; • Water quality and forage supporting juvenile development; • Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side

Species	FR Notice Date	Physical or Biological Features Essential for the Conservation of the Species
Steelhead Trout (*O. mykiss*) • Lower Columbia River DPS • Middle Columbia River DPS • Upper Columbia River DPS West Coast Salmon: Chum Salmon (*O. keta)* • Columbia River ESU • Hood Canal summer-run ESU Sockeye Salmon (*O. nerka)* • Ozette Lake ESU • Snake River ESU Chinook Salmon (*O. tshawytscha)* • Lower Columbia River ESU • Puget Sound ESU • Upper Columbia River spring-run ESU • Upper Willamette River ESU Steelhead Trout (*O. mykiss*) • Lower Columbia River DPS • Middle Columbia River DPS • Upper Columbia River DPS (continued)	70 FR 52629 09/02/2005 70 FR 52630 09/02/2005 58 FR 68543 12/28/1993	channels, and undercut banks supporting juvenile and adult mobility and survival; Estuarine areas free of obstruction and excessive predation with: • Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh & saltwater; • Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; • Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation. Nearshore marine areas free of obstruction and excessive predation with: • Water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and • Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels. Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.
Coho Salmon (*O. kisutch)* • Central California Coast ESU • Southern Oregon / Northern California Coast ESU	64 FR 24049 05/05/1999	Within the range of both ESUs, the species' life cycle can be separated into five essential habitat types: Juvenile summer and winter rearing areas; juvenile migration corridors; areas for growth and development to adulthood; adult migration corridors; and spawning areas.

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		Essential features of coho critical habitat include adequate: (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) safe passage conditions.
Steelhead *Oncorhynchus mykiss* Puget Sound DPS Coho Salmon *Oncorhynchus kisutch* Lower Columbia River ESU	81 FR 9251 03/25/2016	• Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development. • Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. • Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival. • Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation. • Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and

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		overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels. • Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.
Steelhead (*O. mykiss)* • Northern California DPS • California Central Valley DPS • Central California Coast DPS • South-Central California Coast DPS • Southern California DPS	70 FR 52629 9/2/2005	• Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development. • Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. • Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival. • Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation. • Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels. • Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.
Steelhead (*O. mykiss)* • Northern California DPS • California Central Valley DPS • Central California Coast DPS • South-Central California Coast DPS • Southern California DPS	70 FR 52629 9/2/2005	

Species	FR Notice Date	Physical or Biological Features Essential for the Conservation of the Species
Coho Salmon *Oncorhynchus kisutch* Oregon Coast ESU	73 FR 7816 2/11/2008	• Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development. • Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. • Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival. • Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation. • Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels. • Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.
Coho Salmon *Oncorhynchus kisutch* Oregon Coast ESU	73 FR 7816 2/11/2008	
Chinook Salmon (*O. tshawytscha)* • Snake River fall-run ESU • Snake River spring/summer-run ESU	58 FR 68543 12/28/1993 64 FR 57399	Juvenile rearing areas include adequate: • Spawning gravel • Water quality • Water quantity • Water temperature • Cover/shelter

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	10/25/1999	• Food • Riparian vegetation • Space Juvenile and adult migration corridors are the same as for Snake River sockeye salmon. Critical habitat for chinook salmon Snake river spring/summer-run ESU is designated as all areas currently accessible to the species within the range of the ESU.
Sockeye Salmon *Oncorhynchus nerka* Snake River ESU	58 FR 68543 12/28/1993	Spawning and juvenile rearing areas: • Spawning gravel • Water quality and Water quantity • Water temperature • Food • Riparian vegetation • Access Juvenile migration corridors: • Substrate • Water quality • Water quantity • Water temperature • Water velocity • Cover/shelter • Food • Riparian vegetation • Space • Safe passage conditions Adult Migration corridor has the same Essential Features, excluding “food”.
Sockeye Salmon *Oncorhynchus nerka* Snake River ESU (continued)	58 FR 68543 12/28/1993	
Beluga *Delphinapterus leucas* Cook Inlet DPS	76 FR 20179 04/11/2011	• Intertidal and subtidal waters of Cook Inlet with depths less than 30 ft (MLLW)(9.1 m) and within five miles (8 km) of high and medium flow anadromous fish streams. • Primary prey species consisting of four species of Pacific salmon (Chinook, sockeye, chum, and coho), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole. • Waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales.

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		• Unrestricted passage within or between the critical habitat areas. • Waters with in-water noise below levels resulting in the abandonment of critical habitat areas by Cook Inlet beluga whales.
North Pacific Right Whale *Eubalaena japonica*	90-Day Finding 87 FR 41271 07/12/2022 73 FR 19000 05/08/2008	Prey species of large zooplankton in areas where right whale are known or believed to feed. In particular, these are the copepods *Calanus marshallae*, *Neocalanus cristatus*, and *N. plumchrus*, and a euphausiid, *Thysanoessa raschii*, whose very large size, high lipid content, and occurrence in the region likely makes it a preferred prey item for right whales. Areas of concentration where right whales feed are characterized by certain physical and biological features which include nutrients, physical oceanographic processes, species of zooplankton described above, and long photoperiod due to the high latitude.
Humpback whale *Megaptera novaeangliae* Central America DPS	86 FR 21082 04/21/2021	Prey species, primarily euphausiids (Thysanoessa, Euphausia, Nyctiphanes, and Nematoscelis) and small pelagic schooling fishes, such as Pacific sardine (*Sardinops sagax*), northern anchovy (*Engraulis mordax*), and Pacific herring (*Clupea pallasii*), of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth.
Humpback whale *Megaptera novaeangliae* Western North Pacific DPS	86 FR 21082 04/21/2021	Prey species, primarily euphausiids (Thysanoessa and Euphausia) and small pelagic schooling fishes, such as Pacific herring, capelin (*Mallotus villosus*), juvenile walleye pollock (*Gadus chalcogrammus*) and Pacific sand lance (*Ammodytes personatus*) of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth.
Humpback whale *Megaptera novaeangliae* Mexico DPS	86 FR 21082 04/21/2021	Prey species, primarily euphausiids (Thysanoessa, Euphausia, Nyctiphanes, and Nematoscelis) and small pelagic schooling fishes, such as Pacific sardine, northern anchovy, Pacific herring, capelin, juvenile walleye pollock, and Pacific sand lance of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth.

Species	FR Notice Date	Physical or Biological Features Essential for the Conservation of the Species
Ringed seal *Phoca (pusa) hispida* Arctic subspecies	87 FR 19232 04/01/2022	• Sea ice habitat suitable for the formation and maintenance of subnivean birth lairs used for sheltering pups during whelping and nursing, which is defined as seasonal landfast (shorefast) ice, or dense, stable pack ice, that has undergone deformation and contains snowdrifts at least 54 cm deep. • Sea ice habitat suitable as a platform for basking and molting, which is defined as sea ice of 15% or more concentration. • Primary prey resources to support Arctic ringed seals, which are defined to be small, often schooling, fishes, in particular, Arctic cod, saffron cod, and rainbow smelt; and small crustaceans, in particular, shrimps and amphipods.
Pacific bearded seal *Erignathus barbatus nauticus* Beringia DPS	87 FR 19180 04/01/2022	• Sea ice habitat suitable for whelping and nursing, which is defined as areas with waters 200 m or less in depth containing pack ice of at least 25% concentration and providing bearded seals access to those waters from the ice. • Sea ice habitat suitable as a platform for molting, which is defined as areas with waters 200 m or less in depth containing pack ice of at least 15% concentration and providing bearded seals access to those waters from the ice. • Primary prey resources to support bearded seals: Waters 200 m or less in depth containing benthic organisms, including epifaunal and infaunal invertebrates, and demersal fishes.