Rogue–South Coast Multi-Species Conservation and Management Plan

OREGON DEPARTMENT OF FISH AND WILDLIFE

FINAL DRAFT

DECEMBER 2021

NOTE: On December 17 the ODFW Commission will be choosing between alternative approaches for management of

1) wild winter steelhead harvest, and

2) hatchery programs.

This draft is written based on the staff recommended alternatives. If the Commission choses another alternative **the relevant sections of this plan will be updated to reflect that choice**. Those sections are highlighted in yellow in this draft (e.g., see Table 8, page 37).

ODFW Mission

To protect and enhance Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations

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Acronyms and Abbreviations

A&P .....Abundance and Productivity
AQI.....Aquatic Inventories Project
BMP .....Best Management Practice
BRT.....Biological Review Team
CCLME ..California Current Large Marine Ecosystem
CCRMP ..Coastal Chinook Research and Monitoring Project
CCT.....Coastal Cutthroat Trout
ChF.....Fall-run Chinook
ChS.....Spring Chinook
CMP .....Coastal Multi-Species Conservation and Management Plan
CO .....Coho salmon
CRH .....Cole Rivers Hatchery
CWT.....Coded-wire tag
D .....Diversity
DEM.....Digital Elevation Model
DEQ .....Oregon Department of Environmental Quality
DIDSON..Dual-Frequency Identification Sonar
DPS.....Distinct Population Segment
ELS.....Electronic Licensing System
ESA .....Endangered Species Act
ESU .....Evolutionarily Significant Unit
FHMP .....Fish Hatchery Management Policy
GHG.....Greenhouse gas
GIS .....Geographic Information System
GRTS .....Generalized Randomized-Tessellation Stratified technique
HGMP.....Hatchery and Genetic Management Plan
HUC .....Hydrologic Unit Coding
HWG.....Habitat Work Group
I&E.....Information and Education
IP .....Intrinsic Potential
IPCC .....Intergovernmental Panel on Climate Change
KMP.....Klamath Mountains Province
MEA.....Mixed Emphasis Area
MR .....Mark-Recapture
MRP .....Marine Resources Program
MSAs.....Management Strategies and Actions
MSY .....Maximum Sustained Yield
N/A .....Not applicable
NADOT...Non-Assessed Direct Ocean Tributary
NFCP.....Native Fish Conservation Policy
NMFS.....National Marine Fisheries Service
NOAA .....National Oceanic and Atmospheric Administration
NPCHS....Naturally produced spring Chinook Salmon
OAR .....Oregon Administrative Rule
OASIS... Oregon Adult Salmonid Inventory and Sampling Project
ODA..... Oregon Department of Agriculture
ODFW .. Oregon Department of Fish and Wildlife
OFWC .. Oregon Fish and Wildlife Commission
OHRC... Oregon Hatchery Research Center
ONFSR . 2005 Oregon Native Fish Status Report
OSGC ... Oregon State Game Commission
OSMB... Oregon State Marine Board
OSP..... Oregon State Police
OSU ..... Oregon State University
OWEB .. Oregon Watershed Enhancement Board
OWRD.. Oregon Water Resources Department
P ..... Productivity
pHOS.... Proportion of hatchery fish on spawning grounds
PVA ..... Population Viability Analysis
QET ..... Quasi-Extinction Threshold
RCP ..... Representative Concentration Pathway
RFT..... Reproductive Failure Threshold
RSP ..... Rogue–South Coast Multi-Species Conservation and Management Plan
SAP ..... Strategic Action Plan
SDM..... Species Distribution Model
SE..... Standard Error
SMSY.... Spawner abundance at Maximum Sustainable Yield
SMU..... Species Management Unit
SONCC. Southern Oregon/Northern California Coast
SS ..... Spatial Structure
SST..... Sea Surface Temperature
STEP..... Salmon and Trout Enhancement Program
StW ..... Winter Steelhead
StS..... Summer Steelhead
SWCD... Soil and Water Conservation District
SW ..... Southwest
TBD ..... to be determined
USACE . U.S. Army Corps of Engineers
USFS..... U.S.D.A. Forest Service
USFWS. U.S. Fish and Wildlife Service
USGS .... United States Geological Service
VSP ..... Viable Salmonid Population
WFEA .. Wild Fish Emphasis Area
WORP .. Western Oregon Rearing Project
WSHC... Rogue–South Coast Wild Steelhead Harvest Card
yr..... year
yrs ..... years

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Introduction

The *Rogue–South Coast Multi-Species Conservation and Management Plan* (RSP) was developed to guide management of steelhead, coho salmon, and cutthroat trout in coastal watersheds of southwest Oregon from the Elk River south to the Winchuck River. The primary purpose of this multi-species plan is to carry out the Oregon Department of Fish and Wildlife's (ODFW) mission[1] by ensuring the continued viability and conservation of the Rogue–South Coast *winter steelhead*, *summer steelhead*, *coho salmon*, and *coastal cutthroat trout* Species Management Units (SMUs)[2] so that they provide substantial ecological and societal benefits. This plan focuses on the long-term conservation[3] of naturally-produced (i.e., wild) steelhead, coho salmon, and cutthroat trout, but also provides the framework for how hatchery salmon and steelhead and fisheries will be managed[4] to maximize fishing opportunity. All SMUs have benefitted from extensive habitat restoration work initiated or maintained under the *Oregon Plan for Salmon and Watersheds* (Oregon Plan) and the *Oregon Conservation Strategy*. The RSP maintains and enhances support of the Oregon Plan (ORS 541.898) and meets the requirements of Oregon's Native Fish Conservation Policy (NFCP) (OAR 635-007-0502 to 0509).

A multi-species plan was developed for the four SMUs covered by the RSP because they share many of the same conservation and management needs, especially with regard to habitat. The plan also recognizes that each SMU has a unique set of needs, and crafted management strategies and actions accordingly. Of the SMUs covered by this plan, only coho salmon are listed under the federal Endangered Species Act (as part of the Southern Oregon/Northern California Coast [SONCC] Evolutionarily Significant Unit) and require status improvement to ensure viability. For the other SMUs, management is directed toward increasing societal benefits, including robust fisheries, and reducing long-term conservation risk.

Changing climate and ocean conditions caused by greenhouse gas emissions pose a risk to all plan species through effects on the freshwater and marine habitats that support them. Although there is uncertainty about the timing and extent of these impacts, increasing confidence in the trajectory of climate and ocean change demands a proactive planning approach. Consistent with ODFW's Climate and Ocean Change Policy (OAR 635-900-0001 to 0020), RSP management goals, strategies, and actions consider predicted future conditions and how species may respond to these conditions, while allowing for near-term conservation and utilization in an adaptive management approach.

[1] ODFW's mission is "*to protect and enhance Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations*".
[2] Species Management Unit is defined as a collection of populations from a common geographic region that share similar genetic and ecological characteristics.
[3] As defined in Oregon Administrative Rule (OAR), the term conservation means managing for sustainability of native fish so present and future generations may enjoy their ecological, economic, recreational and aesthetic benefits (OAR 635-007-0501-10).
[4] The RSP does not provide all details of hatchery and fishery management. Other documents, such as Hatchery Program Management Plans and the annual *Oregon Sport Fishing Regulations*, do or will provide more detail.

Protecting and improving habitat for plan species is central to mitigating expected climate and ocean change impacts and achieving the goals of this plan, and will also benefit other native fish[5] and wildlife species. Habitat enhancement will require effective enforcement of existing regulations and voluntary, non-regulatory restoration work by local conservation groups and private landowners (e.g., Soil and Water Conservation Districts [SWCDs], watershed councils, industrial forestland owners, Salmon and Trout Enhancement Program [STEP] volunteers, and other individuals and groups). A key element of the RSP is direction on the type of habitat work needed to address limiting factors for populations covered by the plan. Community-based organizations have demonstrated an impressive record of planning and implementing habitat improvement projects through their participation in the Oregon Plan and the RSP is intended to help maximize the benefits of those projects in the future.

Plan Development Process

This plan meets the requirements for conservation plans described in the NFCP (OAR 635-007-0502 to 0509). The NFCP was adopted by the Oregon Fish and Wildlife Commission (OFWC) in 2002 to support and increase the effectiveness of the 1997 Oregon Plan. The NFCP employs conservation plans to identify and implement appropriate strategies and actions necessary to restore and maintain native fish in Oregon to levels that provide benefits to the citizens of the state. This is achieved by completing the following items, which are described in detail in this plan:

1. Define SMUs and constituent populations.
2. Determine current status.
3. Define a desired status.
4. Determine any gap between current and desired status and the factors causing the gap (limiting factors).
5. Identify and implement strategies and actions that address the limiting factors.
6. Monitor and evaluate the SMU status and actions implemented and use adaptive management to make adjustments necessary to achieve desired status.

The NFCP also requires ODFW to seek input and involvement from appropriate tribal, state, local, and federal management partners and the public during the planning process. The following describes some specific aspects of plan development.

SMU and Population Boundaries

The SMU and population boundaries[6] identified in this plan are the same for all SMUs to avoid confusion and provide consistency in management and implementation across species. Populations are grouped into two geographic strata—Coastal and Rogue (Interior Rogue for coho salmon).

Status Assessment

The RSP relied on a weight-of-evidence approach for assessment of the current status utilizing all

[5] Native fish are defined as indigenous to Oregon and include both naturally and hatchery produced fish (OAR 635-007-0501-36).

[6] SMU boundaries encompass all watersheds that flow into the ocean from the Elk River in the north to the Winchuck River in the south. Summer steelhead are only found in the Rogue basin.

available data and the most appropriate scientific methods. The recent performance of the fish was measured by assessing abundance, productivity, spatial structure, and diversity. Field biologists also provided local knowledge for consideration where other data were lacking or inconclusive. ODFW considered all sources of information, and the status conclusions identified in the RSP reflect the preponderance of the information and confidence in analytical assessments.

Strategies and Actions

Strategies and actions are identified in the RSP within seven Management Categories: habitat, other species, hatcheries, fishing, research and monitoring, outreach/enforcement, and facilities. The strategies and actions are intended to address identified limiting factors that are likely to impede the ability of each SMU to achieve desired status or meet other management goals primarily related to improving fishing opportunity and access. An adaptive management process, including research and monitoring, is outlined in this plan to ensure the strategies and actions will be effective.

Plan Development Partners

To develop a conservation plan that seeks to achieve society's desired status for each SMU, ODFW enlisted the help of two Stratum Stakeholder Teams—interest group representatives who live, work or recreate within that stratum (Coastal [South Coast] or Rogue). Interest groups represented on these teams included watershed councils, conservation groups, fishing guides, angler groups, a fishing industry association, local governments, federal land management agencies, and the public-at-large. Six rounds of meetings provided a forum for Stakeholder Teams to provide ODFW with input and guidance for development of strategies and actions to achieve a desired status. Stakeholder Team meetings were open to the public and public comment was accepted throughout the process. A summary of the Stakeholder process is presented in **Appendix V – Stakeholder Process Report**. Prior to the Stakeholder process, ODFW conducted a survey of licensed anglers in the RSP planning area and surrounding counties to better understand fishing preferences and gauge public opinion about potential changes in fishery management. Results of the survey are presented in **Appendix VI – Rogue–South Coast Angler Survey.**

During plan development, ODFW sought input from the Confederated Tribes of Grand Ronde, Confederated Tribes of Siletz Indians, Coquille Indian Tribe, and Cow Creek Band of Umpqua Tribe of Indians, and the National Marine Fisheries Service (NMFS). Additionally, ODFW formed a Habitat Work Group to provide initial feedback on habitat components and strategies in the RSP. Invited members of this group included Stakeholder Team members, watershed councils, local and state government agencies, conservation groups, industry associations, and land managers. Finally, in addition to the Stakeholder Team process, general public comment opportunities were provided at multiple other points in the development and approval process.

The following plan is a roadmap for managing steelhead, coho salmon, and cutthroat trout in the Rogue–South Coast area to achieve long-term sustainability and provide significant ecological, economic, and cultural benefits for present and future generations.

Species and Populations

The four SMUs covered in the RSP consist of native fish that exhibit significant differences in their life history (**Table 1**). Plan species reside in freshwater, estuaries, and the ocean for different periods of time; migrate to different ocean areas; and mature at different ages. These variable life history strategies affect each species' resilience, productivity, and current and historical abundances. Thus, accounting for such characteristics is crucial for guiding effective management and conservation programs. This section presents background information about the Rogue-South Coast planning area (hereafter referred to as the "planning area") relevant to conservation and management of plan species, provides key background information about each SMU, and identifies populations used in the planning process. Populations are grouped in two geographic strata for status assessment and management purposes. In general, the Rogue Stratum encompasses the Rogue River and its tributaries and the Coastal Stratum includes all other basins in the planning area (see Coho Salmon SMU description below for exception).

Planning Area Background

The planning area is defined by its diverse range of inland and coastal aquatic habitat types, which differ from the rest of Oregon's coastal watersheds as a result of its unique climate and geology. Due to these characteristics, the planning area is more ecologically similar to northern California than the rest of western Oregon. Ocean conditions off the coast of the planning area are also distinctive due to stronger, more consistent coastal upwelling—the movement of cold, nutrient-rich ocean water to the surface—south of Cape Blanco (Weitkamp et al. 1995). Salmon populations in the planning area have a more southerly ocean distribution than populations to the north (Nicholas and Hankin 1988; Weitkamp and Nealy 2002; Weitkamp 2010), and steelhead originating south of Cape Blanco are rarely recovered in offshore or nearshore collections north of Cape Blanco (Pearcy et al. 1990). These distinctions are reflected in the grouping by NMFS of steelhead and coho salmon from the RSP planning area in evolutionary units that include northern California populations (see **Appendix I – Additional Background Information**).

Three major ecoregions (Coast Range, Klamath Mountains, and Cascades) are represented in the planning area (Omernik 1987), all of which contribute to habitat diversity in the Rogue Basin (**Figure 1).** Most coastal watersheds in Oregon flow out of forested hillslopes down to coastal valleys before meandering to the sea. In the Rogue, large river valleys are located inland, east of the coast range. Downstream from these inland valleys, the river re-enters forested habitat and a narrow canyon on its way to the ocean. A similar pattern is present in the Illinois sub-basin. Due to steep topography in the lower basin, the Rogue Estuary is small (~630 acres at mean high tide) and tidal influence only extends about 4.5 miles from the river mouth (Bottom et al. 1979). Tideflats, marshes and eelgrass beds are noticeably absent in the Rogue Estuary.

With most of the valley habitat located well inland from the ocean, low gradient streams of the Rogue are exposed to much warmer air temperatures than other coastal watersheds in Oregon (see **Appendix I – Additional Background Information**). Everest (1973) noted that many small tributaries of the inland valley sustain flows only during the winter and spring and become intermittent or dry in summer. A hotter, drier summer climate in the Rogue Basin compared to other coastal watersheds in Oregon is

reflected in higher peak water temperatures observed over time. Everest (1973) reported several peak temperatures in the Rogue that exceeded 80°F (27°C). In most low elevation streams, water temperatures commonly exceed 20°C during summer, regardless of land use observed in the surrounding watershed. For example, water temperatures in July 2003 exceeded 20°C in all fourteen surveyed tributaries entering the Rogue River between the Applegate River and Lobster Creek (Watershed Sciences 2004), including five tributaries located within the Wild Rogue Wilderness.

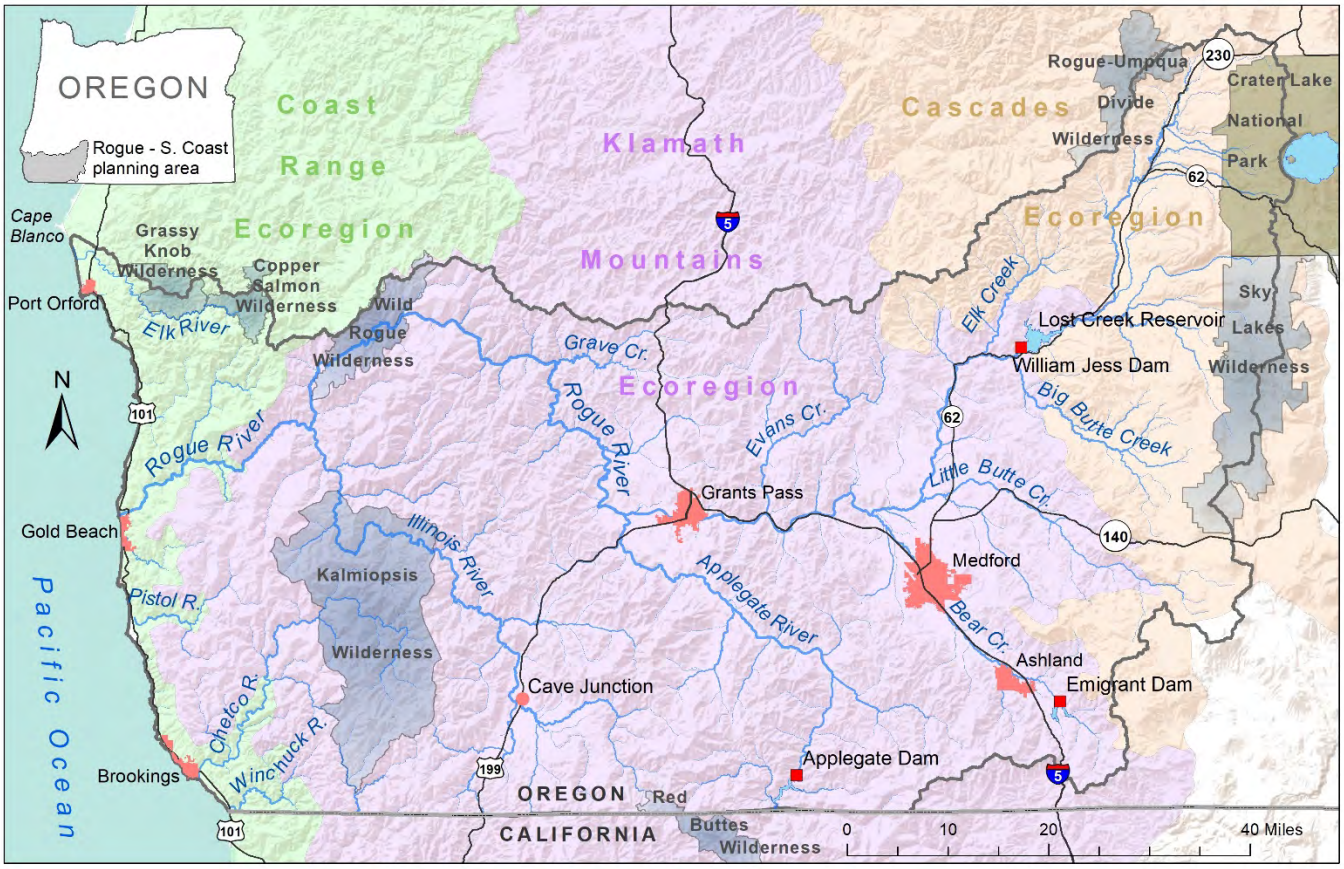


Figure 1. Map of the Rogue–South Coast planning area.

Coastal Stratum watersheds in the planning area, as well as tributaries of the lower Rogue, are characterized by rugged topography and steep river canyons (Frissell 1992). Wider valleys are typically only present on the narrow, irregular coastal plain. All Coastal Stratum basins have small estuaries, and most are "blind" estuaries where low summer flows are often insufficient to maintain an opening at the estuary mouth (Bottom et al. 1979). Streamflow in Coastal Stratum basins varies by 2–3 orders of magnitude on an annual basis due to a combination of heavy winter rainfall and very dry summers. Coniferous forest is the dominant land cover in these basins. The majority of land is privately owned in some basins, while in others federally-owned lands predominate (see **Appendix 1 – Additional Background Information**). Historically, timber and agricultural practices impacted many Coastal Stratum streams through increased erosion, loss of riparian function, and changes in channel structure and complexity. Evolving land-use regulations and practices, changes in federal land management, and

voluntary conservation measures on private lands, including restoration work conducted under the Oregon Plan, have ameliorated many of these impacts.

In the Rogue, the history and magnitude of development is unique compared to other coastal watersheds in Oregon. One simple example is the size of the human population. More people live in the Rogue watershed than any other coastal watershed in Oregon (see **Appendix I – Additional Background Information**). Details of development impacts can be found in various Rogue watershed assessments (see Southern Oregon Digital Archives Bioregion Collection). Healthy watersheds, many with federal ownership, are found throughout the Rogue Basin, but impacts from barriers, water diversions, and loss of riparian function are widespread in low elevation streams. The problem of barriers to fish passage merits emphasis in the RSP because of the magnitude of impact on interior Rogue steelhead and the highly migratory nature of juvenile steelhead during freshwater rearing (see **Appendix I – Additional Background Information**). Rivers (1964) reported that "…several hundred dams within migratory ranges of the Rogue fish runs were built and maintained for various periods before 1941. Most were small and located on tributaries and could easily be passed by fish, at least at higher stages of flow." But Rivers (1957) also noticed that during winters with low flows, the distribution of steelhead on the spawning grounds was limited by low dams of less than 30 inches in height. The effect on juvenile migration from the collective impact of dams, diversions, and poorly designed and constructed culverts is even more significant.

Fish surveys were initiated in the Rogue River Basin during the 1940s and 1950s primarily as a result of regional interest in the construction of reservoirs for the multiple purposes of flood control, hydroelectric power, and water supply. Directed surveys of fish resources in the 1940s were conducted by the Oregon State Game Commission (OSGC). Findings from these surveys were reported by Rivers (1964). This work included construction of a fish counting station at Gold Ray Dam, which began operation in the spring of 1942. More extensive surveys of fish populations, stream habitat, and recreational fisheries were conducted by the OSGC and the United States Fish and Wildlife Service (USFWS) during 1949-1954. Findings from these surveys can be found in a series of unpublished reports (USFWS 1955a; USFWS 1955b; USFWS 1955c; USFWS 1955d). Interest in the construction of flood control projects intensified after a major flood event in December of 1955.

Eventually the United States Army Corps of Engineers (USACE) recommended to the United States Congress that three dams be constructed in the Rogue River Basin. Congress authorized the proposed project in 1962, including the construction of Lost Creek Dam (subsequently re-named William Jess Dam), Applegate Dam, and Elk Creek Dam. William Jess Dam was completed in 1977 and Applegate Dam was completed in 1979. Elk Creek Dam was never finished and was eventually notched in 2008. Congress authorized the dams to provide fish enhancement as a primary purpose of the dams, primarily through the allocation of stored water in summer for flow augmentation (see **Appendix I – Additional Background Information**). Intensive studies conducted before and after construction of USACE dams in the Rogue Basin (Everest 1973; ODFW 1989; ODFW 1990; ODFW 1994) provide invaluable historical abundance and life history information about steelhead and coho salmon populations covered by this plan.

Species Management Units

Winter Steelhead

Winter steelhead are widely distributed in the Rogue–South Coast SMU (**Figure 2**). Spawning and rearing occurs in mainstem and tributary habitats (most spawning occurs in larger tributaries). Winter steelhead exhibit life-history diversity in the duration of freshwater rearing, ocean residence time, and timing of the spawning migration (**Table 1**). In addition, many winter steelhead in the Rogue Basin make a "half-pounder" run into freshwater after spending 2-4 months at sea. Half-pounders typically do not spawn and return to sea after overwintering in freshwater. The half-pounder life history observed in the Rogue is unique among steelhead populations in Oregon, and rare among steelhead populations in their entire North Pacific range (Everest 1973; Hodge et al. 2014). Approximately a third of Rogue winter steelhead make a half-pounder run, although this percentage varies from year to year (ODFW 1990). Winter steelhead are capable of surviving to spawn more than one time.

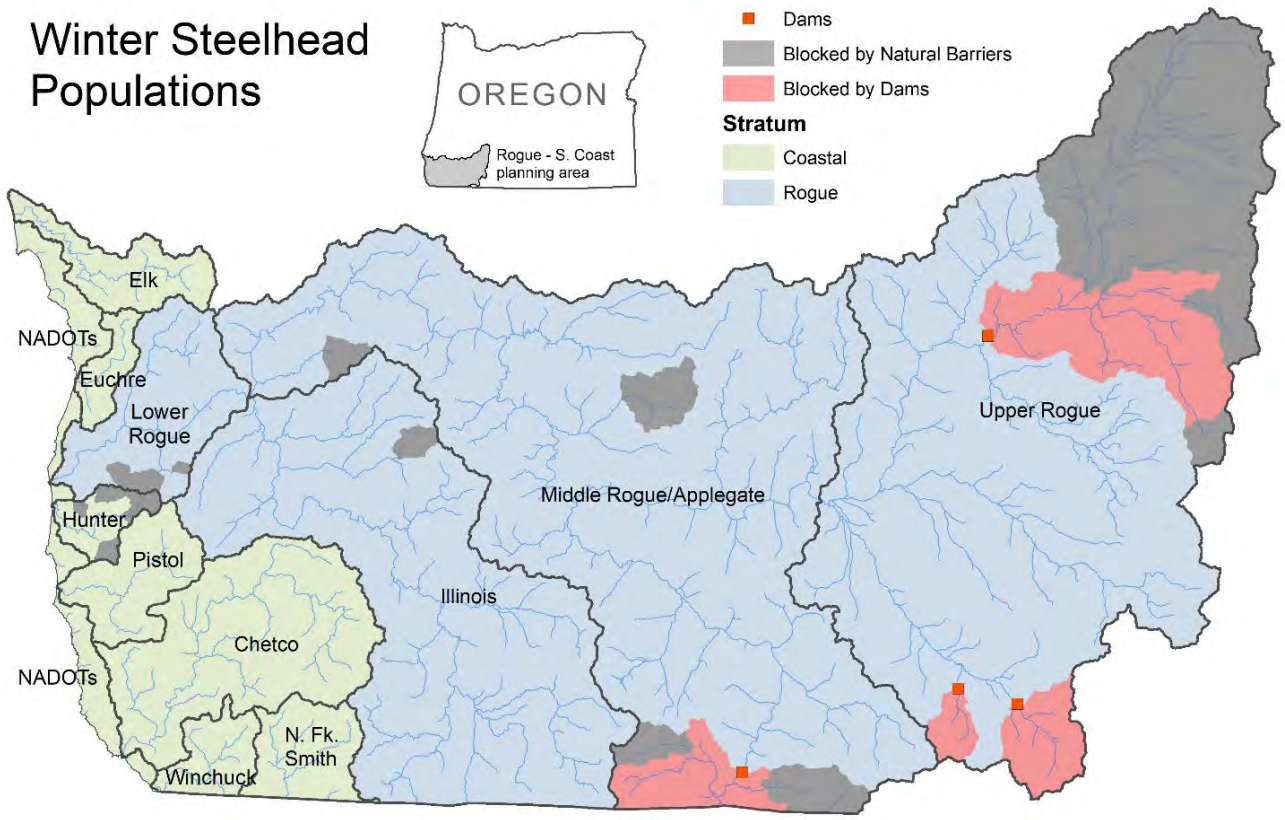


Figure 2. Location of winter steelhead populations in the Rogue–South Coast SMU.

No comprehensive analysis of genetic population structure is available for the SMU (see **Appendix II – Genetic Structure and Diversity Summary**), so population delineations (**Figure 2**; **Table 2**) are based on presumed differences among Coastal Stratum basins and between major sub-basins or ecoregions within the Rogue Basin. The populations identified in this plan are similar to those in the

Oregon Native Fish Status Report (ONFSR) (ODFW 2005), but differ in that Euchre Creek and Hunter Creek are considered separately from the Lower Rogue, and the Applegate and Middle Rogue are considered a single population separate from the Upper Rogue (Middle and Upper Rogue were considered a single "Mainstem Rogue" population in the ONFSR).

Public petitions to list RSP coho salmon and steelhead populations under the federal Endangered Species Act (ESA) began in the early 1990s, a period that featured a multi-year drought and a very large El Niño ocean event. All coastal steelhead populations were in a low period of abundance relative to estimates in the early 1970s (ODFW 1995). ODFW responded to the downturn with multiple management actions, including angling regulation changes that are still in place today (see **Fishing Actions** for details).

A 1992 petition to list the Illinois winter steelhead population under the ESA was denied in 1993 because the population did not constitute a listable unit under federal policy. NMFS then conducted a status review of coastal steelhead populations in California, Oregon, and Washington to identify Evolutionarily Significant Units (ESUs) and determine whether listing under the ESA was warranted for any ESU. The status review for the Klamath Mountains Province (KMP) steelhead ESU (Busby et al. 1994), which is now identified as the KMP Distinct Population Segment, concluded that "the ESU is not now at risk of extinction, but if trends continue, it is likely to become so in the foreseeable future." Subsequently, ODFW completed additional work to refute and respond to the five primary points raised in the status review's Threshold Assessment.

In 1998, NOAA announced that KMP steelhead would be protected by special conservation plans designed in cooperation with California and Oregon, including a steelhead supplement to the Oregon Plan for Salmon and Watersheds. ODFW initiated a project to develop population health goals for wild steelhead populations in the Oregon portion of the KMP, and a monitoring program to characterize population status. Along with other findings, the KMP project developed four different methods for estimating population size for wild adult steelhead in the Oregon portion of the KMP (see **Appendix I – Additional Background Information**), and concluded that KMP steelhead are very abundant compared to current and historical numbers of steelhead elsewhere in Oregon (ODFW letter to NOAA, Oct 28, 2001). In 2001, the status of the KMP ESU was re-evaluated by the NMFS West Coast Steelhead Biological Review Team (BRT). The highest likelihood outcome from the risk assessment approach used by the BRT was that the KMP steelhead ESU was "not in danger of extinction nor likely to become so."

Summer Steelhead

The current and historical range of summer steelhead in the planning area is the middle and upper Rogue Basin (**Figure 3**). Rogue summer steelhead utilize a wide variety of streams for spawning and rearing, including intermittent streams that may dry completely in summer. Summer steelhead display considerable life-history diversity in the duration of freshwater rearing, ocean residence time, and timing of the spawning migration (**Table 1**). In addition, a very high percentage of summer steelhead exhibit the half-pounder life history described in the winter steelhead section above. ODFW found that 95% of the wild late-run adult summer steelhead that returned to the Rogue River had previously made

a half-pounder run (ODFW 1994). Summer steelhead are capable of surviving to spawn more than one time. The two summer steelhead populations identified in this plan (**Table 2**) are consistent with those in the ONFSR (ODFW 2005). The SMU has been recognized as a Sensitive Species by the state of Oregon since at least 2005 because of risk factors associated with limited distribution and unique habitat requirements.

Separate winter steelhead and summer steelhead SMUs are delineated in this plan, recognizing differences in management needs for the two runs and the critical importance of conserving both run types. However, winter steelhead and summer steelhead are the same species, *Oncorhynchus mykiss*. Differences in spawn timing and distribution limit breeding between the two run types (Everest 1973), but there is regular genetic exchange. Accordingly, for purposes of federal management and listing decisions, the two run types are both part of the same KMP Distinct Population Segment (DPS). In addition to the anadromous life history form (steelhead), *O. mykiss* has a freshwater resident life history form (rainbow trout). Steelhead and rainbow trout can interbreed (McMillan et al. 2007; Christie et al. 2011), and both life history forms can produce offspring of the other form (Christie et al. 2011; Hodge et al. 2016). Resident rainbow trout likely comprise a small proportion of *O. mykiss* populations in the Coastal Stratum and in the Rogue Basin below major anthropogenic barriers. In the upper Rogue Basin above Lost Creek Reservoir, resident rainbow trout are abundant and appear to be self-sustaining. Resident rainbow trout were not assessed for this plan, but contribute to the diversity and long-term viability of *O. mykiss*, particularly in the Rogue Basin.

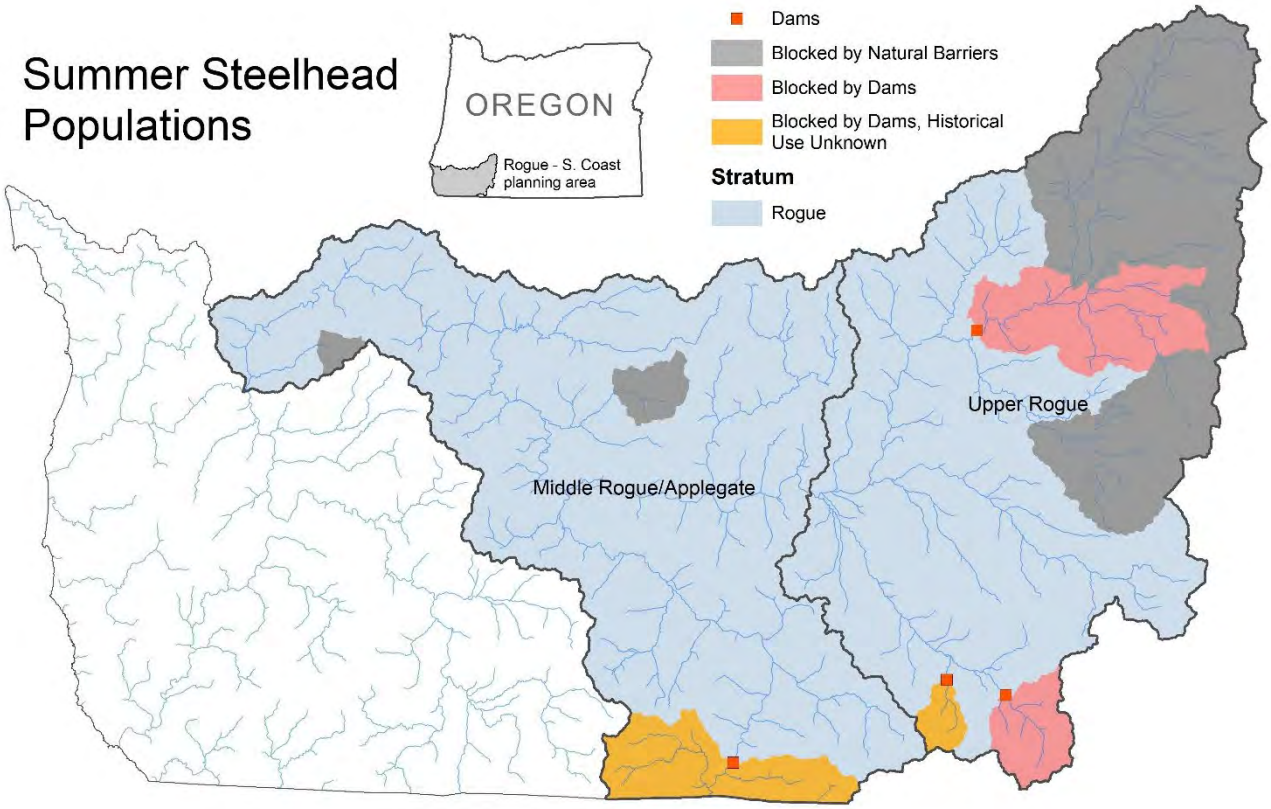


Figure 3. Location of summer steelhead populations in the Rogue SMU.

Coho Salmon

Coho salmon are found throughout the area covered by this plan, although in several cases they occur as small, dependent populations (**Figure 4**). Coho salmon typically spawn and rear in low gradient tributaries and thus have a more restricted distribution within the planning area compared to steelhead and cutthroat trout, and, given the different geography, compared to coho salmon in coastal basins to the north. Coho salmon generally spend one year in freshwater prior to their spring smolt migration to the ocean, and estuary rearing is likely limited in populations covered by this plan. Coho salmon typically mature after two summers of ocean rearing, but a proportion of males mature after one summer at sea and return to freshwater to spawn as jacks (**Table 1**).

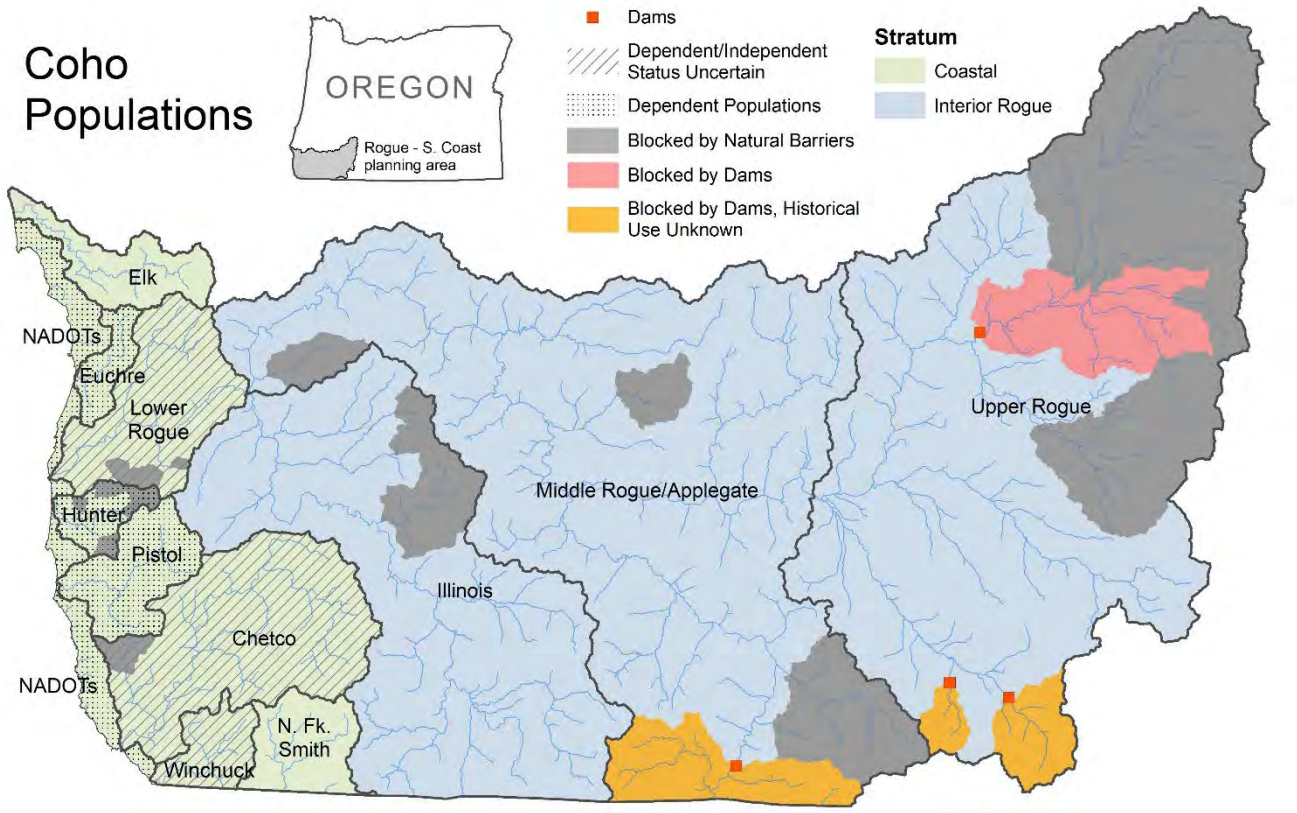


Figure 4. Location of coho salmon populations in the Rogue–South Coast SMU. See Table 2 for additional details about population designations.

Coho salmon populations in the Rogue–South Coast SMU are part of the Southern Oregon/Northern California Coast (SONCC) coho salmon Evolutionarily Significant Unit (ESU), which also extends into California (see **Appendix I – Additional Background Information**). SONCC coho salmon were listed as Threatened under the federal ESA in 1997 and remain so currently. Population and strata designations in this plan generally follow those in the SONCC Final Recovery Plan (NMFS 2014). However, the status of several populations in the Coastal Stratum as functionally or potentially independent remains uncertain (**Table 2**). Coho salmon population designations in this plan follow NMFS (2014) by placing the Lower Rogue population in the Coastal Stratum (**Figure 4**). In contrast,

Lower Rogue populations of winter steelhead and cutthroat are placed in the Rogue Stratum, consistent with the *Rogue Fall Chinook Salmon Conservation Plan* (ODFW 2013). Additional research is needed to determine whether coho salmon and other salmonid species in the Lower Rogue are more similar to interior Rogue populations or neighboring Coastal Stratum populations. Populations identified in this plan for the Interior Rogue Stratum are consistent with the Rogue SMU in the ONFSR. The SMU has been recognized as a Sensitive Species by the state of Oregon since 1990 (ODFW 1995).

Coastal Cutthroat Trout

Coastal cutthroat trout are the most widely distributed salmonid in the planning area (**Figure 5**). Cutthroat trout occur in areas accessible to anadromous fish, as well as in many areas upstream from natural or artificial barriers. Cutthroat trout generally spawn in very small streams, but exhibit diverse life-history strategies for rearing. Many cutthroat trout remain in small to medium-size streams throughout their life, while others undergo seasonal migrations to larger rivers. Sea-run cutthroat typically rear in freshwater for at least two years before making a spring migration to the estuary or ocean, where they reside for several months before returning to freshwater (**Table 1**). Population structure for cutthroat trout in the SMU is complex, with many small, isolated populations in addition to larger populations with more genetic exchange. For management consistency, population delineations in this plan are the same as for winter steelhead. Cutthroat populations identified in this plan are very similar to those in the ONFSR except for differences in population boundaries for the Middle Rogue, Applegate, and Upper Rogue.

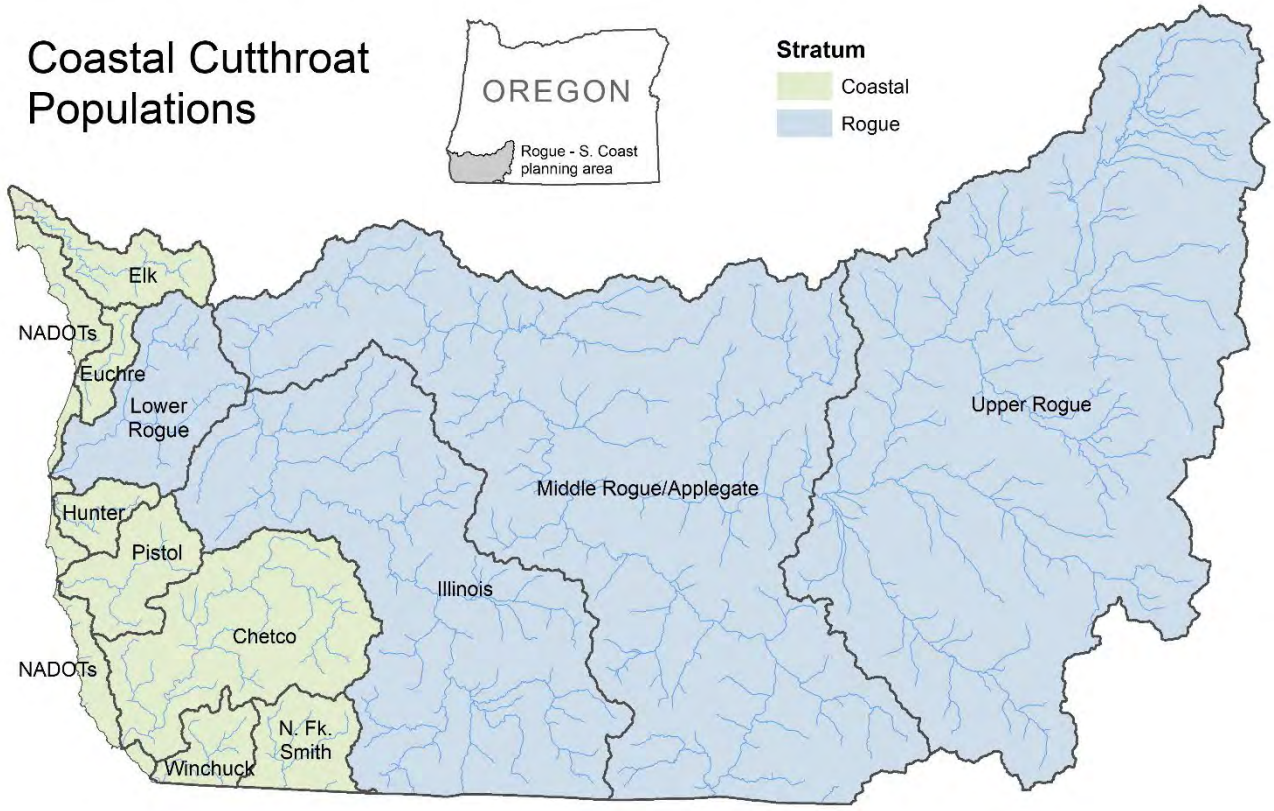


Figure 5. Location of coastal cutthroat trout populations in the Rogue–South Coast SMU.

Table 1. Summary of life history characteristics for RSP species.

	Winter Steelhead	Summer Steelhead	Coho Salmon	Coastal Cutthroat Trout
Freshwater Rearing Period	1–3 years (occasionally 4 yrs)	1–3 years	1 year (occasionally 2 yrs)	2+ years
Estuary Rearing	Very Limited	Very Limited	Limited	Limited – Extensive
Smolt Season	Spring	Spring	Spring	Spring
Return Season	Nov – Apr	Apr – Oct	Sep – Jan	Jul – Dec
Spawning Season	Dec – May	Dec – Feb	Nov – Jan	Jan – Mar
Ocean Distribution	Nearshore Northern CA – OR; Offshore Poorly Documented	Nearshore Northern CA – OR; Offshore Poorly Documented	Northern CA – OR	Nearshore Northern CA – OR
Typical Age at Maturity	3 –5 years	3–5 years	3 years (2 years for jacks)	2–3 years
Ocean Rearing Duration	1–3 years	1–3 years	6 months (jacks) – 18 months (adults)	< 1 year
Current vs. Historical Distribution	Presumed Similar	Presumed Similar	Presumed Similar	Presumed Very Similar

Other Salmonid Species

Fall Chinook

Fall Chinook salmon in the Rogue SMU are managed according to the *Rogue Fall Chinook Salmon Conservation Plan* adopted by the Oregon Fish and Wildlife Commission (OFWC) in 2013. The Rogue Fall Chinook SMU includes populations in the Rogue Basin and coastal basins from Euchre Creek south to the Winchuck River. The Elk River fall Chinook population appears to be more genetically similar to coastal populations to the north, and so is managed as part of the Coastal SMU under the *Coastal Multi-Species Conservation and Management Plan* (CMP). Detailed information about fall Chinook salmon in the planning area can be found in the *Rogue Fall Chinook Salmon Conservation Plan* and the CMP. Management actions in the RSP have been crafted to complement those in the CMP and *Rogue Fall Chinook Salmon Conservation Plan*.

Spring Chinook

Similar to fall Chinook salmon, spring Chinook salmon in the Rogue SMU are managed under their own conservation plan. The *Rogue Spring Chinook Salmon Conservation Plan* was adopted by the OFWC in 2007 and updated in 2019 with the *Rogue Spring Chinook Salmon Conservation Plan Comprehensive Assessment and Update*. Management actions in this plan are designed to complement those in the *Rogue Spring Chinook Salmon Conservation Plan*.

Chum Salmon

Adult chum salmon are occasionally observed in several basins in the RSP planning area, including the Elk River, lower Rogue River, and Chetco River. Chum salmon are always encountered in very small numbers and there is no indication of self-sustaining populations in any of the RSP basins. Although the planning area falls within the historical range of chum salmon (Johnson et al. 1997), we lack information about historical population size or structure. The CMP (ODFW 2014) identifies coastal chum salmon population structure as a critical uncertainty to address through genetic research. That research has been initiated and will attempt to incorporate samples from chum salmon in the RSP area, if available, to investigate genetic affinities to other coastal populations in Oregon. As uncertainties are investigated, ODFW will continue to document chum salmon presence in RSP basins and implement management actions in the RSP and *Rogue Fall Chinook Salmon Conservation Plan* (ODFW 2013) that protect and restore spawning and rearing habitats potentially used by chum salmon. Available historical information and current chum salmon presence does not warrant designation of a separate Rogue–South Coast Chum Salmon SMU, and chum salmon will be managed as a single Coastal SMU under the CMP unless research results indicate otherwise.

Populations

The NFCP states that the Department shall manage for sustainability of naturally produced native fish at the level of the species management unit (SMU), incorporating the importance of population structure within each species management unit and basing sustainability standards on biological attributes directly related to species performance. The NFCP effectively establishes the "population" as the fundamental management scale for assessing and managing anadromous salmonid species because "locally adapted populations provide the best foundation for maintaining and restoring sustainable naturally produced native fish" (OAR 635-007-0505(2)). In concept, each population represents a largely discrete reproductive unit, but genetic data indicating these units has not been systematically collected. Therefore, the population designations in the RSP represent a combination of scientific rationale, management pragmatism, and traditional thinking. Some currently defined population units possibly include several distinct reproductive units (e.g., winter steelhead and cutthroat) and some currently defined population units may actually be subsets of a single larger reproductive unit (e.g., coho salmon populations in the Rogue Basin). Regardless, these population designations are used throughout this plan and its implementation period absent new information that warrants modification. As noted above, some of these population designations are updates of those identified in ODFW's ONFSR (ODFW 2005).

Table 2. Populations within the Rogue–South Coast *winter steelhead, summer steelhead, coho salmon and coastal cutthroat trout* SMUs. "yes" indicates an independent population that was assessed for viability. "---" indicates that a population is not present.

Stratum	Basin/Population Area	Winter Steelhead	Summer Steelhead	Coho Salmon	Cutthroat Trout
Coastal	Elk	yes	---	yes	yes
	Euchre	yes	---	see below [a]	yes
	Hunter	yes	---	see below [a]	yes
	Pistol	yes	---	see below [a]	yes
	Chetco	yes	---	see below [b]	yes
	Winchuck	yes	---	see below [b]	yes
	North Fork Smith	see below [c]	---	see below [c]	see below [c]
Rogue	Lower Rogue	yes	---	see below [b]	yes
	Illinois	yes	---	yes	yes
	Middle Rogue/ Applegate	yes	yes	yes	yes
	Upper Rogue	yes	yes	yes	yes

[a] These populations are considered dependent (Hunter and Pistol) or ephemeral (Euchre) in the *Final Recovery Plan for the SONCC Evolutionarily Significant Unit of Coho Salmon* (NMFS 2014).

[b] These populations are considered functionally independent (Chetco) or potentially independent (Lower Rogue and Winchuck) by NMFS (2014), but were not assessed for viability in this plan due to uncertainty about their current and historical status as independent or dependent populations. Note that the Lower Rogue population is placed in the Northern Coastal Diversity Stratum by NMFS (2014), separate from Interior Rogue populations.

[c] The RSP planning area includes the Oregon portion of the North Fork Smith River, which supports winter steelhead, coho salmon, and coastal cutthroat trout. However, most of the Smith River Basin (the appropriate scale for assessment of these populations) is located in California, so they were not included in our assessment.

Other Direct Ocean Tributaries

In addition to those basins in which populations have been identified, there are numerous other small coastal direct ocean tributaries which support plan species. These are identified in **Appendix I – Additional Background Information**. For convenience, all of these locations are collectively referred to as "NADOTs" (Non-Assessed Direct Ocean Tributaries).

Other Management Scales

Even though the population is the primary management scale called for in the NFCP, limitations in scientific information, the ability to monitor, and the ability to affect actions, as well as other management needs, require other management scales to be considered. SMUs were described earlier and constitute the largest scale and basis for the RSP. Another scale, the Stratum, consists of groupings of different populations; this scale is used for status assessment purposes, harvest management decisions, and monitoring. Many populations are also sub-divided into Management Areas, usually corresponding to distinct tributaries within a larger basin, for the purpose of making hatchery and harvest management decisions, and associated monitoring needs, at a finer scale than the populations. Finally, habitat guidance is framed in a non-species-specific approach at the Watershed scale, which includes smaller drainages within a population or management unit.

Current Status

Status Assessment Approach

Populations, strata, and SMUs of winter steelhead, summer steelhead, coho salmon, and cutthroat trout in the planning area are the biological units of this status evaluation. SMUs are divided into two strata, Rogue and Coastal, composed of multiple populations linked by geographic proximity and similarity. The rationale for population and stratum delineation for the four SMUs addressed in this plan is described above.

We assessed populations and strata based on measurable criteria that define viability relative to four biological Viable Salmonid Population (VSP) parameters. The VSP parameters are abundance, productivity, spatial structure, and diversity (McElhany et al. 2000). Populations are the basic unit of status assessment, and ideally form the building block on which to assess the viability of strata and SMUs. ODFW evaluated all known data sources that could contribute to a quantitative analysis of current status relative to VSP parameters. A robust evaluation of these parameters requires data of a reasonable accuracy and precision collected at an appropriate spatial scale. Ideally, data sources are as current as possible while also covering an adequate time series to capture the natural range of variation expressed by populations. Data sets that met these criteria are described in **Appendix III – Current Status Methods and Results**.

For each independent population, the status assessment determined a viability risk score based on measurable criteria that inform viability relative to the four VSP parameters. ODFW assessed the four VSP parameters as available data and information allowed. If data represented multiple populations, the score was applied to each population. Each parameter's risk relative to the population's long-term viability was assessed on a scale of 1 to 5 to combine the parameters into a single risk score for the population. Criteria were developed for the score (or scores) in each parameter, with 1 representing very low risk (i.e., high persistence) and 5 representing very high risk (i.e., low persistence). Given that the abundance and productivity parameters are often interrelated and difficult to separate as independent variables in their effect on a population's viability, ODFW evaluated and scored these parameters as a single abundance and productivity parameter (A&P).

When combining the four VSP parameters into a single score, the A&P parameter was weighted more heavily than the spatial structure (SS) and diversity (D) scores given that this parameter was generally the most direct quantitative evaluation of a population. The four VSP parameters were combined into a single score as the *greater* of the following (ODFW 2010; ODFW 2014):

$$2/3*A\&P + 1/6*SS + 1/6*D \textbf{ or } A\&P$$

In some populations, A&P data were unavailable. In these cases, the SS and D scores were simply averaged for the overall viability score.

Population scores were rolled up into a categorical viability risk for each stratum. The stratum categorical viability risk was based on the average of population viability risk scores using the following criteria:

Very Low Risk: average risk score < 1.5
Low Risk: 1.5 ≤ average risk score < 2.5
Moderate Risk: 2.5 ≤ average risk score < 3.5
High Risk: 3.5 ≤ average risk score < 4.5
Very High Risk: average risk score ≥ 4.5

SMU Status

The overall SMU conservation status designation was based on the viability risk category of all strata in the SMU, population risk scores, confidence in the assessment results based on trend risk scores and VSP data completeness, and other risk factors (**Table 3**). Trend risk scores were evaluated in the context of other viability indicators and the inherent sensitivity of trend analysis to the particular window of time being considered. Note that SMU status categories include designations associated with the state Threatened and Endangered List (OAR 635-100-0080 to 0160) and Sensitive Species List (OAR 635-100-0040). These long-term risk categories differ from those used in the ONFSR (ODFW 2005), which were for an interim, short-term risk assessment.

Table 3. SMU Status Categories, based on viability risk category, confidence in results, and other risk factors.

		SMU Status Categories					
Considerations		Strong	Strong – Guarded	Sensitive	Sensitive – Critical	Threatened [a]	Endangered [a]
1) Viability Risk	Strata	All Low or Very Low Risk	All Low or Very Low Risk	Most Low Risk	Most Moderate Risk	Most High Risk	All High or Very High Risk
	Population	Most with Risk Score < 2	Most with Risk Score ≤ 2	Most with Risk Score < 3	Most with Risk Score ≤ 3	Most with Risk Score > 3	Most with Risk Score ≥ 4
2) Assessment Confidence	Abundance Trend	All with Risk Score ≤ 2	Varies	Varies	Varies	Varies	Varies
	VSP Data Completeness	High	Low to Medium	Varies	Varies	Varies	High
3) Other Risk Factors		Not Applicable	Naturally Limited Range, Small Historical Population Size, etc.				

[a] This designation is for State of Oregon purposes and does not imply or promote an association or consistency with status determinations under the federal ESA.

Strong SMUs are widely distributed, have little if any viability concerns across populations, and high confidence in the status assessment. The management approach for these SMUs allows for providing societal benefits and fisheries in a manner consistent with long-term viability.

Strong-Guarded SMUs are widely distributed and have little if any viability concerns across populations. However, either a lack of robust data relative to all VSP parameters or conflicting indications of viability warrant a cautious management approach when providing societal benefits and fisheries, especially with respect to potential threats and limiting factors.

Sensitive SMUs have little if any viability concerns across populations but are naturally limited in their range within the planning area and/or have a moderate level of immediate threats that may affect viability in the future. Assessment confidence for these SMUs varies. A cautious management approach when providing societal benefits and fisheries, especially with respect to potential threats and limiting factors is warranted. Additionally, pro-active management of existing threats and limiting factors is warranted.

Sensitive-Critical SMUs are characterized by moderate to high viability risk for most populations and strata. Assessment confidence for these SMUs varies. Pro-active management of threats and limiting factors is warranted.

Threatened[7] SMUs are not considered viable into the future, although individual populations may be viable and many may be able to persist in the near term, especially with pro-active management of threats and limiting factors. Assessment confidence for these SMUs varies.

Endangered[8] SMUs are not considered viable into the future and few, if any, populations will be able to persist without prompt pro-active management of threats and limiting factors. Assessment confidence for these SMUs varies.

SMU Results

Table 4 provides a summary of VSP parameter risk scoring, indicators of assessment confidence, and the overall current status for each SMU. See **Appendix III – Current Status Methods and Results** for additional details about abundance and productivity, spatial structure, and diversity viability assessment.

Winter Steelhead: Strong-Guarded

Available VSP metrics indicated low or very low viability risk for winter steelhead populations. PVA results for the Upper Rogue winter steelhead population indicated a 100-year persistence probability greater than 98%. Juvenile steelhead density in the SMU was comparable to or higher than density in the Coastal SMU, where steelhead are considered viable (ODFW 2014). Spatial structure metrics indicated that juvenile steelhead have a broad distribution and high probability of occurrence throughout the SMU. Although viability risk appears to be low, incomplete VSP data and negative trends in juvenile steelhead abundance increased uncertainty about assessment results and resulted in “Strong-Guarded” status for the SMU.

[7] This designation is for State of Oregon purposes and does not imply or promote an association or consistency with status determinations under the federal ESA.
[8] This designation is for State of Oregon purposes and does not imply or promote an association or consistency with status determinations under the federal ESA.

Summer Steelhead: Sensitive

Limited VSP data were available for the two populations of summer steelhead, but what was available indicated a low risk. Trend analysis for late-run summer steelhead at Huntley Park indicated risk, but returns have increased in recent years and the steelhead half-pounder abundance trend indicated low risk. Given the naturally limited range, incomplete VSP data for the SMU, and habitat that is disproportionately at risk, the existing "Sensitive" status was maintained.

Coho Salmon: Sensitive-Critical

Abundance and productivity were assessed for interior Rogue populations in aggregate, and PVA results indicated a 100-year persistence probability slightly below 95%. Juvenile coho salmon rearing density was low in both strata compared to density in the neighboring Coastal SMU. Spatial structure metrics indicated a patchy distribution with low probability of occurrence in most streams, and this spatial structure appeared to be relatively stable over time in the interior Rogue. In Elk River, spawning survey data indicated a relatively stable abundance trend despite the low number of spawners. The SMU's "Sensitive-Critical" status reflects moderate viability risk for Rogue populations, higher viability risk for the one assessed population in the Coastal Stratum, mixed trend results, interior Rogue abundance better than the post-1940s nadir, and a lack of population-specific VSP data.

Coastal Cutthroat Trout: Strong-Guarded

Available VSP data indicated low or very low viability risk for all populations. Cutthroat trout density in the SMU was comparable to or higher than density in neighboring SMUs, and abundance trends indicated very low risk in both strata. Spatial structure metrics indicated that cutthroat trout have a broad distribution and moderate to high probability of occurrence throughout the SMU. Although viability risk appears to be low, incomplete VSP data resulted in "Strong-Guarded" status for the SMU.

Table 4. Summary of assessment results and overall status of SMUs. See *Appendix III – Current Status Methods and Results* for additional details.

			Viable Salmonid Population (VSP) Parameter Assessment								**Viability Risk**		Indicators of Confidence in Viability Results					**CURRENT STATUS**
			Abundance & Productivity			Spatial Structure			Diversity				Trend Risk Scores					
SMU	Stratum	Population	100-year Extinction Risk	Juvenile Rearing Density	*A&P Score*	% Historic Distribution Score	Probability of Occurrence	*SS Score*	Life History Loss Score	*Diversity Score*	**Population Scores**	**Stratum Risk Category**	Adult Abundance	Half-Pounder Abundance	Juvenile Abundance	Spatial Structure	VSP Data Completeness	
WINTER STEELHEAD	Coastal	Elk	-	1	*1.0*	1	1	*1.0*	1	*1.0*	**1.0**	**Very Low**	-	-	5	-	Low	**Strong-Guarded**
		Euchre			*1.0*	1	1	*1.0*	1	*1.0*	**1.0**							
		Hunter			*1.0*	1	1	*1.0*	1	*1.0*	**1.0**							
		Pistol			*1.0*	1	1	*1.0*	1	*1.0*	**1.0**							
		Chetco			*1.0*	1	1	*1.0*	1	*1.0*	**1.0**							
		Winchuck			*1.0*	1	1	*1.0*	1	*1.0*	**1.0**							
	Rogue	Lower Rogue	-	2	*2.0*	1	1	*1.0*	1	*1.0*	**2.0**	**Low**	-	1	5	1	Medium	
		Illinois			*2.0*	1	1	*1.0*	1	*1.0*	**2.0**							
		Middle Rogue/Applegate			*2.0*	1	2	*1.5*	1	*1.0*	**2.0**							
		Upper Rogue	2		*2.0*	2	2	*2.0*	2	*2.0*	**2.0**		2					
SUMMER STEELHEAD	Rogue	Middle Rogue/Applegate	-	-	-	1	-	*1.0*	2	*2.0*	**1.5**	**Low**	4	1	-	-	Very Low	**Sensitive**
		Upper Rogue			-	2		*2.0*	2	*2.0*	**2.0**							
COHO SALMON	Coastal	Elk	-	4	*4.0*	1	4	*2.5*	2	*2.0*	**4.0**	**High**	1	-	-	-	Low	**Sensitive-Critical**
	Interior Rogue	Illinois	3	3	*3.0*	1	4	*2.5*	2	*2.0*	**3.0**	**Moderate**	3	-	5	1	Low	
		Middle Rogue/Applegate			*3.0*	1	3	*2.0*	2	*2.0*	**3.0**							
		Upper Rogue			*3.0*	2	3	*2.5*	2	*2.0*	**3.0**							
CUTTHROAT TROUT	Coastal	Elk	-	1	*1.0*	1	2	*1.5*	2	*2.0*	**1.3**	**Very Low**	-	-	1	-	Low	**Strong-Guarded**
		Euchre			*1.0*	1	2	*1.5*	2	*2.0*	**1.3**							
		Hunter			*1.0*	1	2	*1.5*	2	*2.0*	**1.3**							
		Pistol			*1.0*	1	2	*1.5*	2	*2.0*	**1.3**							
		Chetco			*1.0*	1	2	*1.5*	2	*2.0*	**1.3**							
		Winchuck			*1.0*	1	1	*1.0*	2	*2.0*	**1.2**							
	Rogue	Lower Rogue	-	1	*1.0*	1	2	*1.5*	2	*2.0*	**1.3**	**Very Low**	-	-	1	1	Low	
		Illinois			*1.0*	1	2	*1.5*	2	*2.0*	**1.3**							
		Middle Rogue/Applegate			*1.0*	1	2	*1.5*	2	*2.0*	**1.3**							
		Upper Rogue			*1.0*	1	2	*1.5*	2	*2.0*	**1.3**							

Note: ODFW did not assess viability of coho salmon in the Lower Rogue, Chetco, or Winchuck population areas due to uncertainty about their current and historical status as independent or dependent populations. These populations may be assessed in the future as part of the Coastal Stratum pending results of research proposed in this plan.

Risk to Future Viability of Plan Populations from Climate and Ocean Change

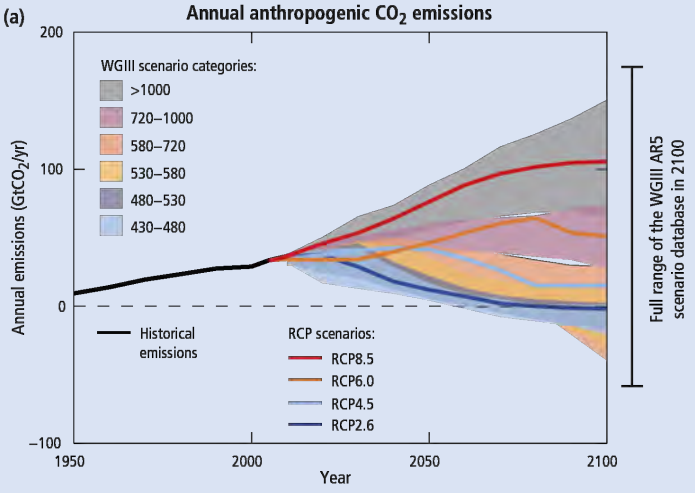
Background

According to the Intergovernmental Panel on Climate Change (IPCC), records spanning up to several thousand years demonstrate that warming of the global climate system and warming and acidification of the ocean are occurring, and that the rate of change since the 1950s is unprecedented (IPCC 2014). The majority of the observed increase in global average temperature since the mid-20th century cannot be explained by natural variability in climate, and is "extremely likely" (defined by the IPCC as 95 percent or higher probability) to be a result of the observed increase in greenhouse gas (GHG) concentrations in the atmosphere as a result of human activities, particularly carbon dioxide emissions from use of fossil fuels (IPCC 2014). These changes are having both direct and indirect effects on fish and fish habitat. Effects are expected to be largely negative for the cold-water salmonids, such as those covered in this plan, though they are not occurring in a uniform manner across the landscape. Some habitats are expected to be more resilient than others due to a combination of factors, including geology, topography/bathymetry, and human alteration. Given this spatial variation in impacts, it will be important to identify the most resilient and vulnerable habitats to help guide actions by ODFW and its partners around habitat protection, restoration, and enhancement.

Projecting Future Changes

The rate and magnitude of future changes will largely be driven by the trajectory for cumulative global emissions of CO_2 and methane. Projections of greenhouse gas (GHG) emissions vary over a wide range depending on assumptions made about socio-economic development and climate policy. Climate scientists have developed four different 21st century pathways (called Representative Concentration Pathways-RCPs) of GHG emissions and atmospheric concentrations to serve as inputs to climate models (see Box 1).

These RCP scenarios are used in climate models to project future changes in temperature and other climate conditions (e.g., Ganguly et al. 2009; van Vuuren et al. 2014). All combinations of models and emissions scenarios yield very similar projections of increases (in the range 0.54°F to 1.26°F) in the most common measure of climate change, average global surface temperature, until about 2035. After 2035, model projections diverge depending on initial assumptions about greenhouse gas emissions (Kirtman et al. 2013 [see Box 1]). Although



BOX 1. RCP scenarios used in climate modeling. The RCPs include a stringent mitigation scenario (RCP2.6), two intermediate scenarios (RCP4.5 and RCP6.0) and one scenario with very high GHG emissions (RCP8.5). Scenarios without additional efforts to constrain emissions ('baseline scenarios') lead to pathways ranging between RCP6.0 and RCP8.5. RCP2.6 is representative of a scenario that aims to keep global warming likely below 2°C.

projections of the magnitude and rate of warming differ after about 2035, the overall trajectory of all the projections is one of increased global warming through the end of this century, even for the projections based on scenarios that assume that GHG emissions will stabilize or decline (**Figure 6**). Thus, there is strong scientific support for projections that warming will continue through the 21st century, and that the magnitude and rate of change will be influenced substantially by the amount of GHG emissions (IPCC 2014).

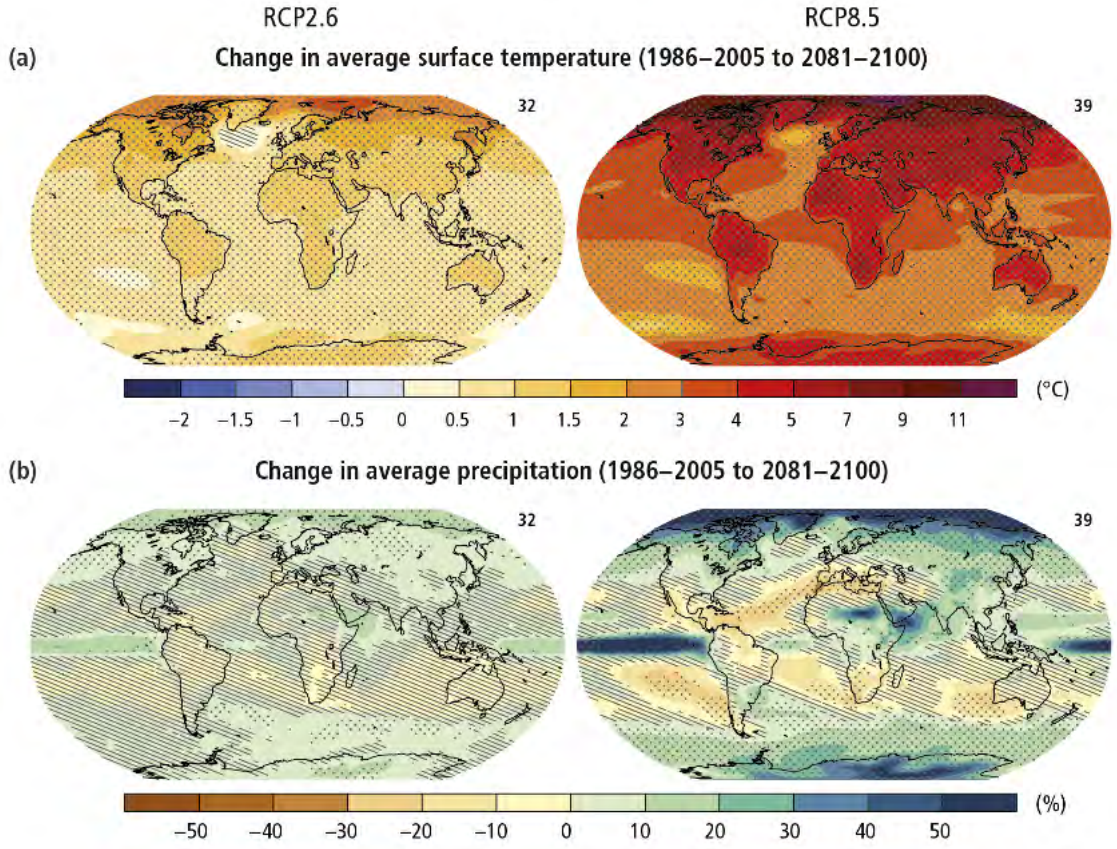


Figure 6. Projected global changes in average surface temperature (a) and precipitation (b) under RCP2.6 and RCP8.5.

According to the IPCC, warming will also continue beyond 2100 under all RCP scenarios except RCP2.6. Surface temperatures will remain approximately constant at elevated levels for many centuries after a complete cessation of net anthropogenic CO_2 emissions. A large fraction of anthropogenic climate change resulting from CO_2 emissions is irreversible on a multi-century to millennial timescale, except in the case of a large net removal of CO_2 from the atmosphere over a sustained period. There is also high confidence that ocean acidification will increase for centuries if CO_2 emissions continue.

Impacts of Climate Change and Ocean Acidification in the Rogue–South Coast Region

The increases in global mean air and ocean temperature and ocean acidification will continue to drive secondary changes in climate and ocean in the Pacific Northwest (Mote et al. 2019; Halofsky et al. 2020; Dalton and Fleishman 2021), and thereby have a significant impact on local fish communities.

The following section outlines the changes that are expected to occur in the geographic area covered by the plan, based on currently available science.

For the purposes of our analyses, we focused on the RCP8.5 scenario for the time period 2070–99, which represents a high level of emissions, similar to the current trajectory. This scenario captures the most likely changes that will occur by the end of this century in the absence of global action to reduce GHG emissions and is a useful guide for planning (Schwalm et al. 2020). This is the equivalent of planning for a worst-case scenario for Oregon to achieve the best outcome for the native fish and wildlife of Oregon during the latter part of the century.

Metrics of interest

The health of plan species is linked to several climate metrics that are projected to change further during the next century (**Table 5**). In freshwater, the plan species are most directly influenced by water quality (*stream temperature*) and quantity (*flow volume and timing*) during the freshwater life history phases. These factors are, in turn, influenced by the pattern of *precipitation* (rain/snow timing, drought), which is in turn influenced by *air temperatures*. In the ocean, the marine survival of plan species, particularly at ocean entry, is closely linked to the occurrence and intensity of *upwelling* which drives the input and retention of cold, nutrient-rich waters to the euphotic zone. This, in turn increases primary productivity resulting in a lipid-rich food-web (Wells et al. 2016). Marine survival is also generally correlated across the Pacific NW with patterns of *sea surface temperature* (SST) and large-scale climate indices such as the Pacific Decadal Oscillation, North Pacific Gyre Oscillation, and various El Niño-Southern Oscillation indices (Mantua et al. 1997; Kilduff et al. 2015).

Additionally, ocean pH levels have been declining as a result of uptake of CO_2 from the atmosphere. Locally, the California Current Large Marine Ecosystem (CCLME) is experiencing greater *ocean acidification* because of the combination of upwelling currents that transport dissolved inorganic carbon rich water from the deep ocean and high productivity of the shelf that increases potential for remineralization (Chan et al. 2017). Within the CCLME, the nearshore region (<10 km from shore) is most strongly affected by current, and likely future, acidification resulting in reduced abundance and increased corrosion in the shells of calcifying organisms (Feely et al. 2016). The direct impacts of pH have been shown for many taxa in the CCLME (Busch and McElhany 2016), including salmon (Williams et al. 2019). There is considerable uncertainty in projecting these impacts at present, but we include an analysis of *ocean acidification* projections because this factor has potential to reshape food webs in ways that may be disadvantageous for plan species.

Table 5. Summary of expected changes in climate metrics. See *Appendix IV – Climate and Ocean Change Assessment* for additional details.

Metric	Expected changes	References
Freshwater		
Air Temperature: Summer	By 2070, summer air temperatures projected to be 5–13°F warmer than 1971–2000 average, depending on location and elevation; doubling of "hot days" (days with daily high temperatures >86 ºF)	Halofsky et al. 2020; Mote et al. 2019
Air Temperature: Winter	By 2070, winter air temperatures projected to be 5–7 °F warmer regionally	Halofsky et al. 2020
Precipitation: Rain	Overall, similar to 1970–1999 baseline or slight increase due to higher average winter precipitation; slight decrease (4%) for spring and fall, and larger decrease in summer (4–20%)	Halofsky et al. 2020
Precipitation: Snow	Transient snowpack at mid-elevations largely eliminated by the 2080s; in high Cascades, average residence time of snow projected to decrease by 6–8 weeks; 11–50% reduction in April 1 Snow Water Equivalents	Halofsky et al. 2020
Extreme Storm Events	20% increase in the frequency of atmospheric river events by 2080 relative to 1970–99 baseline; 10% increase in extreme precipitation events in winter in Western Oregon by mid-century	Warner et al. 2015; Mote et al. 2019
Drought	Increased spatial extent of the area experiencing drought in summer; 40–50% chance of experiencing an 11-year drought and 20–50% chance of experiencing a 35-year plus mega-drought in the coming century	Ault et al. 2014; Ahmadalipour et al. 2017
Summer Stream Flow	Impact varies due to influence of snowpack, rainfall, and geology; some locations projected to see significant decreases in summer and fall stream flows by 2080, others will be minimally impacted	Asarian and Walker 2016; Halofsky et al. 2020
Streamflow Permanence	Spatial and temporal extent of stream drying will increase as a result of changes in average conditions (e.g., mean snowpack) and increasing frequency and severity of drought	Jaeger et al. 2019
Stream Temperature	Increase in many locations as a result of direct (e.g. increasing air temperature) and indirect (e.g. fire) climate change impacts; 11% increase in extent of streams with August temperatures >20°C/68°F by 2080	Isaak et al. 2017
Marine		
Ocean Acidification	Surface pH in offshore areas expected to decrease in pH by 0.24–0.32 units by the end of the century; nearshore impacts may be greater and plan species will likely experience considerable heterogeneity in pH	Chan et al. 2017
Upwelling	Upwelling in northern California Current projected to become more intense in the spring and less intense in the summer; changes will emerge primarily late in the second half of the century	Rykaczewski et al. 2015; Brady et al. 2017
Sea Surface Temperature	Annual average sea surface temperature projected to increase by 4.3–6.5°F by the end of century in the northeast Pacific; marine heatwaves projected to increase in frequency, duration, extent, and intensity	IPCC 2019

Climate and Ocean Change Assessment

Given the expected changes outlined in the previous section, we assessed the risk to long term viability of plan populations using two different approaches. First, we conducted a Climate Vulnerability Assessment for all independent populations using a framework developed by Crozier et al. (2019) and modified for this region. The assessment evaluated the sensitivity, adaptive capacity, and exposure of plan populations to climate and ocean change using an expert panel approach. Vulnerability in this context is a product of exposure and sensitivity to climate change effects (see **Appendix IV – Climate and Ocean Change Assessment**). Adaptive capacity is "the potential for behavioral, physiological, or other adaptive response to ameliorate climate stress" (Crozier et al. 2019). Populations with high vulnerability and low adaptive capacity face the highest risk to viability from climate change effects. Second, for winter steelhead populations we used existing data to develop a distribution-abundance model with spatial and temporal covariates to predict changes in juvenile rearing abundance under a potential climate change scenario. See **Appendix IV – Climate and Ocean Change Assessment** for details on the climate vulnerability analysis and juvenile distribution-abundance modeling.

Results of the Climate Vulnerability Assessment and juvenile distribution-abundance analysis are summarized in **Table 6** below. Based on these results, we qualitatively estimated the risk to end of century viability as a result of climate and ocean change (climate and ocean change risk) for each population and strata *in the absence of management actions* using a precautionary approach that assumed the worst categorical score from the two analyses described above (**Table 6**).

Our categorization of risk suggests that coho salmon populations, particularly interior Rogue populations, face the highest risk to viability as a result of climate and ocean change among SMUs covered by this plan. The risk to coho salmon is driven by moderate to high vulnerability and relatively low adaptive capacity. There is moderate risk for most winter and summer steelhead populations and strata. The expert panel generally believed that steelhead populations had lower vulnerability and higher adaptive capacity than coho salmon. Finally, cutthroat trout populations generally had the lowest risk to viability as a result of climate and ocean change among SMUs covered by this plan. Life history diversity of cutthroat trout, including their capacity to complete their life cycle in freshwater, contributes to low vulnerability and high adaptive capacity for these populations.

Table 6. Summary table showing Current SMU Status; results of the Climate Vulnerability Assessment and Juvenile Distribution-Abundance Analysis; and a final Climate and Ocean Change Risk designation for each population and stratum.

SMU	Stratum	Population	Current SMU Status	Climate and Ocean Change Assessment			Climate and Ocean Change Risk	
				Climate Vulnerability Assessment		Juvenile Distribution-Abundance Analysis [a]	Population	Stratum
				Vulnerability	Adaptive Capacity			
WINTER STEELHEAD	Coastal	Elk	**Strong-Guarded**	Low	Moderate	Low	Low	Moderate
		Euchre		Low	Moderate	Moderate	Moderate	
		Hunter		Low	Moderate	Moderate	Moderate	
		Pistol		Low	Moderate	Moderate	Moderate	
		Chetco		Low	Moderate	Moderate	Moderate	
		Winchuck		Low	Moderate	Moderate	Moderate	
	Rogue	Lower Rogue		Low	Moderate	Moderate	Moderate	Moderate
		Illinois		Low	Moderate	Moderate	Moderate	
		M Rogue/Applegate		Low	Moderate	Low	Low	
		Upper Rogue		Low	Moderate	Low	Low	
SUMMER STEELHEAD	Rogue	M Rogue/Applegate	**Sensitive**	Moderate	Moderate	-	Moderate	Moderate
		Upper Rogue		Moderate	Moderate	-	Moderate	
COHO SALMON	Coastal	Elk	**Sensitive-Critical**	Moderate	Moderate	-	Moderate	Moderate
	Interior Rogue	Illinois		Moderate	Low	-	Moderate	High
		M Rogue/Applegate		High	Low	-	High	
		Upper Rogue		Moderate	Low	-	Moderate	
CUTTHROAT TROUT	Coastal	Elk	**Strong-Guarded**	Low	High	-	Low	Low
		Euchre		Low	Moderate	-	Low	
		Hunter		Low	Moderate	-	Low	
		Pistol		Low	High	-	Low	
		Chetco		Low	High	-	Low	
		Winchuck		Low	Moderate	-	Low	
	Rogue	Lower Rogue		Low	High	-	Low	Low
		Illinois		Low	High	-	Low	
		M Rogue/Applegate		Low	Moderate	-	Low	
		Upper Rogue		Low	High	-	Low	

[a] Scores reflect risk due to a predicted decrease in abundance.

Using projections in this plan

Salmon and steelhead populations rise and fall over time in response to cyclical variation in numerous factors, including precipitation and ocean productivity. Overlaying these cyclical climate and oceanic patterns we are also observing a trend in several metrics that are linked to the quality of fish habitat, and expect this to continue for many decades even if greenhouse gas reduction efforts are successful. Consistent with direction in ODFW's Climate and Ocean Change Policy (OAR 635-900-0001), our understanding of the trajectory and spatial variability of likely changes in fish habitat (freshwater and marine), as well as the projected impact of these changes on species abundance and other parameters that affect viability (see **Table 6**), were used to inform desired status goals for SMUs (see **Desired Status**) and to develop the management strategies needed to achieve and maintain desired status.

The primary management strategy to minimize the longer-term impacts of climate and ocean change on plan species centers on the protection, restoration, and enhancement of key freshwater habitats. Adequate freshwater habitat helps ensure the expression of the full complement of life history diversity and sustains populations through cycles in ocean productivity. In this plan, climate change projections are used to inform expectations for the type and amount of habitat restoration and enhancement needed to improve resiliency within each population area, as well as identifying the areas needing most focus. Harvest and Hatchery Management Strategies also consider these projections in the context of ensuring that strategies are sufficiently proactive and protective of natural spawners and maintaining genetic and life history diversity. Achieving this during plan implementation will require an adaptive approach, as there is uncertainty in the timing and extent of impacts. Also, long-term negative trends can be moderated in the short term by naturally occurring climate cycles, such as El Niño-Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO), which occur on a shorter time scale. Given this, and the fact that the primary target species (salmon and steelhead) typically spawn only once, harvest management frameworks can be sustainably constructed to scale harvest according to near-term conditions of population health or environmental conditions, accounting for the life history needs discussed above (e.g., harvest is constrained when conditions are poor and/or when run size is low).

At a large scale, the projections for climate and ocean change suggest that both freshwater and ocean habitats will become less suitable for salmonids during the next 80 years. However, at the geographic scale of the populations within the plan, the impacts of climate and ocean change will not be uniform. Some locations/populations within the planning area and the ocean will experience less change than others and there will continue to be areas that meet the life history needs of plan species, though these areas will likely be smaller in size. Additionally, although the general trend is negative, shorter term climate cycles such as ENSO and PDO will result in conditions that are more favorable in the near term, though such conditions are likely to become less common towards the end of the century. It is also important to note that the level of expected impact increases after 2035 but with less agreement among the models. Additionally, many of the projected changes in the freshwater areas are lower in magnitude than those observed following alteration of habitat for human uses so *there is clear potential to mitigate against climate change with actions to restore or enhance habitat.*

Desired Status

Desired management outcomes for SMUs are driven both by the ODFW mission "*to protect and enhance Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations*" and the Native Fish Conservation Policy goals (OAR 635-007-0503) to:

1) *prevent the serious depletion of any native fish species* by protecting natural ecological communities, conserving genetic resources, managing consumptive and non-consumptive fisheries, and using hatcheries responsibly so that naturally produced native fish are sustainable,

2) maintain and restore naturally produced native fish species, taking full advantage of the productive capacity of natural habitats, in order to *provide substantial ecological, economic, and cultural benefits* to the citizens of Oregon, and

3*) foster and sustain opportunities for sport, commercial, and tribal fishers* consistent with the conservation of naturally produced native fish and responsible use of hatcheries.

As outlined in the NFCP, each conservation plan describes an SMU desired status that reflects the ecological, economic and cultural benefits to be sought from naturally produced fish. This is the outcome which management actions in the plan are trying to attain or maintain. The RSP identifies categorical desired status for SMUs (**Table 7**) and numerical desired status thresholds for populations or strata (**Table 8**). Desired status for a population or stratum is driven by desired status for the SMU, which could be improving categorical status or securing and strengthening status within the current category. Desired status for SMUs covered by the RSP are described below and summarized in **Table 7**. These resulted from considering current status, climate and ocean change risk, and other intrinsic factors (such as a naturally limited distribution) relative to achieving ODFW's mission and NFCP goals. Achieving desired status for populations, strata, and SMUs will reduce viability risk, increase resilience to climate change, and ensure strong, consistent fisheries.

In the RSP, desired status thresholds are set higher than current levels for <u>all</u> population- or strata-level abundance metrics in order to restore populations at risk and improve populations that are not at risk.

<u>SMU Desired Status</u>

Winter Steelhead

Desired status for the Rogue–South Coast Winter Steelhead SMU is to maintain the current *Strong-Guarded* classification (**Table 7**). Populations in this SMUs are expected to have moderate climate and ocean change risk in the future (**Table 6**) due to expected changes in freshwater and ocean environments. These climate effects will likely require significant action on limiting factors to maintain current SMU status. **Research and Monitoring Actions** called for in this plan will improve management confidence for this SMU, but a lack of complete VSP data for all populations contributed to the guarded status. Higher abundance goals identified in this plan (**Table 8**) for winter steelhead are believed to be achievable and would provide additional societal benefits from these SMUs.

Summer Steelhead

For the Rogue Summer Steelhead SMU, desired status is to maintain the current *Sensitive* classification (**Table 7**). This SMU is naturally more sensitive than the Rogue–South Coast Winter Steelhead SMU given its narrow distribution, unique habitat requirements, and life history. Given potential threats to habitat from development, and moderate climate and ocean change risk (**Table 6**), a cautious fishery management approach is needed for this SMU. Maintaining the current classification will require significant actions to improve resiliency, as reflected in the higher abundance goal identified in this plan (**Table 8**). Such improved resiliency and abundance is expected to provide additional societal benefits from the SMU, including increased fishing opportunity.

Coho Salmon

Desired status for the Rogue–South Coast Coho Salmon SMU is an improvement from *Sensitive-Critical* to *Sensitive* status (**Table 7**). Coho salmon have the highest climate and ocean change risk among SMUs covered by this plan (**Table 6**), and significant habitat enhancement will likely be needed to offset expected climate change impacts. Intrinsic factors that naturally limit coho salmon distribution and abundance in the SMU also contribute to their *Sensitive* status. Protection of existing habitat and restoration of other habitat to foster an increase in coho salmon distribution and abundance will be needed to achieve desired status for this SMU. Abundance targets for coho salmon identified in this plan (**Table 8**) are achievable and would contribute to recovery of the ESU. Higher coho salmon abundance will also provide societal benefits, including the possibility of increased fishing opportunity.

Cutthroat Trout

Desired status for the Rogue–South Coast Coastal Cutthroat Trout SMU is to maintain their current *Strong-Guarded* classification (**Table 7**). Cutthroat trout have the lowest climate and ocean change risk of the SMUs covered by this plan (**Table 6**), but will be impacted by expected changes in freshwater and ocean environments. However, the difficulty of collecting VSP data for cutthroat trout populations is the primary reason that the guarded status will be maintained. Higher abundance goals identified in this plan (**Table 8**) for cutthroat trout are believed to be achievable and would provide additional societal benefits from the SMU.

Table 7. Summary of strata Current Viability Risk, Current SMU Status, strata Climate Change Risk, and Desired SMU Status for Rogue–South Coast winter steelhead, summer steelhead, coho salmon, and coastal cutthroat trout SMUs. See Table 3 for a general description of the SMU status categories.

SMU	Stratum	Population	Current Viability Risk	Current SMU Status	Climate Change Risk	Desired SMU Status
WINTER STEELHEAD	Coastal	Elk	**Very Low**	**Strong-Guarded**	**Moderate**	**Strong-Guarded**
		Euchre				
		Hunter				
		Pistol				
		Chetco				
		Winchuck				
	Rogue	Lower Rogue	**Low**		**Moderate**	
		Illinois				
		M Rogue/Applegate				
		Upper Rogue				
SUMMER STEELHEAD	Rogue	M Rogue/Applegate	**Low**	**Sensitive**	**Moderate**	**Sensitive**
		Upper Rogue				
COHO SALMON	Coastal	Elk	**High**	**Sensitive-Critical**	**Moderate**	**Sensitive**
	Interior Rogue	Illinois	**Moderate**		**High**	
		M Rogue/Applegate				
		Upper Rogue				
CUTTHROAT TROUT	Coastal	Elk	**Very Low**	**Strong-Guarded**	**Low**	**Strong-Guarded**
		Euchre				
		Hunter				
		Pistol				
		Chetco				
		Winchuck				
	Rogue	Lower Rogue	**Very Low**		**Low**	
		Illinois				
		M Rogue/Applegate				
		Upper Rogue				

Numerical Status Metrics

As outlined in the NFCP, the RSP identifies current and desired status for SMUs covered by the plan. Desired status reflects the ecological, economic and cultural benefits to be sought from naturally produced fish. This is the goal which management actions in the plan are trying to attain or maintain. Specific, measurable criteria are also identified relative to meeting the SMU desired status—biological attributes of fish populations such as abundance or distribution. Measurable criteria are developed for primary and secondary biological attributes "depending upon available information". Measurable criteria indicating a significant deterioration in status ("conservation status" in this plan) are also identified. The following sections describe the measurable criteria available for RSP populations, how thresholds for status elements were determined, and how they will be applied. **Table 8** summarizes status metrics and thresholds for all SMUs covered by this plan and identifies additional status metrics that may be developed in the future based on new monitoring (see **Research and Monitoring Actions**).

Current/Observed Status

Current/Observed values report the recently observed performance of the population, in metrics that are directly relevant to metrics included in the desired status statement. This is our starting point. Current/Observed abundance is generally calculated as the 50th percentile of the log-normal distribution of the metric for the data period used in the current status assessment (see values in bold in **Table 8**). For the Elk River coho salmon population, mean adult spawner abundance for the data period was used. For spatial structure, current/observed values are average site occupancy for the data period used in the current status assessment (2002–2019). The most recent 5-year averages for all status metrics are also presented in **Table 8** (see values in parentheses).

Desired Status

Progress toward desired status will be evaluated based on a 5-year running average for each metric. For a given population or stratum to achieve desired status, the value of the metric must meet or exceed the threshold listed in **Table 8** on average over a 5-year period.

Abundance

Desired status for abundance is the mean future wild abundance goal which management actions in the RSP are trying to attain. Unless otherwise indicated, desired abundance is equivalent to the 75th percentile of the log-normal distribution of the metric for the data period used in the current status assessment, which is generally a 25–50% increase in the current/observed abundance for the same data period (**Table 8**). ODFW used a very similar approach to identify desired abundance in the CMP (ODFW 2014). Achieving desired abundance will strengthen populations, provide greater resiliency of the populations to future threats such as climate change, fluctuating ocean conditions, and development associated with human population growth or expansion, and provide consistent and improved fisheries.

Spatial Structure

Desired status for spatial structure is the mean future site occupancy percentage for juvenile steelhead or cutthroat trout in randomly selected snorkel surveys in the coastal stratum. Percent site occupancy is

determined using observed species presence in a site, but a species may be present in low numbers even when not observed by a surveyor. In addition, the sampling frame used to select random sites includes streams that may not have sufficient water or other habitat conditions to support juvenile rearing every year. Recognizing that observed site occupancy may not be 100% even when steelhead or cutthroat trout are utilizing all available habitat, desired status for spatial structure is 90% or greater site occupancy.

Conservation Status

Measurable criteria are needed as indicators of a significant deterioration in SMU status. Conservation status is a value below which long-term persistence becomes uncertain and life history diversity may be at risk. The level of risk is a function of the trend (rate of decline), length of time below this threshold, and environmental forecasts. Abundance and spatial structure levels at conservation status are intended to be high enough to allow time for management actions to be implemented to improve a population's status before risk becomes too great, but not too high that they unnecessarily constrain fisheries when viability is not at risk. Unless otherwise indicated, abundance levels are calculated as the 5th percentile of the log-normal distribution of the metric for the data period used in the current status assessment (**Table 8**). ODFW used a very similar approach to identify critical abundance in the CMP (ODFW 2014).

A 2-year running average will be used to determine when an abundance or spatial structure metric has dropped to the conservation status threshold; forecasted metric values can be used for this average where they are estimated. The life history of steelhead and cutthroat trout and the monitored metrics of juvenile abundance and site occupancy will allow managers to respond promptly to expected critical adult abundance. For instance, Rogue winter steelhead status is measured by half-pounder abundance. If wild half-pounder counts drop below the level that identifies conservation concern, it will occur two years prior to the adult return that appears to be at risk. As proposed, ODFW will have adequate time to implement management changes.

If metrics indicate that a population or group of populations is at the conservation status, this would trigger a modification of, or renewed focus on, management actions implemented as part of this conservation plan. Managers will use the weight of evidence approach with all available information to evaluate management actions. Adaptive management will be employed by ODFW as a means to identify and implement additional or modified management actions consistent with management strategies. Examples include, but are not limited to, (1) additional fishery enforcement; (2) additional fishery restrictions[9]; (3) focus habitat protection/restoration effort in key habitat for the target SMU, stratum, or population; (4) take additional measures to reduce impacts of other species if warranted; (5) additional research and/or monitoring; and (6) transition hatchery programs (primarily coho salmon) to conservation releases with approval from NOAA.

[9] Fishery restrictions are described in more detail in the **Fishing Actions** section; fishery restrictions may include a total fishery closure and ODFW will explore specific criteria for triggering that action during plan implementation.

Table 8. Desired status and conservation status metrics and thresholds. Progress toward desired status is evaluated based on a 5-year running average; a 2-year running average is used to determine when a metric has dropped to the conservation status threshold. Asterisks (**) indicate metrics that may be developed with additional proposed monitoring.

SMU	Stratum	Population	Adult Abundance			Juvenile Abundance			Site Occupancy (Juveniles)		
			Desired Status	Current/ Observed [a]	Conservation Status	Desired Status	Current/ Observed [a]	Conservation Status	Desired Status	Current/ Observed [a]	Conservation Status
Winter Steelhead	Coastal	Elk	**	**	**	*Parr (Age-1+) Index* 80,000	*Parr (Age-1+) Index* **63,645** (52,930)	*Parr (Age-1+) Index* 30,000	≥ 90%	**97%** (94%)	75%
		Euchre Cr	**	**	**						
		Hunter Cr	**	**	**						
		Pistol	**	**	**						
		Chetco	**	**	**						
		Winchuck	**	**	**						
		NADOTs									
		NF Smith									
	Rogue	Lower Rogue				*Huntley Wild Half-Pounders* 1,000	*Huntley Wild Half-Pounders* **650** (988)	*Huntley Wild Half-Pounders* 200			
		Illinois									
		M Rogue / Applegate									
		Upper Rogue	**	**	**						
Summer Steelhead	Rogue	M Rogue / Applegate	*Late-Run* 11,000	*Late-Run* **7,681** (8,706)	*Late-Run* 3,250						
		Upper Rogue	*Early-Run***	*Early-Run***	*Early-Run***						
Coho Salmon	Coastal	Elk	800	**267** (297)	150						
	Interior Rogue	Illinois	*Huntley* 10,000	*Huntley* **5,497** (5,746)	*Huntley* 1,870				**	**	**
		M Rogue / Applegate							**	**	**
		Upper Rogue	*Upper Rogue 5,222* [b]	*Upper Rogue **2,590*** [b]	*Upper Rogue 683* [b]				**	**	**
Cutthroat Trout	Coastal	Elk				*Age-1+ Index* 28,000	*Age-1+ Index* **18,469** (30,772)	*Age-1+ Index* 6,500	≥ 90%	**94%** (95%)	75%
		Euchre Cr									
		Hunter Cr									
		Pistol									
		Chetco									
		Winchuck									
		NADOTs									
		NF Smith									
	Rogue	Lower Rogue									
		Illinois									
		M Rogue / Applegate									
		Upper Rogue									

[a] Current/Observed includes 50th percentile for data period used in current status assessment (**bold**) and most recent 5-year average (parentheses).

[b] Status thresholds for Upper Rogue coho salmon are based on historical Gold Ray Dam counts and are not proposed to be tracked at this time (see below).

Desired and Conservation Status Metrics

Metrics used for desired and conservation status are measurable criteria that: 1) were used in the current status assessment; and/or 2) are based on long-term monitoring expected to continue in the future (see **Research and Monitoring Actions**). Below are descriptions of status metrics, including figures showing the full time series for each metric relative to desired and conservation status thresholds in **Table 8**. **Thresholds are shown for reference and will be evaluated based on running averages not shown in the figures.** Gold Ray Dam counts are provided where relevant for additional context about historical abundance in the Rogue Basin; "management counts" publicly available at ODFW's website are presented in the figures.

The absence of status metrics for a stratum or population indicates that we do not currently have an adequate monitoring baseline and/or proposed monitoring to identify and track numerical targets. Nevertheless, the goal for all SMUs covered by this plan is to improve status and maintain viability of independent populations. As new monitoring projects are implemented and have generated an adequate time series of data, additional relevant or population-specific desired and conservation status metrics and thresholds may be added. Additionally, if new analytical methods provide different historical data for any metrics, the thresholds in **Table 8** will be revised accordingly at the time of plan re-assessment.

Abundance Metrics

Wild Half-Pounder Steelhead Count at Huntley Park

ODFW's Huntley Park seining project captures steelhead half-pounders returning to the Rogue Basin from July-October, and the wild half-pounder count for the season is an index of total abundance. Historically, half-pounder counts at Huntley Park have been strongly correlated with wild winter steelhead counts at Gold Ray Dam (Upper Rogue population) 2–3 years later (**Figure 7; Figure 8).** The period from 1999–2018 (most recent 20 years) was used to calculate desired and conservation status thresholds for this metric (top panel in **Figure 8**).

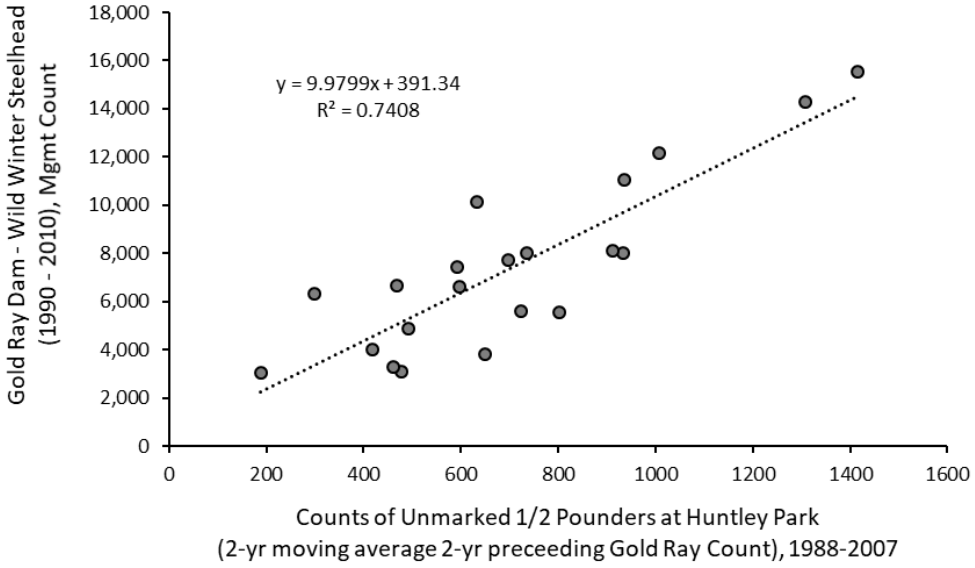


Figure 7. Relationship between counts of wild (unmarked) winter steelhead at Gold Ray Dam and wild half-pounder counts at Huntley Park.

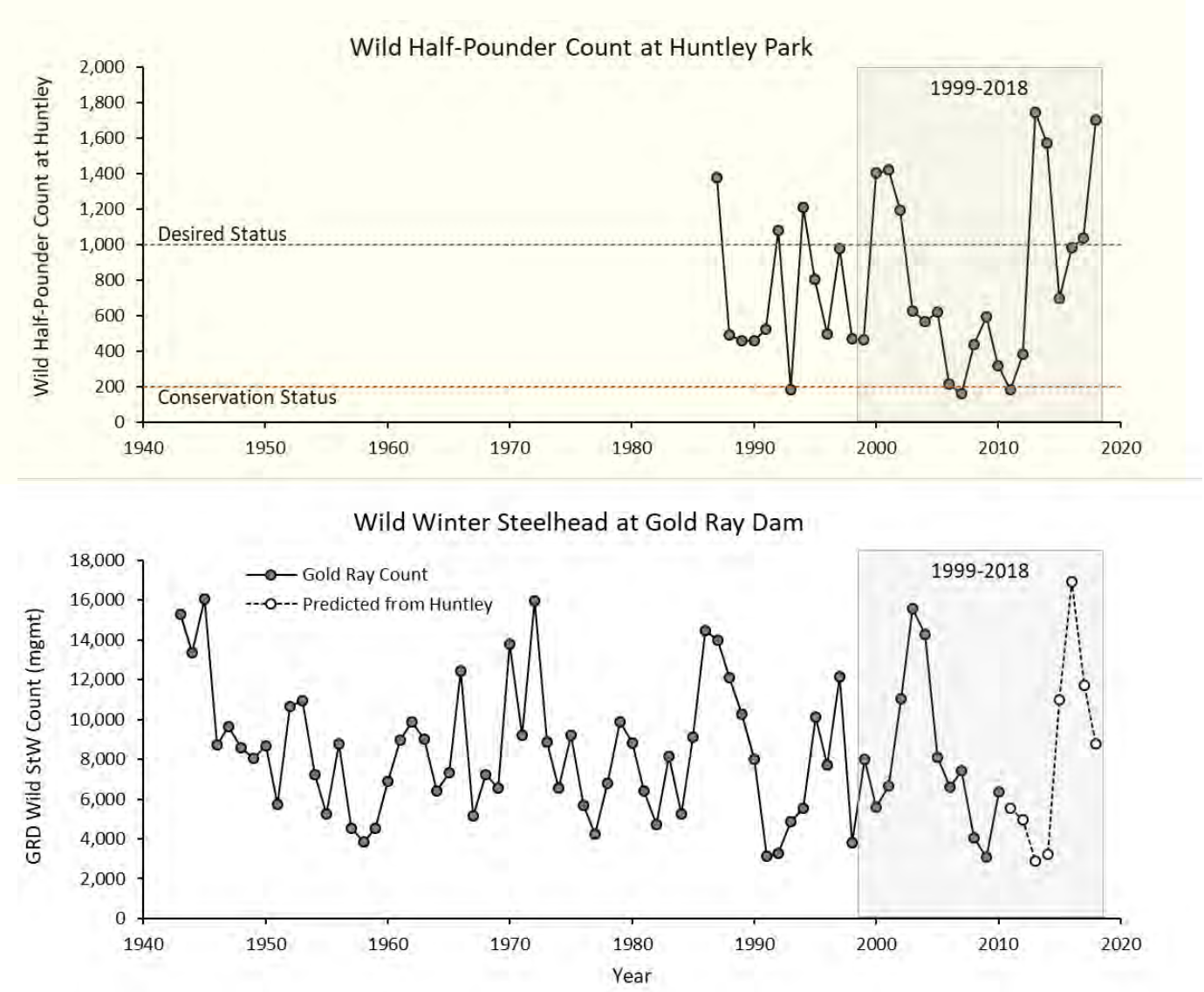


Figure 8. Counts of wild half-pounders at Huntley Park from 1987–2018 (top panel) and wild (unmarked) winter steelhead at Gold Ray Dam from 1942–2010 (bottom panel). Wild winter steelhead counts at Gold Ray Dam from 2011–2018 were predicted based on the historical relationship with wild half-pounder counts at Huntley Park (see Figure 7).

Late-Run Summer Steelhead Abundance at Huntley Park

ODFW annually estimates abundance of wild late-run summer steelhead returning to the Rogue Basin (July to October) based on the catch of adults at the Huntley Park seining project and a river flow-based expansion. The estimate is an aggregate of Middle Rogue-Applegate and Upper Rogue populations, but does not include early-run summer steelhead. Wild summer steelhead counts at Gold Ray Dam (which include early-run and late-run summer steelhead) were historically correlated with late-run summer steelhead estimates at Huntley Park (**Figure 9**). The period from 1999–2018 (most recent 20 years) was used to calculate desired and conservation status thresholds for abundance at Huntley Park (top panel in **Figure 9**). A comparison of thresholds based on the 75th percentile of abundance for Gold Ray Dam summer steelhead counts beginning in 1942, 1976, and 1999 indicates that all three produce similar results (bottom panel in Figure 9).

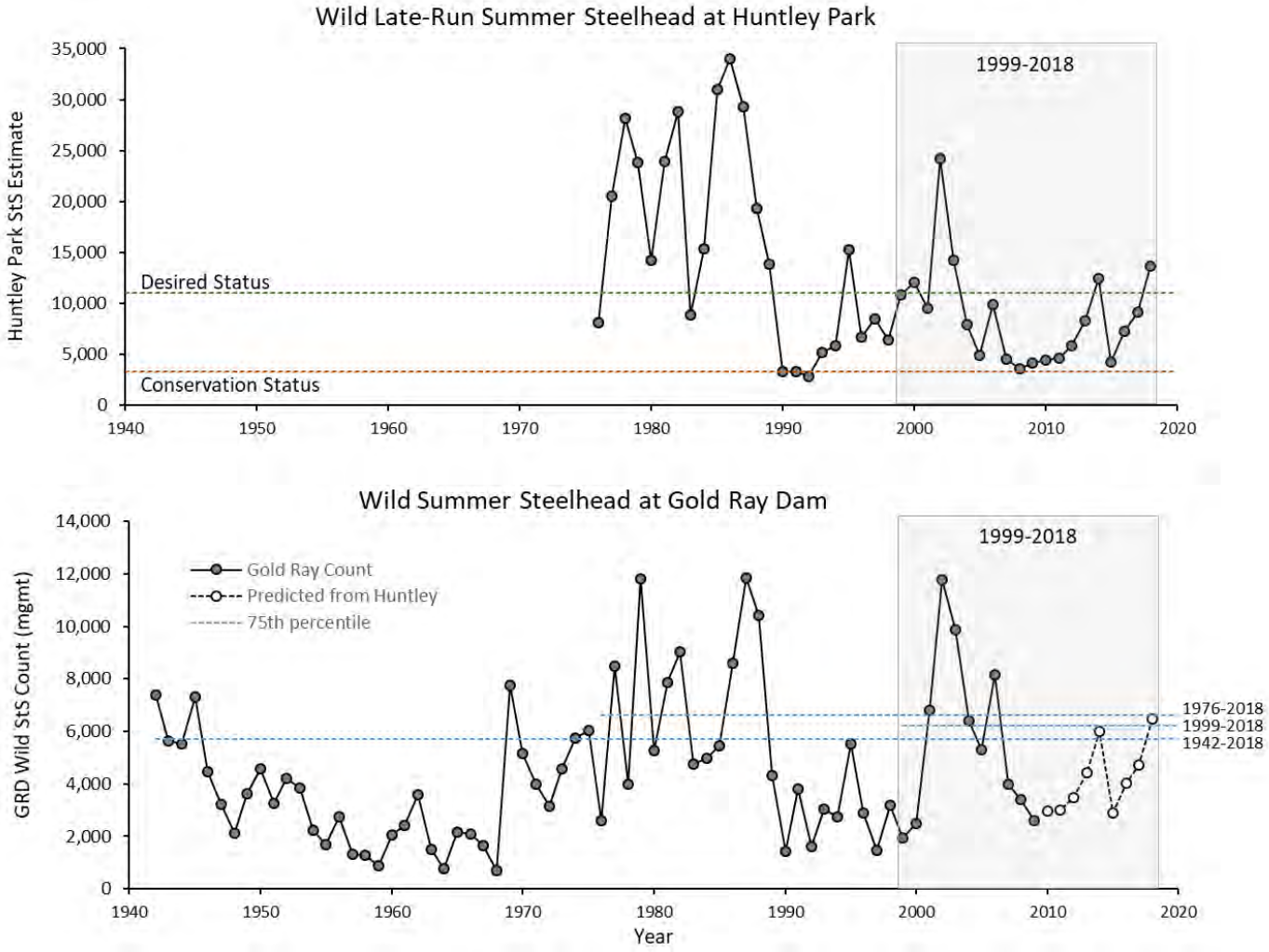


Figure 9. Estimates of wild late-run summer steelhead at Huntley Park from 1976–2018 (top panel) and counts of wild (unmarked) summer steelhead at Gold Ray Dam from 1942–2009 (bottom panel). In the bottom panel, blue lines indicate the 75th percentile of the lognormal distribution for Gold Ray Dam counts in the periods 1942–2018, 1976–2018, and 1999–2018. Summer steelhead counts at Gold Ray Dam from 2010–2018 were predicted based on the historical relationship (1987-2009) with Huntley Park estimates (y = 0.3824x + 1251.6, R^2 = 0.65).

Adult Coho Salmon Abundance at Huntley Park

ODFW annually estimates abundance of wild coho salmon returning to the Rogue Basin based on the ratio of wild and hatchery coho salmon captured at Huntley Park, and hatchery coho salmon returns to Cole Rivers Hatchery. The Huntley Park estimate represents the aggregate of Illinois, Middle Rogue-Applegate, and Upper Rogue populations. Wild adult coho salmon counts at Gold Ray Dam were historically correlated with wild coho salmon estimates at Huntley Park (**Figure 10**), although a comparison of the two indicates that Huntley Park methods may underestimate total abundance in some years. The period from 1996–2018 was used to calculate desired and conservation status thresholds for abundance at Huntley Park (top panel in **Figure 10**). The 10th percentile of the log-normal distribution of the metric was used to calculate the conservation status threshold, which is likely comparable to average abundance in the 1950s through 1970s. A slightly

longer time period (23 years instead of 20 years for steelhead) was included for this metric because this captured the entire period that was recently revised for the spawner-recruit analysis in the current status assessment (see **Appendix III – Current Status Methods and Results).**

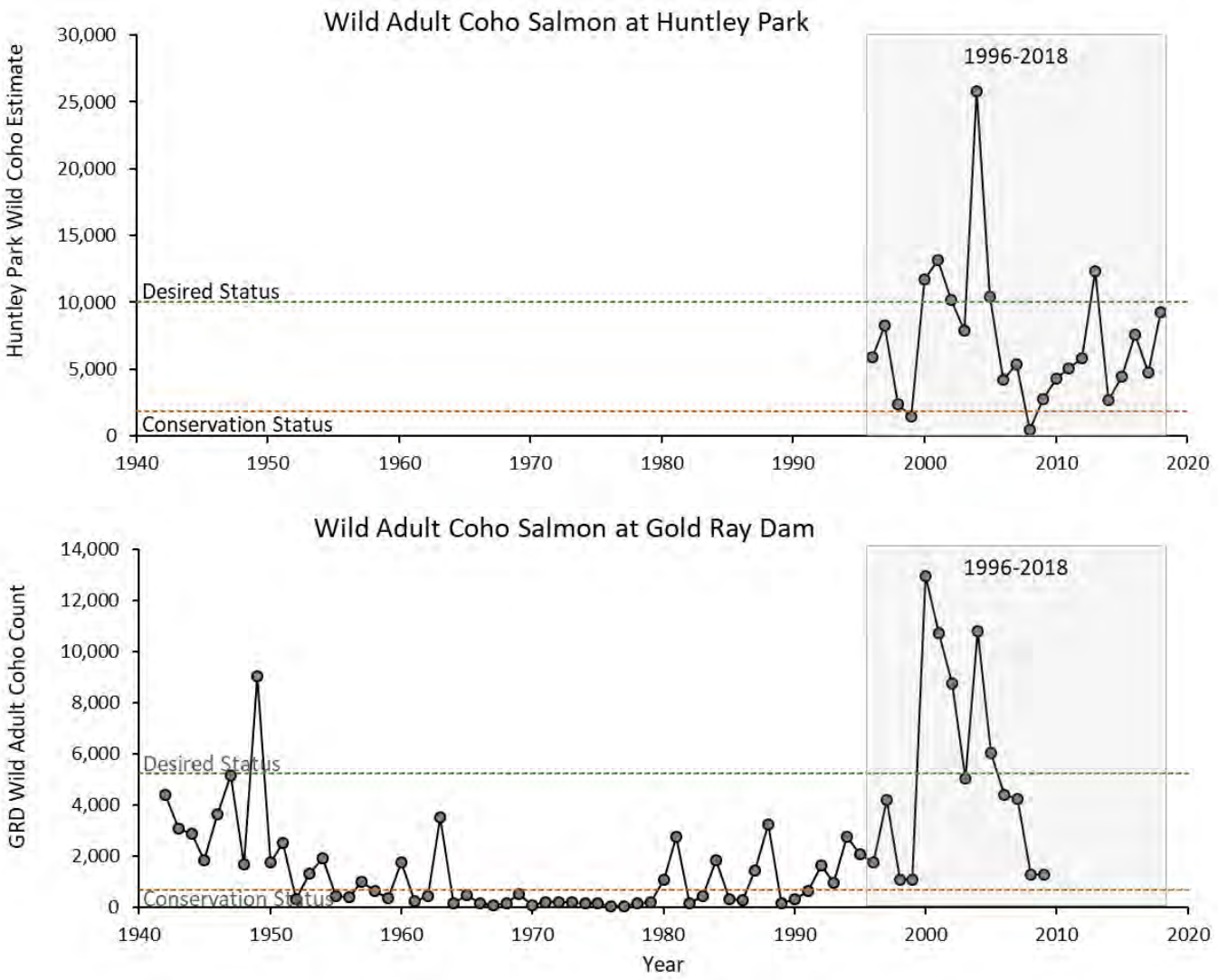


Figure 10. Estimates of wild adult coho salmon at Huntley Park from 1996–2018 (top panel) and counts of wild (unmarked) adult coho salmon at Gold Ray Dam from 1942–2009 (bottom panel).

Adult Coho Salmon Abundance at Gold Ray Dam

There was consensus support in the Rogue Stratum Stakeholder Team to add Upper Rogue coho salmon status criteria to **Table 8** based on historical Gold Ray Dam counts. Counts of wild coho salmon at Gold Ray were collected from 1942–2009 (**Figure 10**), but ended with the removal of the dam and associated counting station in 2010. This metric is not proposed to be tracked at this time, but could be used as a status metric in the future under a different monitoring framework. The period from 1990–2009 (most recent 20 years) was used to calculate desired, current, and conservation status thresholds (bottom panel in **Figure 10; Table 8)**. Thresholds were calculated using the same methods described above for coho salmon abundance at Huntley Park.

Elk River Adult Coho Salmon Spawner Abundance

ODFW conducts annual spawning ground surveys for Chinook salmon and coho salmon in the Elk River. Using peak counts of coho salmon in these standard surveys and a habitat-based expansion, coho salmon abundance can be estimated for the population. The estimate is best viewed as an index of abundance because survey frequency varies among sites, and sampling does not occur in all areas where coho salmon spawn. Desired abundance is a three-fold increase in spawner abundance (see **Figure 11** below), consistent with the *Strategic Action Plan (SAP) for the Recovery of the Elk River Population of Wild Coho*. The period from 1999-2018 (most recent 20 years) was used to calculate the conservation status threshold for abundance. The 25th percentile of the log-normal distribution of the metric during this period was used due to the small number of spawners in this population.

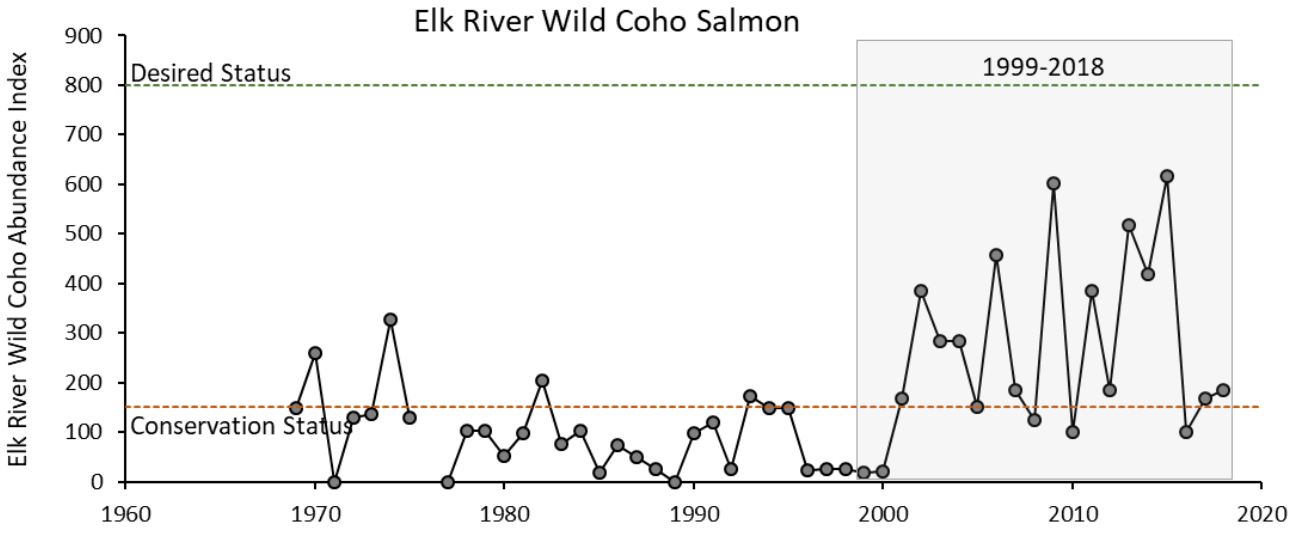


Figure 11. Wild adult coho salmon spawner abundance index in Elk River from 1969–2018.

Coho Abundance and the Federal Recovery Plan

Desired abundance goals in the RSP for coho salmon populations in the Interior Rogue and Elk River differ from viability criteria for these populations in the *Final Recovery Plan for the Southern Oregon/Northern California Coast Evolutionarily Significant Unit of Coho Salmon* (NMFS 2014). The RSP identifies 10,000 adult coho salmon at Huntley Park as the desired level of abundance for coho salmon in the Rogue watershed. This goal would be calculated as an average (see details above) and is nearly double the abundance observed in recent years (**Table 8**). Viability criteria for Rogue coho salmon populations in NMFS (2014) are significantly higher, summing to 28,000 spawners for the three Interior Rogue populations. Likewise, desired abundance for Elk River coho salmon in the RSP (800 spawners) is significantly lower than the viability criterion of 2,400 spawners in NMFS (2014).

Viability criteria in the *Recovery Plan* (NMFS 2014) were based on a GIS-based "intrinsic potential" (IP) model of the amount of historic habitat for coho salmon within the ESU. ODFW provided

comments, and continues to believe, that model results are unrealistically high given the geology and climate of much of the Oregon portion of the SONCC coho salmon ESU, which would not have historically supported widespread distribution and persistence of juvenile coho salmon. ODFW's perspective is also mirrored in current monitoring and modeling, where densities of juvenile coho salmon tend to be low in the SONCC ESU relative to the Oregon Coast ESU, and species distribution modeling indicates a patchy distribution with a low probability of coho salmon occurrence in most streams.

One example used as support for the Rogue viability goals in the recovery plan was a report of 58,000 coho salmon harvested in the Rogue in 1892 (Mullen 1981). ODFW notes that the recovery plan highlighted the single highest yearly harvest reported in the record by Mullen. The harvest between 1892 and 1904 averaged 25,000 fish.

Counts of the upper Rogue coho salmon population began in 1942, and averaged about 3,964 wild coho salmon adults in the 1940s. Per the recovery plan, the upper Rogue provides 37% of the IP habitat in the interior Rogue. Based on habitat, and assuming the populations co-vary, total abundance of wild coho salmon in the Rogue likely averaged 10,000-11,000 fish in that decade. The low point for coho salmon in the Rogue watershed can be easily observed in the graph of the Gold Ray Dam count (**Figure 10**). For 25 years from 1955-1979, the abundance of the upper Rogue population averaged 470 wild coho salmon adults, and on four separate years the count was less than 100. Extrapolating again based on habitat, the Rogue population may have averaged 1,270 wild coho salmon in this time period. Populations in the Rogue have rebounded since this time period, showing that innate resilience has not been lost despite the effects of poorly regulated development through much of the 19^{th} and 20^{th} centuries.

Coho salmon in the Rogue have certainly experienced a significant decline in abundance since the late 1800s. The decline reached its nadir by 1980, and the population appears to be building slowly since 1980. But more work needs to be done, especially in anticipation of new impacts coming from a changing climate. The question is identifying goals that are both aspirational and attainable, and acknowledge that habitat protection and restoration will not fully restore historical carrying capacities.

ODFW considered other approaches to determine the desired level of abundance. An estimate of S_{msy} (spawner abundance that produces maximum sustainable yield) for Rogue coho salmon was produced from the stock-recruit analysis in the current status assessment. However, ODFW staff do not consider S_{msy} a good tool for management of coho salmon in the Rogue because of uncertainty about the contribution of component populations to aggregate abundance and productivity. Furthermore, S_{msy} is lower than the spawner abundance that gives maximum recruitment. This metric should not be the benchmark for achieving a healthy, self-sustaining populations of coho salmon on the Rogue that contribute to removal from listing under the federal ESA.

The federal recovery plan (NMFS 2014) acknowledged ODFW's concerns and the uncertainty in the IP model, describing the resultant spawner density criteria as "an initial framework that can be

adjusted or replaced" as new information becomes available with respect to SONCC coho salmon habitat use and viability requirements. The plan also states that NMFS "intends to work with partners to reevaluate the population structure, and associated recovery criteria within the Northern Coastal and Interior Rogue diversity strata as part of a conservation planning process." This plan identifies several **Research and Monitoring Actions** to inform this re-evaluation. ODFW is committed to working with NMFS to identify appropriate recovery criteria, hone the array of management actions needed to recover the species in the Oregon portion of the ESU, direct limited restoration resources towards populations most likely to sustain SONCC coho salmon into the future, and reduce conservation risk by improving the viability of multiple populations.

Coastal Stratum Winter Steelhead Parr Abundance and Cutthroat Trout Abundance

ODFW annually calculates abundance indices for Age 1+ juvenile steelhead and Age- 1+ cutthroat trout in the Coastal Stratum based on visual underwater snorkel pool counts in randomly selected sites. These indices are not population estimates because snorkelers see only a portion of the fish resident in pools, pools in large (non-wadeable) streams are not sampled, and pools compose only about 20% of the habitat within the SMU (Thom et al. 1999). Furthermore, sites are located in streams within steelhead distribution, which does not include the entire distribution of cutthroat trout. Cutthroat trout counts include juvenile and adult fish due to the life history diversity of this species. The period from 2002-2019 (all years available) was used to calculate desired and conservation status thresholds for this metric (**Figure 12**).

The sampling frame for juvenile abundance index surveys includes some NADOTs (small direct ocean tributaries), but the NF Smith is not currently monitored within the sampling frame. Habitat conditions and remoteness of the NF Smith watershed currently do not warrant the additional monitoring effort. ODFW District staff and the US Forest Service (USFS) have and will continue to periodically monitor fish populations in the watershed as time and funding allow.

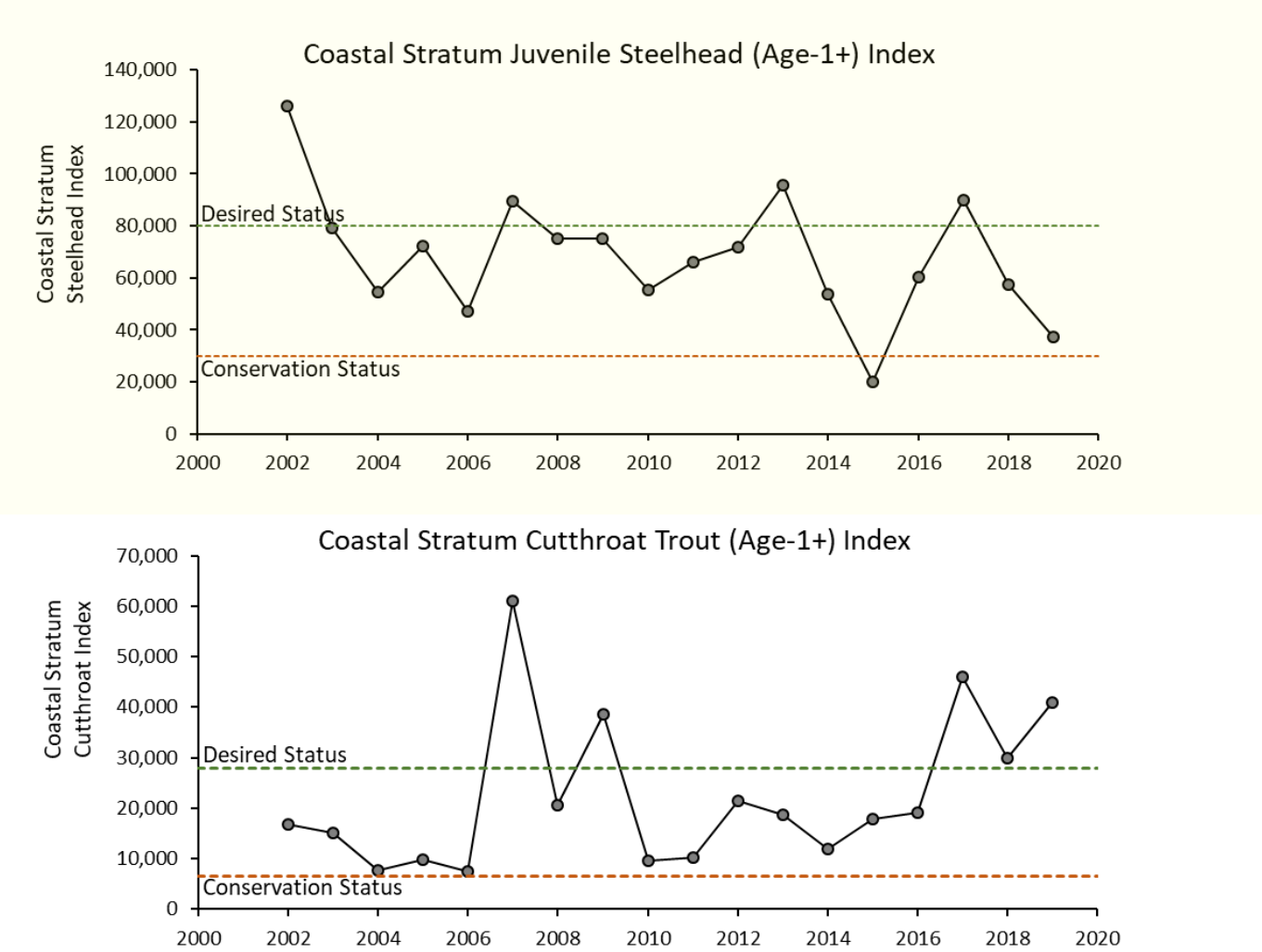


Figure 12. Coastal Stratum juvenile steelhead (age-1+) abundance index (top panel) and cutthroat trout (age-1+) abundance index (bottom panel) from 2002–2019.

Spatial Structure Metric

Site Occupancy

Site occupancy is the percentage of Coastal Stratum randomly selected snorkel survey sites (same sites used for abundance indices described above) with observed presence of Age-1+ juvenile winter steelhead or Age-1+ cutthroat trout. This metric measures the loss of steelhead or cutthroat distribution due to fish passage barriers, habitat loss (*including habitat loss associated with climate change*), and low abundance. **Figure 13** shows observed site occupancy for Age-1+ juvenile winter steelhead or Age-1+ cutthroat trout from 2002-2019 (all years available). Conservation status thresholds for steelhead and cutthroat trout are based on input from ODFW staff, comparisons with neighboring ESUs, and discussion in RSP Stakeholder Team meetings.

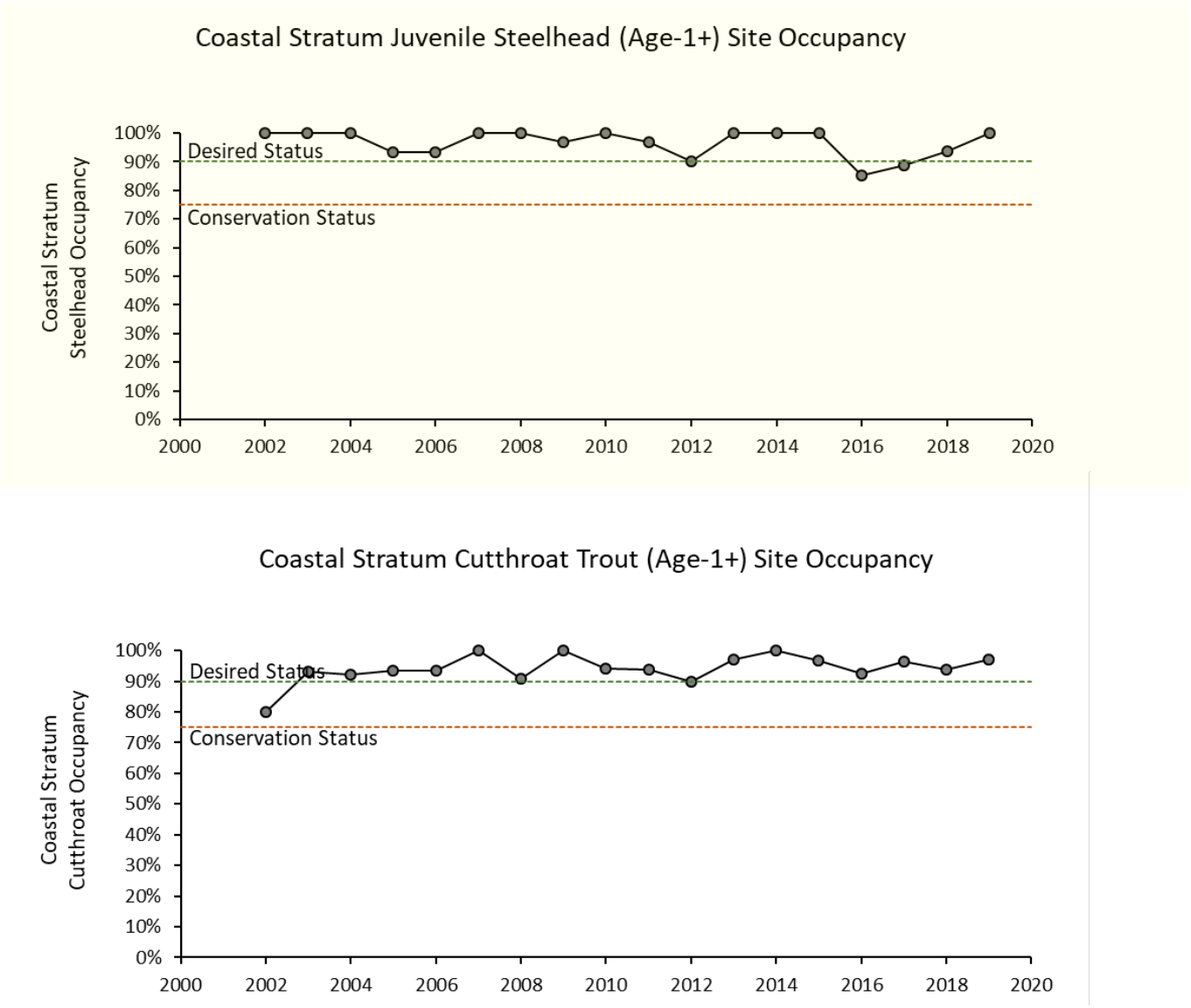


Figure 13. Coastal Stratum juvenile steelhead (age-1+) site occupancy (top panel) and cutthroat trout (age-1+) site occupancy (bottom panel) from 2002-2019.

Limiting Factors

The difference between current status and desired status for a population or SMU is referred to as the "gap" in the NFCP. Limiting factors affecting the gap are identified to determine general management strategies and more specific actions within Management Categories that are consistent with achieving desired status (which includes improved fishing opportunity). So, in order to achieve plan goals for desired status and maintain sustainable native fish populations, conservation plans identify limiting factors associated with six categories. Manageable limiting factors are defined as *biological, physical, or chemical conditions altered to such an extent by anthropogenic (i.e., human-related) activities that they impede achievement and/or maintenance of population biological performance goals*.

Table 9 identifies limiting factors for RSP basins/population areas. Limiting factors were identified based on professional judgment of ODFW biologists, informed by data interpretation and experience. See **Table 10** for a description of potential limiting factors that were considered.

Ocean conditions and marine factors (e.g., current patterns, water temperature, marine predators and competitors, food sources, etc.) strongly influence the abundance of anadromous fishes. However, these factors are not considered "manageable" so are not identified in **Table 9**. Ocean conditions were directly or indirectly included in the status assessments in the RSP and are an important component for monitoring and adaptive management into the future.

Collective effort to address manageable limiting factors allows populations to remain viable through the population variability (natural cycles of population highs and lows) inherent in the life history of salmon and steelhead—in effect more often at desired status and less often at conservation status. *Note that climate effects act through limiting factors, potentially increasing the severity of individual limiting factors and the collective impact of individual limiting factors (e.g., increased drought frequency will affect water quantity and water temperature).*

Table 9. Limiting factors affecting populations in the Rogue–South Coast winter steelhead (StW), summer steelhead (StS), coho salmon (CO), and cutthroat trout (CCT) SMUs. "❶" indicates a primary limiting factor, believed to contribute significantly to the gap between current and desired status. "②" indicates a secondary limiting factor, believed to contribute to a lesser degree to the gap between current and desired status. "?" indicates a potential limiting factor which requires additional information or assessment. Indicated limiting factors apply to all species that occur in a basin/population area unless otherwise noted. Other limiting factors may affect populations within the SMUs, but primary and secondary limiting factors warrant priority to close the gap.

		Coastal Stratum						Rogue Stratum			
Management Category	Limiting Factor	Elk	Euchre	Hunter	Pistol	Chetco	Winchuck	Lower Rogue	Illinois	M Rogue/ Applegate	Upper Rogue
Direct Management	Hat. Fish: Gen. Introgr.										
	Hatchery Fish: Pred.									?	?
	Hatchery Fish: Comp.	?(CO)									?
	Fishing / Harvest										
Other Species	Pred.: Non-Nat. Fish								?	?	?
	Predation: Avian										
	Predation: Other										
	Comp.: Non-Nat. Fish			②(StW,CCT)					?	②	?
	Hybrid.: Non-Nat. Fish										
	Food Source										
	Disease										
Habitat Access	Upstream Passage								?	❶	❶
	DS Passage / Screening								?	❶	❶
	Peripheral Connection	②	②	②	②	②	②			②	②
Water Quality	Temperature	②	②	❶	②	②	②	②	❶	❶	❶
	Toxic Pollutants										?(CO, Bear Cr)
	Sedimentation			②						?	②
	Other: Estuary	②(CO)	②	②	②	②	②				
Water Quantity	Low Flows	❶(StW,CCT)	❶	❶	❶	❶	❶	❶	❶	❶	❶
	Flashy / High Flows	?	?	?	?	?	?	?		?	?
Instream Phys. Habitat	Structure / Complexity	❶(CO)						?	?	?	?
	Gravel										

Table 10. Description of potential limiting factors considered for Table 9 above. Descriptions are from the perspective of interactions or effects on naturally-produced native fish. Limiting factors in the ocean are not addressed here; even though these have a large effect on populations, there is no ability to control these through local management actions.

Category	Description
Direct Management	
Hatchery Fish: Genetic Introgression	inter-breeding with hatchery fish resulting in reduced population fitness, reproductive success, or productivity
Hatchery Fish: Predation	consumption by hatchery fish
Hatchery Fish: Competition	interaction with hatchery fish for a limited environmental resource (e.g., food, refuge, spawning gravel)
Fishing / Harvest	reduction in spawners through removal (intentional or not), as well as influence on population demographics or diversity through selective pressure on potential spawners
Other Species	
Predation: Non-Native Fish	consumption by non-native fish
Predation: Avian	consumption by birds
Predation: Other	consumption by other animals
Competition: Non-Native Fish	interaction with non-native fish for a limited environmental resource (i.e., food, refuge)
Hybridization: Non-Native Fish	inter-breeding with non-native fish resulting in reduced population fitness, reproductive success, or productivity
Food Source	availability of appropriate food, including prey, for metabolic maintenance and growth
Disease	pathological condition resulting from infection
Habitat Access	
Upstream Passage	injury or impaired access to stream, river, or lake habitat due to partial or complete barriers
Downstream Passage / Screening	injury or egress from stream, river, or lake habitat due to water flowing out of streams, rivers, or lakes
Peripheral Connection	impaired access to natural off-channel (peripheral) habitat such as wetlands, side-channels, and floodplains
Water Quality	
Temperature	temperature that is not conducive to fulfilling life cycle needs or survival
Toxic Pollutants	toxins or contaminants in the water column or sediment
Sedimentation	sediment suspension (i.e., turbidity) and deposition that affects egg incubation, food source production, feeding, or other survival needs
Other	other physical, chemical, or biological water characteristics that affect condition or survival (e.g., dissolved oxygen, pH)
Water Quantity	
Low Flows	timing, duration, or magnitude of low flows or water levels that interfere with life cycle needs
Flashy / High Flows	timing, duration, or magnitude of high flows or water levels that interfere with life cycle needs
Instream Physical Habitat	
Structure / Complexity	minimal structure and complexity of physical habitat within the bed and banks of the stream channel (e.g., large wood, boulders, beaver dams, and sinuosity affecting the composition of pools, riffles, and glides)
Gravel	stream channel substrate not conducive to spawning

Direct Management: Hatchery fish have the potential to have either genetic or ecological (i.e., competition or predation) impacts on any population with which they spatially and temporally overlap (Araki et al. 2008; Buhle et al. 2009; Chilcote et al. 2011). Based on observed rates of hatchery straying, genetic introgression is not considered a limiting factor for any RSP population. Possible limiting factors related to hatchery fish include competition and predation by juvenile hatchery fish in the Upper Rogue,

predation by juvenile hatchery fish in the Middle Rogue/Applegate, and competition with hatchery fish on the spawning grounds for Elk River coho salmon.

Plan species are not subject to directed harvest in the ocean, and indirect impacts from ocean fisheries are low for coho salmon (generally ≤10%) and negligible for steelhead and cutthroat trout. Based on the best available information regarding harvest rates (see **Fishing Actions**) and indirect fishery impacts, Fishing/Harvest is not considered a primary or secondary limiting factor for any plan population.

Other Species: Predation due to pinnipeds and birds occurs across all SMUs, but is not considered a primary or secondary limiting factor at this time. Non-native fish competition and/or predation are considered secondary or possible limiting factors in several population areas where non-native minnows are established.

Habitat Access: Barriers to upstream passage and impacts related to downstream passage and screening are primary limiting factors for Middle Rogue/Applegate and Upper Rogue populations, and possible limiting factors for Illinois populations. Loss of peripheral connection (access to natural off-channel habitat) is a secondary limiting factor for most populations.

Water Quality: High stream temperatures during summer are a primary or secondary limiting factor for all populations. Toxic pollutants are considered a possible limiting factor for coho salmon in the urbanized Bear Creek watershed in the Upper Rogue population area (see note in **Habitat Actions**). Sedimentation impacts are identified as a secondary limiting factor for Hunter Creek and Upper Rogue populations, and as a possible limiting factor for Middle Rogue/Applegate populations. Poor estuary water quality is considered a secondary limiting factor for all Coastal Stratum populations.

Water Quantity: Low flows during summer and early fall are a primary limiting factor for all populations. Flashy/high flows during winter are a possible limiting factor for most populations.

Instream Physical Habitat: Instream physical habitat is considered a primary limiting factor for the Elk River coho salmon population and a possible limiting factor for all populations in the Rogue Stratum. The availability of gravel for spawning is not considered a limiting factor for any population.

Limiting Factor Confidence

Given the complex interactions between salmonids, co-occurring species, and their habitats, it is difficult to determine the relative importance of limiting factors in producing life stage "bottlenecks," whereby negative effects on one life stage subsequently affect the abundance of other life stages. Primary limiting factors may also vary spatially and temporally. To account for some level of uncertainty associated with the limiting factor analysis, the RSP identifies limiting factors within broad categories (“primary”, “secondary”, “potential”) in which there is a varying level of confidence. The optimal management approach would be to address all primary and secondary limiting factors (in priority order) and to seek a better understanding of the unknowns. As localized data are available, this will inform more specific management actions.

Management Strategies and Actions

To achieve and/or maintain desired status for SMUs covered by this plan, it will be necessary to address limiting factors identified for species and populations. Nearly all primary and secondary limiting factors relate to habitat, particularly habitat access, water quality, and water quantity. Actions taken to address habitat limiting factors will not only help achieve desired status, they will also increase resilience to climate and ocean change and will be beneficial to all other native fish species residing in these streams. Actions in other management categories address limiting factors or achieving other plan objectives of improving fishing opportunity. Many of these actions will benefit other native, indigenous fish species and negative impacts are not expected.

> In the following sections, strategies and actions which will increase resilience of plan species to climate and ocean change are indicated with this symbol: 

I. Habitat Actions

Management Strategies

I-1. Promote and implement a tiered approach to habitat restoration efforts and funding to achieve maximum benefit for plan species. Prioritize restoration actions, including actions identified in Coho Strategic Action Plans, in the following order: 1) actions to address primary limiting factors in population areas with an independent coho salmon population; 2) actions to address primary limiting factors in other population areas; and 3) actions to address secondary limiting factors for all population areas.

I-2. Within the Rogue and Coastal strata, identify watersheds that will be key to supporting plan populations in the future, and focus habitat protection and restoration activities[10] towards these watersheds.

I-3. Consistent with ODFW's mission, policies, and laws, continue to coordinate with and advise other agencies, local governments, and regulatory entities to ensure that habitat protection processes and actions provide the best possible outcomes for native fish.

I-4. Exhibit leadership in coordinating the implementation of actions to adapt to climate change.

I-5. Encourage citizen involvement to help implement habitat protection and restoration actions.

I-6. Promote beavers and beaver-related pond habitat to increase water quantity and stream complexity, primarily through riparian restoration and helping landowners learn to live with beaver impacts.

<u>Habitat Approach</u>

Achieving desired status for the SMUs covered by this plan will require a focused approach with the right habitat actions being implemented in the right places at the right scale. First and foremost, this

[10] In this plan, protection activities are generally considered to be those that *reduce or eliminate potential impacts* to maintain existing fish habitat, either on a voluntarily or regulatory basis. Restoration activities are those that *improve* existing fish habitat, primarily on a voluntary basis.

entails prioritizing work that addresses primary and secondary limiting factors identified for each population area and species (**Table 9**). In nearly all cases, the most important limiting factors relate to habitat access, water quality, and water quantity. *Work to address these limiting factors is the primary way that the impacts of climate change will be mitigated. Climate change is expected to exacerbate these limiting factors, amplifying the negative effects of passage barriers, lack of peripheral connection, high water temperatures, and low summer flows on plan species. Climate change will also increase the severity of individual limiting factors because they will happen collectively with climate events* (e.g., increased drought frequency will affect water quantity and water temperature, which may allow non-local species like redside shiners and pikeminnow to have a competitive advantage over plan species for available habitat).

Actions to counteract or mitigate these effects are needed throughout the planning area, but there are important differences in habitat protection and restoration needs for coastal watersheds (Elk, Euchre, Hunter, Lower Rogue, Pistol, Chetco, and Winchuck population areas) compared to watersheds in the interior Rogue Basin (Illinois, Middle Rogue/Applegate, and Upper Rogue population areas). These differences are due to intrinsic factors (climate, geology, landforms, etc.) and the extent of development in the interior Rogue (population size, urban and rural development, dams and other fish passage barriers, water withdrawals, etc.) relative to coastal watersheds. Climate change impacts are also expected to vary between coastal and interior Rogue watersheds (See **Appendix IV – Climate and Ocean Change Assessment**).

Recognizing that time and resources to implement habitat actions are limited, a key component of our habitat approach is *prioritization*. Habitat restoration and protection should be focused on the most important factors limiting plan species, rather than what may be more traditional or easily implemented. In addition, the location of habitat protection and restoration work needs to be in watersheds most likely to support plan species into the future. This approach is consistent with direction in ODFW's Climate and Ocean Change Policy (OAR 635-900-0001). The RSP identifies the limiting factors and identification of spatial priorities is being conducted by ODFW in a separate statewide effort that is part of implementation of the Climate and Ocean Change Policy. *Focusing protection and restoration resources on the right things in the right locations is a key approach to addressing climate change in the RSP.*

Habitat relies on good stewardship practices by landowners and all agencies that regulate actions in and near streams. Collective stewardship responsibility exceeds ODFW's direct authority. Some members of the community interested in fish and fishing narrowly advocate for fish management activities under ODFW's direct authority to improve fish numbers or fishing: either producing more fish in hatcheries or focusing solely on angling regulations. Hatcheries and fisheries must be managed consistent with native fish conservation, but significant improvements in fish and fishing will only happen by addressing primary limiting factors, which are all related to habitat. The NFCP specifies that conservation plans identify and address all primary limiting factors. **Table 11** lists actions to address habitat limiting factors in each management category (*Habitat Access*, *Water Quality and Quantity*, and *Instream Physical Habitat*). Additional details and rationale are provided below.

Table 11. Habitat Actions.

Actions	*Strategy*	*Population*	*Species*	*LFs Addressed*
A. General				
I.A.1. Identify priority watersheds (5th-field, 10-digit Hydrologic Units) where habitat protection and restoration will be focused; identification will consider current and future conditions and the outcome will guide the spatial implementation of other habitat actions.	*I-1 – I-6*	All	All	All
B. Habitat Access				
I.B.1. Work with habitat restoration partners to remove priority passage barriers for adult and juvenile fish. a. Utilize ODFW Statewide Fish Passage Priority List and Rogue District priority list (see Action I.B.2). b. Utilize statewide programmatic agreements to improve passage at ODOT barriers and to improve high priority barriers off of the state highway system.	*I-1* *I-2* *I-4*	Illinois M Rogue/Applegate Upper Rogue	All	Upstream Passage
I.B.2. Maintain and update a list of priority barriers for restoration of fish passage in the Rogue Basin. a. Focus on priority watersheds. b. Prioritize barriers that maximize fish-producing habitat and complete previous work in a stream reach. c. Identify lower priority barriers with low cost of removal, modification possibilities or that can be packaged with higher priority barriers.	*I-1* *I-2* *I-4*	Illinois M Rogue/Applegate Upper Rogue	All	Upstream Passage
I.B.3. Work with partners to develop outreach material and training on proper culvert sizing and construction for installers and the general public; coordinate with relevant entities (e.g., DSL, counties, etc.) to distribute information.	*I-4*	All	All	Upstream Passage
I.B.4. Work with interested community members to install and maintain temporary structures to improve passage at barriers in urban areas, while working toward permanent passage improvements in the long-term.	*I-5*	M Rogue/Applegate Upper Rogue	All	Upstream Passage
I.B.5. Develop a metric of barrier-impacted stream miles and associated loss in fish production, and report on improvements over time.	*I-1* *I-4*	Illinois M Rogue/Applegate Upper Rogue	All	Upstream Passage
I.B.6. Develop and communicate best management practices for seasonal irrigation diversion structures that can affect upstream migration of adult steelhead and Pacific lamprey, downstream migration of smolts, and survival of juveniles.	*I-3*	Illinois M Rogue/Applegate Upper Rogue	All	Upstream Passage DS Passage/Screening
I.B.7. Continue coordination and outreach to install screens at unscreened diversions, with focus on priority watersheds and priority opportunities.	*I-3*	All	All	DS Passage/Screening

Actions	*Strategy*	*Population*	*Species*	*LFs Addressed*
I.B.8. Promote riparian protection through coordination with regulatory authorities to foster natural processes (e.g. large woody debris as trees age, die and fall into streams) that contribute to peripheral connectivity, shading, and habitat structure and complexity.	*I-3*	All	All	Peripheral Connection Temperature Structure/Complexity
I.B.9. Work with restoration practitioners to increase the scope and efficacy of riparian restoration, with focus on priority watersheds. a. Prioritize streams where intact riparian habitat from forested reaches can continue down toward the valley bottom. b. Encourage riparian restoration practitioners to focus efforts once planting starts on a stream and continue working with all willing landowners before leaving the area (maximize restoration "patches"). c. Promote use of tools that prioritize planting locations based on shade/water temperature reduction potential.	*I-1* *I-2* *I-4*	All	All	Peripheral Connection Temperature Structure/Complexity
I.B.10. Continue and strengthen outreach on the importance of riparian vegetation. a. Partner with a variety of agencies and entities to share information on the multiple benefit of native trees and shrubs in riparian areas (keeping streams clean and cool, reducing impacts of non-local invasive minnows, reducing risk of erosion, encouraging beavers and beaver dams by providing food source, promoting wildlife diversity, growing future large woody debris for structure and channel diversity, etc.). Intact and diverse riparian habitat will improve channel structure and diversity as it matures over time and falls into streams. b. Continue to recruit volunteers to participate in the Small Stream, Urban Stream, Intermittent Stream project to create awareness of fish use in streams that are too often ignored. c. Develop and implement recognition award recognizing good stewardship of riparian habitat by private landowners. d. Ask local governments to post and distribute riparian ordinances; maintain a copy of riparian ordinances on the ODFW website to facilitate public involvement in riparian protection and public oversight of implementation of the riparian ordinance by local governments. e. Encourage community members in Grants Pass to work with city officials to strengthen the riparian ordinance. f. Look for opportunities to promote other existing programs that foster good stewardship practices.	*I-3* *I-4* *I-5* *I-6*	All	All	Peripheral Connection Temperature Structure/Complexity
I.B.11. Continue to comment on fill/removal and other applicable development applications that could negatively affect stream structure, function, and floodplain connectivity.	*I-3*	All	All	Peripheral Connection Flashy/High Flows Structure/Complexity

Actions	*Strategy*	*Population*	*Species*	*LFs Addressed*
I.B.12. Work with partners to conduct outreach on the importance of large woody debris in improving habitat quality and maintaining connectivity with off-channel habitats through instream structure.	*I-3*	All	All	Peripheral Connection Flashy/High Flows Structure/Complexity
I.B.13. Remove barriers to migration into tributaries to improve linear connectivity in small valley bottom streams where development constrains floodplain use or cost limits floodplain restoration opportunity.	*I-4*	M Rogue/Applegate Upper Rogue	All	Upstream Passage Peripheral Connection Flashy/High Flows
I.B.14. Projects to improve peripheral connectivity must focus on riparian protection and restoration and natural processes that contribute large wood to streams. At some specific priority sites, work with restoration partners to re-connect habitat consistent with natural function (e.g. secondary channel, alcove, etc.). a. Support continued restoration in the publicly-owned valley bottom of Elk Cr. (large wood placement; dike removal; culvert replacement; planting Ponderosa pine and black oak for future large woody debris).	*I-2* *I-4*	All	All	Peripheral Connection
C. Water Quality and Quantity				
See ***Actions I.B.8–I.B.13***				
I.C.1. Work with agencies and organizations to purchase or temporarily lease water rights from willing sellers to place instream, with focus on priority watersheds and priority opportunities.	*I-2* *I-4*	Illinois M Rogue/Applegate Upper Rogue	All	Temperature Low Flows
I.C.2. Conduct outreach on purchase and lease opportunities to water rights holders, with focus on priority watersheds and priority opportunities. a. Use the Little Applegate Stream Habitat Enhancement Project (LASHEP) as an example to promote the benefits associated with placing some water rights instream.	*I-2* *I-4*	Illinois M Rogue/Applegate Upper Rogue	All	Temperature Low Flows
I.C.3. Continue to comment on water right applications that will negatively affect water quality/quantity and, where applicable, direct mitigation to high priority watersheds.	*I-3* *I-4*	All	All	Temperature Low Flows
I.C.4. Recommend OWRD identify areas that have no water available to meet biological targets and they be removed from appropriation, or applicants be made aware upfront of the need for mitigation.	*I-4*	All	All	Temperature Low Flows

Actions	*Strategy*	*Population*	*Species*	*LFs Addressed*
I.C.5. Promote beavers and beaver-related pond habitat to increase water quantity and instream habitat. a. Conduct outreach with landowners on "living with beavers." b. Prioritize habitat- and co-existence- based solutions over beaver relocation. c. Consider beaver needs in riparian management and advocate for riparian restoration and diversity as the primary method for encouraging beavers. d. Initiate "Beaver Emphasis Areas" in Elk Cr (Upper Rogue), Evans Cr (Mid Rogue/Applegate), and Deer Cr (Illinois).	*I-4* *I-6*	All	All	Temperature Low Flows Structure/Complexity
I.C.6. Continue restoring diverse riparian vegetation on Whetstone Creek (Denman Wildlife Area) to encourage beavers and beaver dams.	*I-6*	Upper Rogue	All	Temperature Low Flows Structure/Complexity
I.C.7. Support water conservation and efficiency outreach projects that benefit fish habitat. a. Support irrigation efficiency and conveyance projects (i.e.ditch piping) that result in saved water protected instream. b. Encourage xeriscaping/native plant landscaping in urban areas and new housing developments. c. Public outreach on voluntary water conservation efforts, particularly during droughts. d. Encourage citizens to become involved in all aspects of water conservation, including advocating for xeriscaping or native plant landscaping in land use reviews, and expressing concern about the effects of housing density and groundwater use on streamflow in rural residential areas. e. Request that cities publish median water use levels for various household sizes, for use as benchmarks to help citizens measure and monitor their personal level of water use.	*I-3* *I-4* *I-5* *I-6*	All	All	Temperature Low Flows
I.C.8. Work with forest interests to implement forest management projects (e.g. stand age, density, composition) that increase summer streamflow.	*I-4*	All	All	Temperature Low Flows
I.C.9. Encourage citizens to monitor water right applications, participate in public reviews of water right applications, and work with OWRD and legislators to facilitate public reporting of illegal water use and agency enforcement.	*I-5*	Illinois M Rogue/Applegate Upper Rogue	All	Temperature Low Flows
I.C.10. Work with OWRD to implement projects to monitor groundwater use for effects on streamflow	*I-3*	All	All	Temperature Low Flows
I.C.11. Recommend the USACE update the fill season rule curves at reservoirs in the Rogue Watershed to increase capacity for flow augmentation with an emphasis on drought years.	*I-4*	Upper Rogue M Rogue/Applegate	All	Temperature Low Flows

Actions	*Strategy*	*Population*	*Species*	*LFs Addressed*
I.C.12. Continue to coordinate with the USACE to ensure that Applegate Reservoir is managed to meet its fishery obligation, including flow augmentation in summer to benefit juvenile coho salmon and steelhead that rear in mainstem reaches of the Applegate.	*I-3*	M Rogue/Applegate	All	Temperature Low Flows
I.C.13. Continue to explore opportunities to protect and enhance ambient spring-fed streamflow in Big Butte Creek.	*I-2*	Upper Rogue	All	Temperature Low Flows
I.C.14. Work with partners to identify and map cold-water refuges to help prioritize protection and restoration; advocate for the importance of springs and seeps to keep them free flowing.	*I-2* *I-3* *I-4*	All	All	Temperature
I.C.15. Work with DEQ on Water Quality Trading to direct projects away from mainstem reaches to high priority areas/tributaries	*I-3*	Illinois M Rogue/Applegate Upper Rogue	All	Temperature
I.C.16. Work with the city of Grants Pass and partners on a pilot project exploring the use of treated wastewater for land application and/or groundwater injection to produce cold water input to the Rogue River.	*I-4*	M Rogue/Applegate	All	Temperature
I.C.17. Work with irrigation districts and partners to minimize risk for fish in streams used to convey summer irrigation releases; potentially adapt irrigation releases to eliminate rapid drops that strand fish, and improve conditions for fish during and immediately after irrigation season.	*I-3* *I-4*	Illinois M Rogue/Applegate Upper Rogue	All	Low Flows
I.C.18. Work with the city of Gold Beach to explore options to extend municipal water service to additional landowners.	*I-3* *I-4*	Hunter	All	Low Flows
I.C.19. Support onsite stormwater management for new development, but outside of riparian setback.	*I-3*	All	All	Flashy/High Flows
I.C.20. Recommend against reductions in riparian setback with new development to minimize risk of flood and erosion damage.	*I-4*	All	All	Flashy/High Flows
I.C.21. Recommend municipalities allow large wood to remain in streams where possible, including changes to urban “stream cleaning” programs where applicable.	*I-3*	Illinois M Rogue/Applegate Upper Rogue	All	Flashy/High Flows
I.C.22. Coordinate with NOAA and other partners to investigate the prevalence and effects of toxic pollutants in the Bear Cr watershed; expand to other developed areas as needed.	*I-3*	Upper Rogue (Bear Cr)	Coho	Toxic Pollutants

Actions	*Strategy*	*Population*	*Species*	*LFs Addressed*
I.C.23. Work with partners to reduce granite sediment input in sections of the interior Rogue. a. Post on website a list of watersheds where decomposed granite (DG) is dominant. b. Encourage additional caution in granite watersheds during land use planning in Grants Pass and Josephine County. c. Support BLM efforts to minimize road miles in DG-dominated watersheds. d. Support efforts to reduce excessive and or illegal off-road use in DG dominated watersheds. e. Recommend caution with fuels reduction in watersheds with DG to minimize chronic input.	*I-3*	M Rogue/Applegate Upper Rogue	All	Sedimentation
I.C.24. Recommend DEQ and ODA reach out to developers and agricultural interests on best management practices (BMPs) to keep excessive sediment out of streams.	*I-3*	All	All	Sedimentation
I.C.25. Work with City of Gold Beach, Curry County, and other local governments in developed locations on outreach to landowners concerning riparian vegetation ordinances and reducing exposed soils and fill along the banks.	*I-3*	Hunter	All	Sedimentation
I.C.26. Work with partners to conduct road inventory to identify potential issues and improvements.	*I-3*	Hunter	All	Sedimentation
I.C.27. Work with agencies with regulatory authority and project proponents to protect estuaries from bank armoring and filling.	*I-3*	Elk Euchre Hunter Pistol Chetco Winchuck	All	Other: Estuaries
I.C.28. Support land acquisition and easements along estuaries that would protect floodplain connectivity and promote water quality.	*I-3*	Elk Euchre Hunter Pistol Chetco Winchuck	All	Other: Estuaries
I.C.29. Conduct outreach about estuary water quality. a. Outreach to promote best management practices around commercial and recreational boat basins b. Support water conservation measures for the City of Brookings	*I-3*	Chetco	All	Other: Estuaries
D. Instream Physical Habitat				
See Actions **I.B.8–I.B.12; I.C.5–I.C.6**				
I.D.1. Recommend that large wood projects use trees that meet ODFW size criteria rather than engineered logjams or undersized wood installed in riverbanks, wherever possible.	*I-1*	All	All	Structure/Complexity

Actions	*Strategy*	*Population*	*Species*	*LFs Addressed*
I.D.2. Implement actions to increase habitat structure/complexity identified in coho salmon strategic action plans (SAPs), including the *Elk River Strategic Action Plan for Coho Salmon Recovery* and the Upper Rogue SAP currently in development.	*I-1*	Elk Illinois M Rogue/Applegate Upper Rogue	Coho	Structure/Complexity
I.D.3. Encourage planting Ponderosa pine in locations where it would naturally occur to increase riparian diversity and provide a future source of long lasting large woody debris.	*I-1*	Illinois M Rogue/Applegate Upper Rogue	All	Structure/Complexity
I.D.4. Work with Marine Board deputies, guides, and other river users to identify areas where large woody debris can remain in rivers, and not be removed as navigation hazards.	*I-3*	All	All	Structure/Complexity
I.D.5. Continue placement of spawning gravel, large wood, and boulders in Big Butte Creek.	*I-2*	Upper Rogue (Big Butte Cr)	All	Structure/Complexity

Habitat Access

Barriers to upstream and downstream passage, including migration barriers created at some water diversions, are primary limiting factors for all plan species in the Middle Rogue/Applegate and Upper Rogue population areas, and potential limiting factors in the Illinois population area. Development in the interior Rogue Basin has left a legacy of fish passage barriers that limit access to habitat and constrain fish movement needed to maximize freshwater production. Environmental extremes increase the severity of partial barriers, often preventing production in miles of fish habitat in some streams of the Rogue watershed.

Passage barriers like poorly designed and installed culverts also create an insidious and added risk of predation by birds and mammals. Barriers on tributaries block upstream migration by juvenile salmon and steelhead, causing high juvenile densities below barriers. This mirrors the migration impact for adult salmon and steelhead at dams on mainstem rivers. Predation risk increases due to unnaturally high densities of fish struggling to pass barriers.

In recent years, collective effort in the Rogue Basin has removed several major barriers and improved passage at many other priority sites, but a large number of smaller barriers remain across the landscape. *Restoring full passage at these barriers will increase resilience to climate change by increasing the productive capacity of watersheds and improving access to cooler water habitats* (Doppelt et al. 2008; Beechie et al. 2013). The importance of full and free passage for wild steelhead is underscored by the fish response to the hot and dry summer climate of the interior Rogue. Juvenile steelhead in the Rogue migrate between tributaries and mainstem reaches repeatedly during multiple years of freshwater rearing. Summer steelhead spawning streams are generally unsuitable for rearing (streams which are not intermittent become inhospitable for salmonids in summer by virtue of high temperatures and low flows) and nearly all summer steelhead juveniles have to rear in the mainstem Rogue or large tributaries (Everest 1973).

Actions in **Table 11** to address passage and diversion are primarily targeted at interior Rogue populations. Due to the large number of barriers and diversions present in these watersheds, prioritization of barrier removal is critical. ODFW will develop and maintain a list of Rogue Basin priority barriers to direct action toward sites where restoring passage will have the maximum benefit for native migratory fish. ODFW will also continue to utilize the Statewide Fish Passage Priority List to identify high priority sites for passage restoration. Barriers and diversions are not considered a primary or secondary limiting factor in Coastal Stratum basins, where plan species can access the vast majority of historical habitat. Nevertheless, ODFW will continue to work with partners to restore fish passage at priority sites in these watersheds, particularly those identified in the Statewide Fish Passage Priority List.

Peripheral connection (access to floodplains, side-channels, and wetlands) is a secondary limiting factor in most population areas, including the Middle Rogue/Applegate, Upper Rogue, and all populations in the Coastal Stratum. Coastal Stratum streams generally have small floodplains due to geomorphology in these basins, and the few areas with larger floodplains have been disproportionately affected by human development and infrastructure. In the interior Rogue Basin, many streams have larger floodplains, but

peripheral connection has been lost or is at risk. Restoring floodplain connectivity is an opportunity at some priority sites like the publicly owned land on lower Elk Creek in the upper Rogue. Due to high costs that can divert funding away from projects that address primary limiting factors, ODFW emphasizes the restoration of natural processes like fostering riparian input of large woody debris as the preferred approach to fostering connectivity, along with passage restoration to restore linear connectivity on small floodplain tributaries. *Actions to maintain or increase peripheral connection can ameliorate climate change effects by providing thermal and flow refugia, as well as supporting life history diversity* (Doppelt et al. 2008; Beechie et al. 2013).

Water Quality and Water Quantity

Limiting factors related to water quality and quantity are of primary importance for all populations covered by this plan. Water quality and quantity are discussed together here because stream temperatures are linked to flow regimes (Poole and Berman 2001), and many actions will address limiting factors in both categories. The RSP planning area experiences hotter, drier summer weather conditions than coastal basins to the north. As a result, summer and early fall is a bottleneck for juvenile fish production for RSP species, all of which spend at least one year in freshwater prior to out-migration. Water withdrawals, loss of riparian vegetation, land management practices, and other factors have contributed to declines in summer base flows and high stream temperatures that negatively affect rearing capacity for juvenile salmonids. *Climate change is expected to exacerbate these effects due to increased air temperature, reduced snow pack, and greater human demand for limited water resources* (see **Table 5** and **Appendix IV – Climate and Ocean Change Assessment**). **Table 11** lists actions to address temperature and low flows as limiting factors for plan species. Implementation of these actions will address multiple limiting factors, including impacts from non-native minnows (see **Other Species Actions**), *as well as ameliorate changes in stream temperature and base flow expected with climate change.* For stream temperature, riparian protection and restoration are particularly important because stream shading has the potential to reduce stream temperatures even in a warming climate (Wondzell et al. 2019), especially in smaller streams.

Temperature and low flows are the most important and pervasive limiting factors related to water quality and quantity, but there are several other secondary or potential limiting factors in these categories. Flashy/high flows are identified as a potential limiting factor in most population areas, *and may become more severe with climate change* (**Table 5**). Implementation of **Actions I.B.11**–**I.B.13** and **Actions I.C.19**–**I.C.21** will reduce risk from flashy/high flows for plan species. Toxic pollutants are considered a potential limiting factor in Bear Creek, the most urbanized watershed in the Rogue Basin. ODFW will coordinate with partners to investigate potential effects of toxic pollutants in Bear Creek (**Action I.C.22**) and track emerging science on the effects of toxic pollutants.

A Note on Toxins

The effects of toxin pollution from anthropogenic chemical compounds as a limiting factor for salmonid populations has received less attention than physical habitat restoration (NRC 1996). While acute pollution events such as toxic spills have a clear and direct mortality impact, examining the indirect effects at appropriate spatial scales must overcome the ecological complexity of

exposure routes across trophic groups, time, and space, and the combinatorial toxicity of co-occurring pollutants from both point and non-point sources (Laetz et al. 2009; Macneale et al. 2010; Ross et al. 2013). In addition, it is now recognized that most chemical toxins affect individual fish health and populations through protracted and convoluted biological processes. These include effects at low concentrations that alter metabolism and behavior, influence sexual differentiation, degrade immune function, and limit growth and development (Ross et al. 2013; Baldwin et al. 2009). The result is a reduction in fitness that can have consequences for population performance (e.g., increased vulnerability to disease and predation, pre-spawn mortality, and homing ability). Recent research has shown that these effects can severely reduce spawner abundance in urban watersheds (Feist et al. 2011; Tian et al. 2020). Given recent findings and as new information emerges, the relative role of toxins as a limiting factor on salmonid performance merits additional attention, particularly in watersheds with significant urban development. In the RSP planning area, toxic pollutants are most likely to act as limiting factor in the Bear Creek watershed in the Upper Rogue population area.

Excessive sediment is not considered a broadscale problem for RSP populations. Sedimentation is identified as a secondary limiting factor in the Hunter Creek and Upper Rogue population areas, and a potential limiting factor in the Middle Rogue/Applegate population area. Problems in the interior Rogue are associated with disturbance in watersheds with granitic geology. As an example, Vannoy and Lathrop creeks near Grant Pass are choked with a tremendous amount of decomposed granite sediment. ODFW would like to work with multiple partners to clean up excessive sediment in these fish bearing streams, beginning with the need for much stronger best management practices coming from Josephine County to guide development. **Actions I.C.23**–**I.C.26** are intended to reduce impacts from sedimentation, primarily through implementation of best management practices that reduce chronic sediment sources. Finally, **Actions I.C.27**–**I.C.29** address water quality in estuaries, a secondary limiting factor in all Coastal Stratum populations.

Citizen involvement is a key component of several of the actions listed above. Volunteers already provide crucial assistance to the salmon and steelhead of Oregon through participation in ODFW's Salmon Trout Enhancement Program (STEP). Public outreach and volunteer efforts can contribute to riparian protection and restoration, identify opportunities to protect and restore in-stream flows, and improve water quality and quantity monitoring. ODFW will coordinate with partners to develop outreach materials and volunteer opportunities focused on water quality and quantity, including citizen science initiatives. In addition to participation in restoration projects and monitoring, this plan challenges citizens to become involved in all aspects of land use planning and permit reviews, to help ensure that agencies follow through on regulatory responsibilities, and both fish populations and communities grow together. Public outreach to achieve the goals above would benefit from a greater focus on the social dimensions of habitat protection and climate change adaptation. ODFW will look for opportunities to collaborate with social scientists and other partners to help achieve desired habitat protection and enhancement outcomes (see **Action VI.H.4**).

Instream Physical Habitat

Habitat structure/complexity is a primary limiting factor for coho salmon in the Elk River Basin, and a potential limiting factor for all populations in the Rogue Basin. Actions to address this limiting factor are listed in **Table 11**.

Increasing habitat structure/complexity through placement of large wood or boulders can provide a short-term benefit to plan species, and several locations where these activities are likely to provide the most benefit are identified in **Table 11**. Over the long term and at the landscape scale, riparian protection and restoration are key to maintaining habitat structure and diversity, growing large trees as a source of large woody debris falling into streams. *As noted above, riparian management is also critical for mitigating climate change impacts.* ODFW will promote riparian protection through several channels and work with restoration practitioners to increase the scope and efficacy of riparian restoration in priority watersheds.

The work of beavers can provide a low-cost tool for addressing multiple limiting factors, and beavers are included as a distinct management strategy in the RSP as a result. **Action I.C.5** promotes beavers to increase water quantity and stream complexity.

Beavers are present in RSP streams, but not all beavers build dams and beavers are not necessarily visible to the public. ODFW habitat surveys document beaver activity and beaver dams among a variety of stream metrics. It might surprise some members of the public to know that surveys in the interior Rogue over the last 20 years show an increasing trend for beavers. Beavers show surprising resilience in specific tributaries, including urban Bear Creek.

ODFW recommends that protection and restoration of diverse riparian habitat be the focus for beaver restoration, along with work to help landowners learn to live with beavers. This is different than more intensive approaches like translocation. ODFW also proposes to put most work in the interior Rogue into specific “Beaver Emphasis Areas”: Elk Cr (Upper Rogue), Evans Cr (Mid Rogue/Applegate), and Deer Cr (Illinois). ODFW is also excited to partner in long-term monitoring to evaluate whether beavers can increase streamflow during drought by slowing the release of snowmelt in mid-high elevation areas of the Rogue, an action proposed in a local climate change planning report (Doppelt et al. 2008). An opportunity for monitoring appears possible in the Little Butte Creek sub-basin.

Although habitat modifications by beaver can provide significant benefits to salmonids, outcomes of beaver-related restoration efforts can vary widely depending on landscape context, social constraints, and other factors (Nash et al. 2021). During implementation of the RSP, ODFW will continue to track research on the effectiveness of different management strategies for promoting beavers and beaver-related pond habitat and will adjust management strategies and actions as needed to align with the best available science.

II. Other Species Actions

Management Strategies:

II-1. Support programs that reduce conflict between predators and anglers.

II-2. Assess predator impacts and feasibility of management options with an over-arching science approach across predators.

II-3. Implement a strategic approach to reducing impacts from non-native minnows, with a focus on water quality to favor salmon and steelhead. Remove non-native minnows where possible to reduce impacts on native fish.

II-4. Prohibit the introduction of non-native fin fish species into flowing waters, and develop and support programs designed to decrease illegal introductions of non-native species.

Steelhead, coho salmon, and cutthroat trout interact with other species in numerous, complex ways. Interactions such as predation, competition, and food availability have the potential to affect population status. Predation is often the most visible interaction, but competition can be equally or more important. For species covered by this plan, impacts from introduced minnows in the Rogue Basin and Hunter Creek (predation and competition by pikeminnow and competition with redside shiners) are the only interactions with other species currently thought to act as a limited factor or potential limiting factor. *Impacts from introduced minnows are strongly influenced by stream temperature, a synergy that could significantly increase their impact in a warming climate. Warming stream temperatures could also increase the distribution and impact of other introduced fish species, especially in the Rogue Basin. Thus, actions to reduce high stream temperatures that generally favor non-native fish (see **Habitat Actions**), actions to limit non-native minnow abundance directly, and actions to avoid introductions of other non-native species are all important proactive responses to climate change.*

Predation by pinnipeds (seals and sea lions) and avian predators (fish-eating birds) is a source of mortality for all RSP species, but is not currently considered a primary or secondary limiting factor for any population. ODFW acknowledges uncertainty about potential predation impacts and recognizes that impacts can change over time. Therefore, multiple research and monitoring actions regarding pinnipeds and avian predators are identified below. Regardless of whether there are conservation impacts, predation impacts both the fishing experience and Oregon's investment in hatchery resources. Therefore, this plan affirms support for an ongoing, successful program to reduce conflict between pinnipeds and anglers, and calls for additional actions to increase the effectiveness of that program.

Table 12 summarizes actions for **Other Species**. Additional detail and rationale for these actions are provided in the discussion below. As additional data and information becomes available through actions described below, ODFW will assess predator impacts and management options with a science approach that considers all sources of predation in the context of the life cycle of plan species. Assessment will take place at 12-year plan reviews or when significant new information becomes available.

Table 12. Other Species Actions.

Actions	*Strategy*	*Population*
A. Sea Lion Hazing		
II.A.1. Continue three-pronged approach (barriers on docks, hazing with non-lethal noise makers, and removal of easy food sources) to reduce pinniped-angler interaction.	*II-1*	Lower Rogue
II.A.2. Expand Port of Gold Beach fish cleaning station carcass program. a. Continue to modify private cleaning stations so that fish carcasses are not disposed of in the estuary. b. Encourage businesses to work with the Port of Gold Beach to assist with the disposal of salmon and bottom fish carcasses. c. Encourage businesses to manage carcasses as to not provide an easy food source for pinnipeds.	*II-1*	Lower Rogue
II.A.3. Educate anglers about carcass disposal at dispersed boat ramps attracting pinnipeds.	*II-1*	Lower Rogue Chetco
B. Pinniped Research and Monitoring		
II.B.1. Continue South Coast Pinniped Food Habits Study in 2021 to look at year to year variations in diet as ocean and river conditions change.	*II-2*	Lower Rogue Pistol River
II.B.2. Conduct genetic work on salmonid bones recovered from seal scat samples to identify which salmonid species are being consumed by seals in the Rogue River.	*II-2*	Lower Rogue
II.B.3. Determine potential impacts to returning salmonids and other prey and focus future collections to evaluate these issues.	*II-2*	Lower Rogue
II.B.4. Track and evaluate impacts (i.e., wounds, scarring) of pinnipeds on returning hatchery fish at Cole Rivers Hatchery and Applegate Dam.	*II-2*	M Rogue/Applegate Upper Rogue
II.B.5. Coordinate with Districts and hatchery managers to focus scat collection around hatchery releases to evaluate juvenile salmonid consumption.	*II-2*	Lower Rogue
II.B.6. Conduct statewide aerial survey of Pacific harbor seal breeding population during May and June 2021 contingent on funding and available staff.	*II-2*	All
C. Avian Predation		
II.C.1. Continue monitoring the abundance and distribution of avian predators in the lower Rogue River and estuary.	*II-2*	Lower Rogue
II.C.2. Continue monitoring avian predators across the Oregon Coast.	*II-2*	All
II.C.3. Continue removing barriers to fish passage in the interior Rogue to minimize avian and other predation.	*II-2*	Illinois M Rogue/Applegate Upper Rogue
D. Non-Native Fish Management		
II.D.1. Riparian protection and restoration (see Actions **I.B.8–I.B.10**).	*II-3*	All
II.D.2. Coordinate with Oregon DEQ on Middle Rogue monitoring and surveillance.	*II-2*	M Rogue/Applegate

Actions	*Strategy*	*Population*
II.D.3. Encourage pikeminnow removal in the Rogue River by angling. a. Conduct outreach and organize pikeminnow fishing events similar to one conducted in 2019 b. Include outreach to educate public about native suckers in the Rogue (Rogue District) and native pikeminnow in the Umpqua (Umpqua District)	*II-3*	Illinois M Rogue/Applegate Upper Rogue
II.D.4. Survey and remove non-local minnows in lower Jump off Joe Cr with volunteer assistance.	*II-3*	M Rogue/Applegate
II.D.5. Test techniques for pikeminnow removal on the lower Applegate River.	*II-3*	M Rogue/Applegate
II.D.6. Survey distribution of redside shiners in Hunter Cr.	*II-2*	Hunter
II.D.7. Avoid the introduction and establishment of non-native fish species. a. Prohibit introduction of non-native fish into flowing waters through the continuation and enforcement of fish transport permitting requirements (http://www.dfw.state.or.us/fish/private_ponds/index.asp) and prohibited and controlled non-native fish (OAR 635-056-0000). b. Take action to investigate and remove newly introduced non-native fish species whenever feasible.	*II-4*	All

Sea Lion Hazing

The Rogue Bay sea lion hazing program started in 2006 as a combined effort of sport and commercial fishing guides, Port of Gold Beach, National Marine Fisheries Service, and ODFW. When the program was implemented, angler estimates of hooked fall Chinook salmon taken by sea lions dropped from 50-75% to 5%. The program has continued to be extremely successful and is currently managed by the Port of Gold Beach. The program uses a three-pronged approach: barriers on docks, hazing with non-lethal noise makers, and removal of easy food sources at cleaning stations. The RSP calls for the three-prong approach to continue, including a specific focus on modifying private cleaning stations so that fish carcasses are not disposed of in the estuary and outreach about carcass disposal at dispersed boat ramps.

Pinniped Research and Monitoring

As noted above, predation by pinnipeds (seals and sea lions) is not currently considered a limiting factor for species covered by this plan. Nevertheless, pinnipeds do consume juvenile and adult salmonids and further research is warranted to understand potential impacts on wild and hatchery fish. The ODFW Marine Mammal Program has conducted research in the planning area for many years and re-instituted the collection of harbor seal scat on the south coast starting in 2019. Sea lion scat is collected opportunistically during other offshore activities at Rogue Reef. The Rogue and Pistol rivers are the focus of this work because pinnipeds are present in high numbers in the Rogue estuary and are common in the lower river (Brown et al. 2005), previous work has been conducted with respect to pinnipeds and salmonids in the Rogue River from 1995-1998 and can be used for comparison, and access to samples is available to researchers by land at both locations. Actions in this plan include continuing the South Coast Pinniped Food Habits Study in 2021 to look at year-to-year variations in

diet as ocean and river conditions change; conducting genetic work on salmonid bones recovered from seal scat samples to identify which species of salmonids are being consumed by seals in the Rogue River; and determining potential impacts to returning salmonids and other prey and focusing future collections to evaluate these issues. The ODFW Marine Mammal Program also plans to conduct a statewide aerial survey of Pacific harbor seal breeding population in 2021 to investigate population trends for this species.

In addition to research and monitoring by the Marine Mammal Program, ODFW will track and evaluate impacts (i.e., wounds, scarring) of pinnipeds on returning hatchery fish at Cole Rivers Hatchery and Applegate Dam. Pinniped predation attempts often leave distinctive wounds, and the incidence of wounds and scars could provide an indication of changing impacts over time.

Avian Predation

Predation of juvenile salmonids by fish-eating birds has been implicated as a potential limiting factor for populations of anadromous salmonids across North America and Eurasia, particularly for those stocks that are declining as result of other causes, such as habitat degradation. However, the impacts of avian predation on abundance of salmonids available for harvest or spawning escapement remain unclear, largely because of the tremendous complexity associated with freshwater, estuarine, and marine food webs, and numerous complex factors that influence survival across the salmonid life cycle. All fish-eating birds that occur in the Rogue Basin are protected under the federal Migratory Bird Treaty Act. In general, federal permits are required to “take” individuals for any purpose except during legal hunting seasons for certain species (i.e. mergansers).

Monitoring of abundance and distribution of fish-eating birds in the lower Rogue River has been ongoing since 2013. ODFW also conducts long-term monitoring of fish-eating birds across the Oregon Coast and participates in region-wide monitoring efforts. ODFW plans to continue these efforts and use information collected when assessing predator impacts. ODFW will also continue to work with partners to remove barriers to fish passage in the interior Rogue (see **Habitat Actions**), which can reduce avian predation on plan species at these sites.

Non-Native Fish Management

Redside shiners (*Richardsonius balteatus*) and Umpqua pikeminnow (*Ptycocheilus umpquae*) are native to other coastal rivers in Oregon, but not to RSP basins. Redside shiners were first documented in the Rogue Basin in 1957, and by 1962 had become widespread in the basin (Rivers 1964). They have since become established in Hunter Creek, as well. Umpqua pikeminnow were introduced in the Rogue Basin in 1979, and by 1990s, the species was common between Grants Pass and Gold Beach (ODFW 2013). Through competition, introduced minnows are considered a secondary limiting factor in the Middle Rogue/Applegate and Hunter Creek population areas, and a possible limiting factor in the Illinois and Upper Rogue population areas. Through predation, pikeminnow are considered a possible limiting factor throughout the interior Rogue. *Climate change could exacerbate impacts of introduced minnows because higher water temperatures favor redside shiners and pikeminnow in*

competitive interactions with juvenile steelhead (Reeves et al. 1987; Reese and Harvey 2002) and will likely increase pikeminnow predation on juvenile salmonids (Peterson and Kitchell 2001).

The RSP identifies several actions to monitor non-native minnow and reduce their impacts in the Rogue Basin and Hunter Creek. Keeping streams cool, particularly through riparian protection and restoration (see **Habitat Actions**), is the best way to decrease the distribution and abundance of non-local minnow populations and give plan species a competitive advantage. However, reducing non-native minnow abundance through direct removal may also be feasible in some locations. ODFW will implement pilot removal projects in Jumpoff Joe Creek and the lower Applegate River to investigate feasibility and effectiveness. ODFW will also encourage pikeminnow removal in the Rogue River by angling, an action called for in the *Rogue Spring Chinook Conservation Plan* (ODFW 2007). ODFW recognizes that pikeminnow in the Rogue are native to the neighboring Umpqua watershed, and that efforts to encourage angling mortality on pikeminnow in the Rogue could also affect the native Klamath smallscale sucker (*Catostomus rimiculus*). Therefore, ODFW will conduct educational outreach to the public about native suckers in the Rogue and native pikeminnow in the Umpqua in conjunction with outreach or events encouraging pikeminnow fishing.

ODFW will also continue proactive management to prevent impacts from non-native fish species by prohibiting the introduction of non-native fish into flowing waters, developing and supporting programs designed to decrease illegal introductions of non-native species, and taking action to investigate and remove newly introduced non-native fish species whenever feasible.

III. Hatchery Actions

Management Strategies:

III-1. Manage hatchery programs to provide optimal harvest opportunities and meet mitigation goals while being consistent with desired status targets for wild populations.

III-2. Manage hatchery programs to minimize risk to the long-term adaptive capacity of wild populations.

*III-3. Manage for wild fish emphasis or mixed emphasis in the appropriate Management Areas as outlined in **Figure 14** of the RSP and obtain Commission approval for starting new or eliminating existing hatchery programs in a Management Area relative to those in **Table 14** of the RSP (excluding educational and research programs and conservation actions).*

Hatchery programs, consistent with their original intent, are vital to providing fishing opportunity and supplementing harvest of wild fish. The vast majority (80%) of hatchery production in the RSP planning area is mitigation for wild production lost to construction of federal dams in the Rogue Basin. Impacts from hatchery programs are not considered primary or secondary limiting factors for any RSP population, but are identified as a potential limiting factor in the Upper Rogue and Middle Rogue/Applegate population areas through competition and/or predation (**Table 9**).

To ensure that hatchery programs do not negatively impact wild populations and continue to meet fishery augmentation and/or mitigation goals, the RSP includes actions to reduce risk from mitigation production and actions to improve fishing opportunity associated with mitigation releases. For all SMUs, the RSP designates management areas where hatchery fish will and will not be released, and establishes targets and limits for hatchery programs. These actions, along with program-specific changes detailed below, are intended to maximize fishery benefits of hatchery programs while ensuring that interactions with hatchery fish do not become a limiting factor for wild populations. *Maintaining the productivity and adaptive capacity of wild populations is critical to long-term viability, particularly given the potential impacts of climate change.* Hatchery actions in the RSP were developed to achieve this objective by keeping risk from hatchery fish low in all populations and managing adaptively based on research and monitoring. Hatchery actions are summarized in **Table 13**; additional detail and rationale for hatchery actions are provided in the discussion below.

In the RSP, the primary measure of hatchery risk will be the percentage of all naturally spawning fish that are of hatchery origin (referred to as "pHOS"). The level of naturally spawning hatchery fish is currently the most feasible way of assessing hatchery risk, though it may not capture all potential risks that hatchery fish might have on wild populations (competition, predation, disease) and can overestimate genetic introgression risk by not accounting for finer-scale spatial and temporal segregation of hatchery and wild fish on the spawning grounds. Studies have shown a link between the level of naturally spawning hatchery fish and wild population productivity (Chilcote 2003, Buhle et al. 2009, Chilcote et al. 2011) without identifying the mechanism for the impact to productivity, so pHOS appears to be a metric that can assess hatchery risk to productivity regardless of the source of the impact.

Table 13. Hatchery Actions.

Actions	Strategy	Population
A. Designate Wild Fish and Mixed Emphasis Areas		
III.A.1. Locate hatchery programs consistent with Mixed Emphasis Areas (MEAs) and Wild Fish Emphasis Areas (WFEAs) identified in **Figure 14**, including the *Euchre: Below Cedar Cr* and *Winchuck: Below Moser Cr* MEAs, which have no current or proposed hatchery programs; OFWC approval is required to eliminate a hatchery program from an MEA or initiate a hatchery program in a WFEA.	*III-1* *III-2* *III-3*	All
B. Establish Hatchery Management Targets and Limits		
III.B.1. Manage hatchery programs to meet the smolt release targets in **Table 14**, meet Rogue Basin hatchery mitigation targets (see **Appendix I-Additional Background Information),** and remain consistent with a pHOS limit of 10% in all populations.	*III-1* *III-2*	All
C. Minimizing Risk from Rogue Mitigation Production		
III.C.1. Promote harvest of adipose fin-clipped rainbow trout in summer in the upper Rogue River.	*III-1* *III-2*	Upper Rogue
III.C.2. Conduct volunteer angling survey for the relative abundance of hatchery steelhead smolts in the upper Applegate in summer. If prevalent, promote angler harvest.	*III-1* *III-2*	M Rogue/Applegate
III.C.3. As techniques and funding allow, genetically test hatchery steelhead in the upper Rogue to determine composition by run type (summer vs. winter steelhead) to inform broodstock collection protocols.	*III-1* *III-2*	Upper Rogue
III.C.4. Periodically collect wild winter steelhead broodstock in upper Rogue at locations other than the hatchery.	*III-1* *III-2*	Upper Rogue
III.C.5. Release restored hatchery coho production (25,000 smolts) near Gold Hill.	*III-1*	Upper Rogue
D. Winter Steelhead		
III.D.1. Establish an acclimation site in the *Chetco: below Nook Cr* Management Area.	*III-1* *III-2*	Chetco
III.D.2. Expand Chetco winter steelhead program by increments of 10,000 as long as pHOS within the whole basin averages <10% at a five-year review.	*III-1*	Chetco
III.D.3. Continue winter steelhead hatchery smolt acclimation in Skunk Creek and Greens Creek in the *Middle Rogue Urban* Management Area.	*III-1*	M Rogue/Applegate
III.D.4. Establish a new winter steelhead hatchery smolt acclimation in a tributary of Jump Off Joe Creek; shift 15,000 smolts from Applegate release to acclimation and release at Jump Off Joe Creek.	*III-1*	M Rogue/Applegate
III.D.5. Implement additional pHOS monitoring, including monitoring associated with smolt acclimation in the Middle Rogue (see **Research and Monitoring Actions**).	*III-1* *III-2*	Chetco M Rogue/Applegate Upper Rogue
E. Summer Steelhead		
III.E.1. Truncate period when "recycling" hatchery summer steelhead.	*III-1* *III-2*	Upper Rogue
III.E.2. Revisit the Rogue River Summer Steelhead Task Force recommendation in 1990 to increase summer steelhead hatchery production.	*III-1* *III-2*	Upper Rogue
F. Coho Salmon		
III.F.1. Increase coho salmon release target from 75,000 to 100,000 smolts.	*III-1*	Upper Rogue

Mixed Emphasis and Wild Fish Emphasis Areas

Table 14 identifies all of the Management Areas[11] defined in the RSP and shows current and/or proposed hatchery releases in each area. Management Areas shown in tan in **Table 14** and **Figure 14** will be managed as Mixed Emphasis Areas (MEAs). MEAs are defined as Management Areas which may be stocked with hatchery fish. The use of the term "mixed emphasis" in the RSP is intended to underscore that natural production is the overriding objective through the entire region, regardless of the existence of hatchery programs that are being implemented to meet specific objectives.

Two small MEAs (*Euchre Cr: below Cedar Cr* and *Winchuck R: below Moser Cr*) have no current or planned hatchery releases. **The MEA designation for these sites is intended to provide flexibility for future management of fall Chinook salmon, which would be subject to pHOS limits established in the *Rogue Fall Chinook Salmon Conservation Plan* (ODFW 2013)**.

Producing hatchery fish for harvest in MEAs will not be at the expense of the long-term viability of the wild populations residing in those Management Areas. All returning hatchery fish, above the number needed for broodstock, are intended to be harvested by anglers and not spawn in the wild. To minimize short- and long-term viability risk, a 10% pHOS limit will apply across all populations, including those with MEAs. This pHOS limit is consistent with other state and federal conservation and recovery plans (e.g., ODFW 2010; ODFW 2011) and is a low-risk threshold based on the integrated broodstock management practices used by hatchery programs covered by this plan (HSRG 2014). Consistent with the NFCP and feasibility, pHOS will be monitored and the limit will be applied at the population scale and not at the Management Area scale[12]. Whenever possible and appropriate, ODFW will report counts of hatchery and wild fish for all Management Areas with caveats about precision and utilization that will likely arise due to the scale of monitoring. The pHOS limit is intended to be evaluated annually as a running 9-year average. During the first 9 years of plan implementation and data collection, pHOS will be evaluated annually as a multi-year average based on available information to determine if any adaptive management is needed.

ODFW will adaptively manage hatchery programs to remain consistent with the pHOS limit, but the true management objective is to ensure adequate productivity and viability of wild populations, which will be periodically assessed (see **Implementation**) along with the adequacy of the pHOS limit. ODFW will also work, in coordination with the Oregon Hatchery Research Center, to better understand the impact of hatchery fish on wild populations, as well as how best to assess that impact more directly than through measurements of pHOS (e.g., measuring genetic introgression).

Management Areas shown in green in **Table 14** and **Figure 14** will be managed as Wild Fish Emphasis Areas (WFEAs), to keep the risk from hatchery fish at very low levels. Wild Fish Emphasis Areas are defined as Management Areas which are not stocked with any hatchery fish. In most WFEAs, straying of hatchery fish from nearby and more distant hatchery programs onto natural spawning grounds is

[11] Management Areas are composed of one or more 5th field Hydrologic Units (federal watershed classification system), except where these do not align with population boundaries.
[12] pHOS will be estimated using the best information and methods available.

expected to be very low. Note that the management emphasis in WFEAs is related to hatchery risk and does not necessarily suggest that these areas should be priorities for restoration or protection (which will be determined though the prioritization processes described in the **Habitat Actions** section).

Table 14. Smolt release targets for hatchery programs in the RSP planning area, which are intended to be met on average over time. Educational and short-term research programs are not documented and are assumed to have little conservation or fishing opportunity impacts. Shaded cells indicate a program change (see text for additional details). "*" indicates a modification that may require additional funding. Abbreviations are: StW = winter steelhead, StS = summer steelhead, ChS = spring Chinook, ChF = fall Chinook.

= Mixed Emphasis Area **= Wild Fish Emphasis Area**

Stratum	Population	Management Area	StW	StS	Coho	ChS [a]	ChF [a]
Coastal	Elk	Elk R: below Bald Mountain Cr					275,000
		Elk R: above Bald Mountain Cr					
	Euchre	Euchre Cr: below Cedar Cr					TBD
		Euchre Cr: above Cedar Cr					
	Hunter	Hunter Cr					
	Pistol	Pistol R					
	Chetco	Chetco R: below Nook Cr	50,000				200,000
		Chetco R: above Nook Cr					
	Winchuck	Winchuck R: below Moser Cr					TBD
		Winchuck R: above Moser Cr					
	NF Smith	NF Smith					
	NADOTs	NADOTs					
Rogue	Lower Rogue	Rogue Bay				78,000	90,000
		Lower Rogue					
	Illinois	Illinois R					
	Middle Rogue/ Applegate	Wild & Scenic Corridor					
		Middle Rogue Urban	20,000 to 35,000	37,000	25,000*	91,000	
		Middle Rogue Focal					
		Applegate Valley					
		Applegate: below Dam	111,000 to 96,000				
		Applegate: above Dam					
	Upper Rogue	Upper Rogue Urban	132,000	183,000	75,000	1,430,877	
		Bear Cr					
		Upper Rogue Focal					
		Upper Rogue R: above Lost Cr					
		Middle Fork & S Fork Rogue					
		Total	**313,000**	**220,000**	**75,000 to 100,000**	**1,599,877**	**565,000**

[a] Spring Chinook salmon and fall Chinook salmon hatchery programs are included here for context, but are not covered by this plan; release targets for these SMUs are managed under the *Rogue Spring Chinook Salmon Conservation Plan*, *Rogue Fall Chinook Salmon Conservation Plan*, and CMP, and are subject to change consistent with those plans.

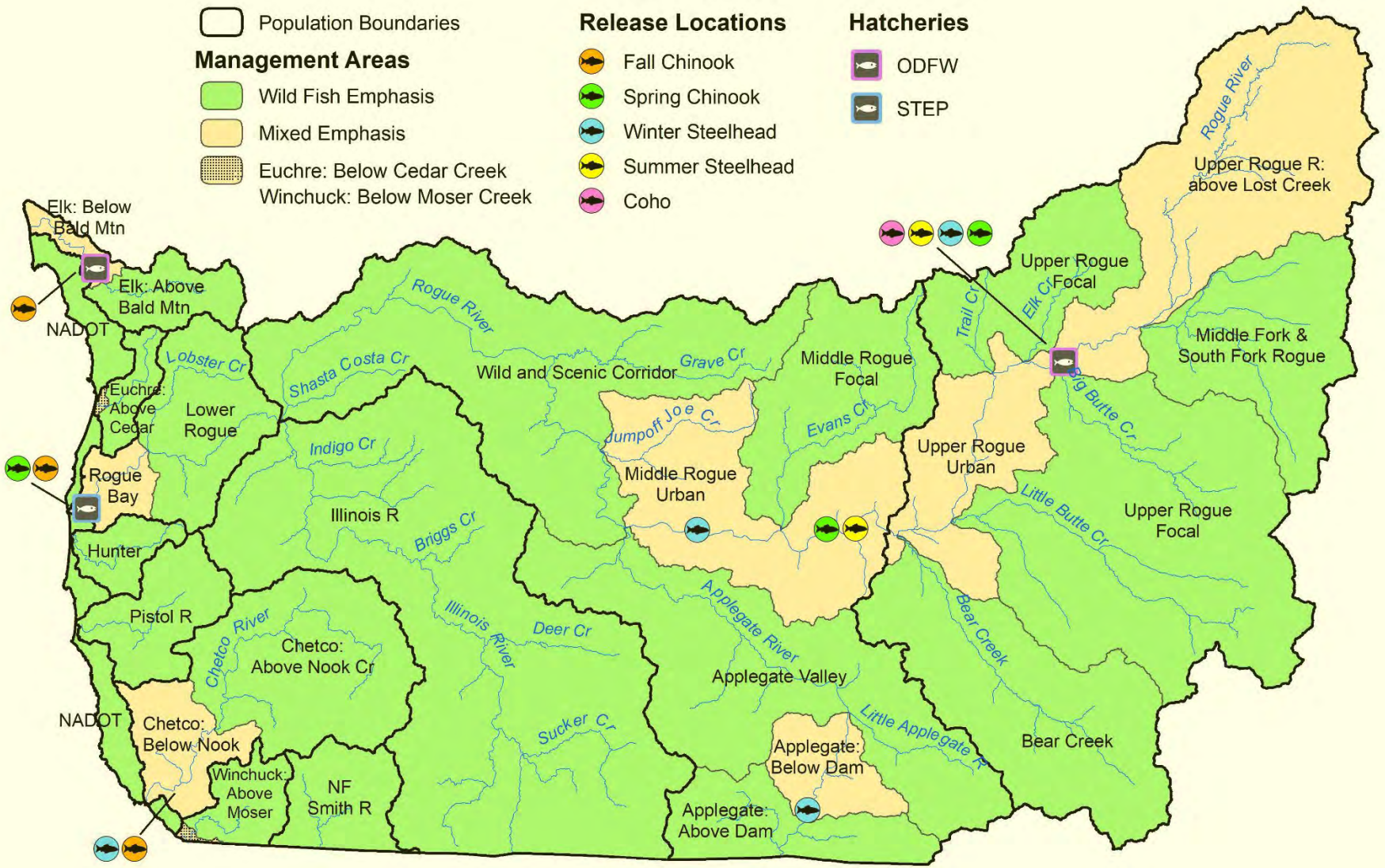


Figure 14. Management Areas designated as Wild Fish Emphasis Areas or Mixed Emphasis Areas within the planning area (all SMUs combined). Note that *Euchre: Below Cedar Creek* and *Winchuck: Below Moser Creek* are MEAs without current hatchery programs (see text).

Minimizing Risk from Rogue Mitigation Production

Predation and Competition

Monitoring on the spawning grounds and at the Elk Creek trap have indicated low stray rates for Rogue hatchery programs (Lewis et al. 2009; ODFW 2016a; ODFW 2016b), and hatchery fish are not considered a primary or secondary limiting factor for Rogue populations covered by the RSP. Nevertheless, hatchery smolts may pose some risk to naturally-produced juveniles through predation and competition. The primary species impacted by hatchery smolt predation would be mainstem spawning Chinook salmon—spring Chinook salmon on the upper Rogue and fall Chinook salmon on the Applegate. Almost all naturally-produced coho salmon and summer steelhead, as well as most winter steelhead, emerge in tributaries and not the mainstem.

Recent changes to hatchery production have reduced the number of smolts released from CRH each spring, reducing risk in the upper Rogue. This includes the reduction of coho salmon hatchery production from 200,000 smolts to 75,000 smolts in brood year 2013, and the release of some smolts off station in Gold Hill below spring Chinook salmon spawning habitat and newly emerged spring Chinook salmon fry. The RSP would add back a portion of the coho salmon production that was cut and would result in releases returning to half the pre-2013 target. The additional production would be released near Gold Hill to reduce predation risk in the upper Rogue (see *Coho Salmon* below).

Some steelhead residualize in the upper Rogue River based on angler catches in summer, and this is assumed to take place in the upper Applegate River, as well. This is not expected to result in significant fry predation after mid-May because naturally-produced fry are generally too large for hatchery smolts to consume by this time. However, residual smolts could have an impact due to competition with naturally-produced steelhead in the river. To reduce the risk of competition between naturally-produced steelhead and hatchery smolts that residualize, ODFW will promote harvest of adipose fin-clipped rainbow trout in summer in the upper Rogue River. In addition, ODFW will investigate whether hatchery steelhead are present in the upper Applegate in summer. If hatchery steelhead are prevalent, ODFW will promote angler harvest similar to the upper Rogue.

Broodstock Management

Rogue hatchery broodstocks were developed from naturally-produced Rogue fish that volitionally entered the hatchery (some Applegate winter steelhead were collected by various techniques), and during most of the intervening years, only those fish that volitionally entered the hatchery were included in the brood stock, including unmarked wild fish. Brood and spawning protocols were implemented to maintain historic run timing. These practices will continue, and ODFW will also periodically integrate wild fish from locations other than the hatchery to ensure that wild steelhead (as opposed to unmarked hatchery-origin fish) are being included in the broodstock. Wild broodstock collection will be periodic, limited in scope (20-30 adults), and will only occur in years when returns are expected to be above average. This approach minimizes short-term demographic risk and reduces long-term risk to wild populations from hatchery fish that stray onto the spawning grounds. Additional changes in broodstock management may be implemented based on research findings from the OHRC or elsewhere.

ODFW believes that the summer and winter steelhead broodstock management has successfully maintained separation between the two run types. To confirm this and inform broodstock collection protocols moving forward, ODFW will genetically test hatchery steelhead at CRH to determine composition by run type (summer vs. winter steelhead) based on the best available science regarding genetic run-timing markers and available funding.

Winter Steelhead

Chetco Winter Steelhead

The Chetco winter steelhead hatchery program currently releases, on average, 50,000 steelhead smolts annually. Hatchery smolts are released in the lower Chetco River, either at Social Security Bar or Loeb State Park. Broodstock is collected from the Chetco River by anglers, with a goal of incorporating at least 65% wild fish in the broodstock. Adults are transferred to Elk River Hatchery (ERH) to mature. Angler-caught wild broodstock are live spawned at ERH and then transported back to the Chetco River and released. Juveniles are reared at ERH and released as 1-year old smolts the following spring in the Chetco River.

An acclimation site will be established in the *Chetco: below Nook Cr* Management Area to increase smolt survival, reduce straying outside the MEA or adjacent watersheds, provide additional volunteer outreach, and increase angler opportunity. Smolts will be acclimated from February to early March. ODFW staff will identify an appropriate location for the acclimation site and develop a temporary facility that can be used for several years while effects on harvest and straying can be evaluated. A portion of the Chetco winter steelhead smolt production will be coded-wire tagged to assist in monitoring the acclimation site, straying, ocean distribution, and smolt-to-adult returns. If significant fishery benefits are observed and pHOS remains below established limits, infrastructure at the acclimation site will be improved to reduce annual costs and workload.

New monitoring will be implemented in the Chetco Basin (see **Research and Monitoring Actions**) to determine whether pHOS at the population scale is below the 10% limit established in this plan. If pHOS within the Chetco Basin averages <10% at a five-year review after plan adoption, ODFW will increase angler opportunity by expanding the Chetco winter steelhead program by 10,000 smolts. ODFW will continue annual monitoring to determine any effects on pHOS. ODFW will consider additional increases, in 10,000-smolt increments, at 12-year plan assessments (see **Implementation**) as long as pHOS within the whole basin averages <10%.

Rogue Community Involvement Projects

To improve harvest of mitigation hatchery production, ODFW will work with volunteers to implement Rogue steelhead community involvement projects. Projects will be consistent with Hatchery and Genetic Management Plans (HGMP) and any other relevant plans. Smolts for these projects will not be additional production, but shifts in the release location away from the Applegate trap, in order to improve angler access to hatchery returns and help address fishery concerns in the middle Rogue. Implementation of these projects depends on community support through volunteer assistance. One project, acclimation and release of up to 20,000 winter steelhead smolts in Skunk

and Greens creeks in Grants Pass, is underway and will continue under the RSP. If a suitable site can be found, an additional 15,000 smolts from Applegate winter steelhead production will be diverted to an acclimation release in a tributary of Jumpoff Joe Creek to increase angler harvest of hatchery fish.

To evaluate the benefits of Rogue steelhead community involvement projects, ODFW will track harvest trends in the middle Rogue and implement new spawning surveys in streams near the acclimation sites to monitor pHOS (see **Research and Monitoring Actions**). If Rogue community involvement projects result in elevated stray rates and population-scale pHOS exceeds the limit established in this plan, ODFW will re-evaluate these programs and make appropriate changes, which could include shifting releases back to the Applegate.

Summer Steelhead

The RSP does not call for any immediate changes in summer steelhead hatchery release targets or locations. The Rogue summer steelhead hatchery program is primarily a mitigation program, and current release levels are based on recommendations from the Oregon Governor's Rogue River Summer Steelhead Task Force in 1990 (ODFW 2016b). At that time, ODFW implemented the task force's recommendation to augment the mitigation release (150,000 smolts) with an additional 70,000 smolts to reach the current release of 220,000 smolts. Among RSP Stakeholder Team members, there was consensus support for revisiting the Governor's task force decision to increase summer steelhead hatchery production, and ODFW will review the 1990 recommendations to determine if they are consistent with current management and conservation needs for Rogue summer steelhead.

Hatchery summer steelhead support a popular fishery, and recycling hatchery steelhead captured at CRH downstream into the fishery increases fishing opportunity and angler harvest in the upper Rogue. Recycling is not thought to significantly increase straying, and monitoring has indicated low pHOS for summer steelhead in the Rogue Basin (ODFW 2016b). Nevertheless, as precautionary measure, ODFW will truncate the period when hatchery summer steelhead are recycled through the fishery to lower the risk of straying.

Some stakeholders have expressed concern that the prevalence of hatchery half pounders in summer in the Rogue puts wild steelhead at risk, purportedly by exceeding the carrying capacity of the mainstem Rogue. ODFW is not aware of any empirical data that supports this supposition. Most hatchery steelhead in the Rogue are released to replace, not augment, steelhead production. Hatchery smolts replace wild smolts that are no longer produced in very high-quality habitat blocked by USACE dams in the watershed. The presence of hatchery fish allows harvest opportunity in the mark-selective half-pounder fishery, a conservation measure recommended by ODFW (1994). Regulations allow the harvest of five hatchery half-pounders daily in the Rogue, so the ratio of hatchery to wild half-pounders counted at Huntley changes with time in the river due to harvest of hatchery fish.

Monitoring and reporting of steelhead abundance and trend relative to elements of status identified in the plan will allow ODFW to detect and adapt management as needed. For example, a drop into conservation status would be a point when adaptive management or the need to modify RSP actions

are considered by ODFW in order to correct the downturn before viability and life history diversity is put at risk. If hatchery fish are found to be a primary or secondary factor limiting production of wild fish, changes to hatchery steelhead programs will be among the alternatives implemented as part of adaptive management to improve population status.

Coho Salmon

In addition to being a mitigation program, the coho salmon program at CRH is intended to be managed as an artificial reserve for potential use in the recovery of Rogue Basin coho salmon, as well as provide monitoring opportunities for Rogue coho salmon (ODFW 1998). Monitoring opportunities include tracking ocean distribution and marine survival, as well as estimating wild coho salmon abundance in the Rogue Basin. The Rogue hatchery coho salmon program had a release target of 200,000 smolts for many years until it was dropped to 75,000 smolts in brood year 2013. This change was implemented to reduce predation risk for naturally-produced spring Chinook salmon fry in the upper Rogue River, reduce pHOS levels, and add to spring Chinook salmon production that has not been meeting mitigation objectives.

In recent years, low hatchery coho salmon returns have resulted in a very limited fishery and few hatchery coho salmon captured by the Huntley Park seining project, which depends on a robust estimate of the hatchery-wild ratio of returning adults to determine wild coho salmon abundance. To improve the fishery and Huntley Park estimates, this plan calls for an increase in the coho salmon release from 75,000 to 100,000 smolts (**Table 14**), pending funding for the increased production. To avoid predation risk for naturally-produced spring Chinook salmon fry, the additional 25,000 smolts would be released near Gold Hill, similar to the current off-site release for summer steelhead.

In RSP Stakeholder Team meetings, some participants expressed concern that hatchery coho salmon releases in the Rogue pose a risk to wild coho salmon and should be maintained at their current level or eliminated. The federally-approved *Operational Protocols with Emphasis on Genetics and Conservation Management for Coho Hatchery Stock 52, Cole M. Rivers Hatchery* (ODFW 1998) restrict pHOS to 10% or less in all naturally spawning populations to protect wild coho salmon from risks introduced by the hatchery program. Past monitoring indicated that pHOS was below 10% in the Upper Rogue population and the Interior Rogue Stratum overall when the release target was 200,000 smolts (Lewis et al. 2009). More recent data from returns at the current release target of 75,000 smolts—including observations on the spawning grounds and the ratio of hatchery to wild fish at Huntley Park—indicate that pHOS in the Rogue Basin is very low. Monitoring at Huntley Park, proposed ODFW spawning surveys in the Upper Rogue population area (see **Research and Monitoring Actions**), and ongoing surveys by federal partners in Elk Creek will indicate if there is a significant change in the ratio of wild and hatchery coho salmon spawners in the Rogue Basin, and thus a need for change in hatchery program management.

Finally, competition with hatchery fall Chinook salmon is identified as a potential limiting factor for coho salmon in Elk River. The CMP (ODFW 2014) identifies actions that address this potential limiting factor by reducing the number of hatchery-origin fall Chinook salmon on the spawning grounds, and these actions are currently being implemented.

IV. Fishing Actions

Management Strategies:

IV-1. Manage recreational fisheries to provide harvest and angling opportunities consistent with conservation of naturally produced steelhead, coho salmon and cutthroat trout, and achievement of desired status goals for each SMU.

IV-2. Manage fisheries proactively for the future and respond to changing environmental conditions.

IV-3. Collect appropriate data to manage wild fisheries.

Angling regulations for wild steelhead, coho salmon, and cutthroat trout in RSP basins have changed significantly in the last 30 years. Protections for wild fish have increased while a limited wild fish harvest opportunity has been maintained for certain species. Hatchery programs also have provided fishing opportunity. Fishing actions identified in this plan build on that framework to ensure the long-term conservation of each SMU while also allowing for fishery opportunities. Under the current regulation framework, ODFW does not consider fishing/harvest to be a limiting factor for any of the populations covered by this plan, and developed the actions below to ensure that this remains the case. *Actions are also intended to add to current proactive management in the face of climate change, consistent with ODFW's Climate and Ocean Change Policy.* To achieve these objectives, management actions in **Table 15** will be implemented. Management action details and rationale for each SMU are provided below.

The following discussion of Fishing Actions pertains primarily to the opportunity to harvest wild steelhead, coho salmon, and cutthroat trout. The RSP does not identify any changes to the allowable harvest limits of hatchery fish, although the opportunity to catch hatchery fish may be affected in some locations (i.e., where hatchery fish releases are shifted, increased, or reduced [see **Hatchery Actions**]).

Table 15. Fishing Actions.

Actions	Strategy	Population
A. General		
IV.A.1. Site-specific modification of angling regulations will be implemented to address conservation or fishing needs, including relative to population health, environmental conditions, site-specific angling practices, and others. This includes any feasible regulation changes, such as adjusting open locations or season, gear, size limits, or other angling regulations.	*IV-1* *IV-2*	All
B. Winter Steelhead		
IV.B.1. Implement new fishing authorizations described in **Table 16** to facilitate mandatory reporting, improve fishery data, and generate funds for monitoring.	*IV-1* *IV-2* *IV-3*	All
IV.B.2. Manage wild steelhead fisheries using new controls and interim regulations identified in **Table 17,** utilizing both a) improved harvest and population monitoring and b) conservation status thresholds based upon on-going monitoring for decisions.	*IV-1* *IV-2* *IV-3*	All
IV.B.3. After five years of implementation, conduct a review of harvest outcomes and spawning information; based on review, adjust regulations as needed to ensure consistency with harvest rate limits in **Table 17**.	*IV-1* *IV-2* *IV-3*	All
C. Summer Steelhead		
IV.C.1. Continue to prohibit harvest of wild summer steelhead, but consider limited wild harvest opportunity in the future if threats are ameliorated, abundance increases, and wild harvest opportunity is consistent with maintaining population viability.	*IV-1* *IV-2*	M Rogue/Applegate Upper Rogue
D. Coho Salmon		
IV.D.1. Continue to prohibit harvest of wild coho salmon, but work with NOAA to consider limited wild harvest opportunity in the Rogue Basin in the future when conditions merit.	*IV-1* *IV-2*	All
E. Cutthroat Trout		
IV.E.1. Maintain current cutthroat trout fishing opportunities.	*IV-1* *IV-2*	All

General Actions

Actions identified in this plan propose new controls in the allowable level of harvest of wild fish, how changes in those harvest levels will be determined, and the general time periods harvest will be allowed. Harvest limits by definition apply to anglers who choose to harvest fish. Anglers can certainly choose to practice catch and release, and ODFW provides instructions for safe catch-and-release practices in the fishing regulations. As part of implementing this plan, it may be necessary to adjust the streams (or sections of streams) open to wild fish harvest, or fishing in general. It may also be necessary to change gear requirements or fish size limits. These changes may be needed to protect spawning fish, unique runs of fish, or overly vulnerable fish in response to various changing conditions, including but not

limited to environmental conditions due to climate change (e.g., low flows, high temperatures)[13]. Any changes to these types of regulations will be consistent with the intent of the RSP and the concept of adaptive management outlined in the RSP, and will follow the process for modifying angling regulations.

Winter Steelhead

Winter steelhead populations in RSP basins support economically and culturally important fisheries utilized by diverse constituencies of local and non-local anglers. To better understand angler preferences and social viewpoints regarding the steelhead fishery, ODFW conducted an angler survey in 2019 (see **Appendix VI – Rogue–South Coast Angler Survey**). The survey found that a majority of anglers in the planning area and surrounding counties favored maintaining harvest opportunity for wild winter steelhead. This aligns with ODFW's current management of providing harvest opportunities while minimizing hatchery releases. Public comments and petitions for changes in angling regulations received by the Oregon Fish and Wildlife Commission indicate that there is also support for more protective regulations among some anglers and members of the general public. A full range of perspectives regarding the winter steelhead fishery were represented on RSP Stakeholder Teams that helped craft fishing actions for winter steelhead in this plan.

Fishing regulations for winter steelhead in RSP basins have changed considerably over the last 30 years. Prior to 1990, wild winter steelhead harvest was allowed in most RSP basins with a bag limit of 2 fish per day and 20 fish per year. Wild winter steelhead harvest rates in the Rogue Basin averaged 26% in 1978–1980, when the 2/20 bag limit was in effect (ODFW 1990). Public petitions to list RSP coho salmon and steelhead populations under the federal Endangered Species Act (ESA) began in the early 1990s, a period that featured a multi-year drought and a very large El Niño ocean event. All coastal steelhead populations were in a low period of abundance relative to estimates in the early 1970s (ODFW 1995). ODFW responded to the downturn with multiple management actions, including additional population monitoring and angling regulation changes.

For example, between 1991 and 1997, a suite of conservative angling regulations was developed on the Rogue to restrict angling impact on wild steelhead at all life stages and remains in place today:

- Protection for juvenile steelhead: almost all tributaries of the Rogue are closed to all fishing
- Protection for juvenile steelhead: wild trout fishing where allowed in the Rogue is closed to harvest (also precludes harvest of wild half-pounder steelhead)
- Protection for juvenile steelhead: the mainstem is closed to fishing during smolt outmigration
- Protection for adult summer steelhead: the fishery is closed to harvest of wild fish
- Protection for adult winter steelhead: wild harvest opportunity is limited to one per day and up to five per year; only fish over 24 inches may be harvested to provide additional protection for summer steelhead

[13] ODFW is developing climate adaptive angling regulation guidelines through a separate statewide process.

After a lengthy federal status review was completed and determined that listing the KMP Steelhead DPS under the ESA was not warranted, limited wild harvest opportunity with a conservative bag limit was maintained in the Rogue Basin and re-instated in some Coastal Stratum basins. Additional changes to angling regulations implemented as protective measures for steelhead have remained in place, including the suite of regulations for the Rogue discussed above, and seasonal closure of Coastal Stratum streams to protect spawning adults and out-migrating smolts.

From 2003 to 2018, wild steelhead harvest opportunity was allowed in portions of the Elk, Euchre, Hunter, Pistol, Chetco, Winchuck, and Rogue basins with a bag limit of 1 fish per day and 5 fish per year. Wild steelhead harvest opportunity in the Illinois River was restored in 2009. In 2018, the Oregon Fish and Wildlife Commission (OFWC) reduced the wild steelhead bag limit to 1 per day and 3 per year in SW Zone streams open to harvest as an interim measure while ODFW staff developed this plan. Since 2003, wild harvest has been allowed in a small proportion of winter steelhead distribution in RSP basins (approximately 15%; see **Figure 15**). Furthermore, only a portion of habitat open to wild steelhead harvest can be readily accessed by the public. The best information available indicates that this management framework has resulted in harvest rates at or below 15% in all populations, and below 10% in most populations (see **Appendix 1 – Additional Background Information**). Harvest and population monitoring in the Sixes River Basin in 2020 supported this conclusion (ODFW, unpublished data), but similar monitoring has not been conducted for RSP populations in recent years.

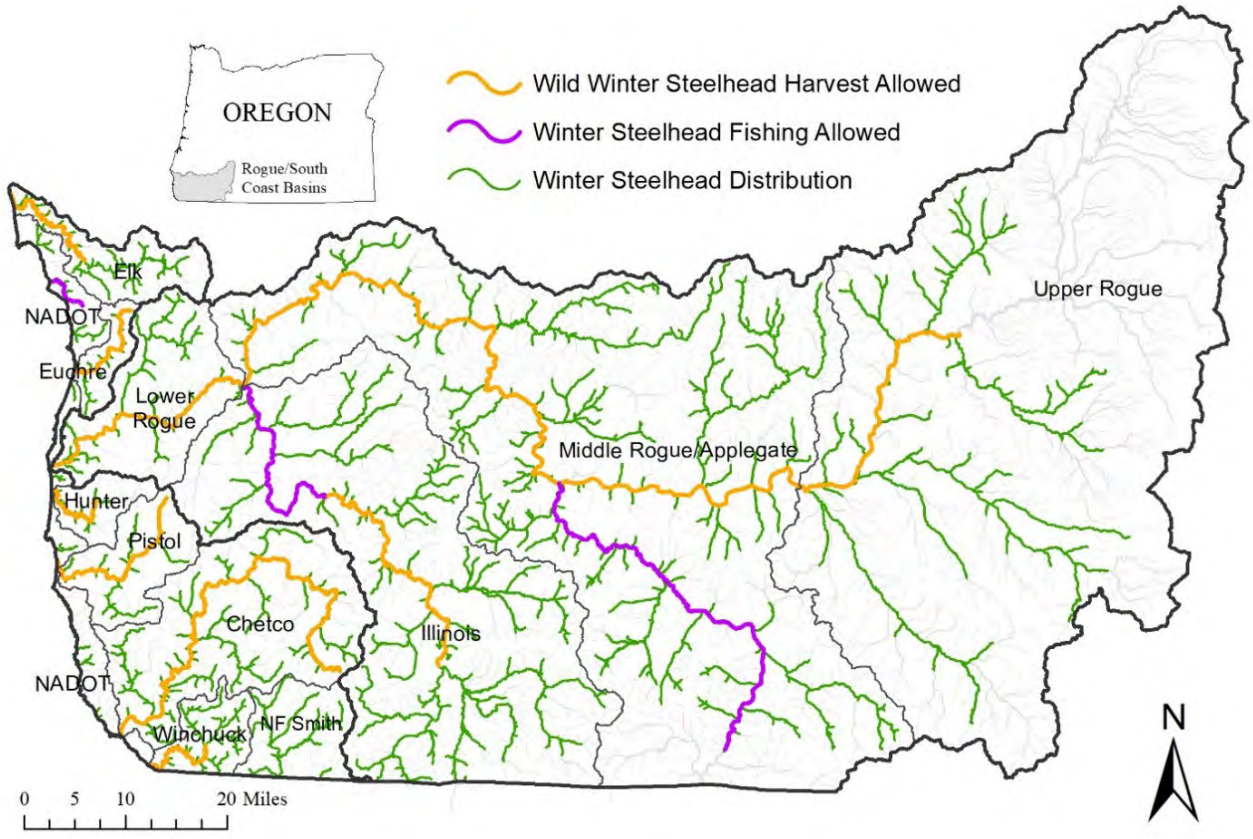


Figure 15. Locations open to wild winter steelhead harvest (orange) or winter steelhead fishing without wild steelhead harvest (purple) relative to winter steelhead distribution (green) in RSP basins at the time of plan development.

Wild Winter Steelhead Angling Framework

Based on the RSP Current Status assessment, viability risk for all winter steelhead populations is low and there is no indication that wild steelhead harvest is negatively impacting viability. ODFW does not consider harvest to be a limiting factor for RSP winter steelhead populations, but recognizes that reducing uncertainty about winter steelhead harvest and spawner abundance is critical for resolving concerns among stakeholders and the general public. Furthermore, ODFW's Climate and Ocean Change Policy directs the Department to "proceed with a precautionary approach that is most likely to result in conservation of native species across as broad a range of future conditions as possible, including when faced with scientific and management uncertainty." Thus, our winter steelhead angling framework is designed to meet the following criteria:

- Improves data on steelhead harvest through mandatory reporting
- Establishes a season structure to the winter steelhead fishery
- Tracks overall participation in the fishery, including catch and release angling
- Improves management through increased monitoring
- Establishes harvest rate limits
- Responsive to poor returns due to ocean conditions and downward trends due to deteriorating freshwater conditions (i.e., climate change)
- Maintains angling opportunity and addresses social concerns

The following sections detail the components of the wild winter steelhead angling framework, which include new fishing authorizations, angling controls, and interim angling regulations.

New Winter Steelhead Fishing Authorizations

Two new steelhead fishing authorizations will be implemented to track overall fishery participation, improve reporting of wild steelhead harvest, and generate funds for winter steelhead monitoring in the planning area (**Table 16**). At the proposed authorization costs, roughly $80,000 per year will be generated for monitoring[14].

First, a new *Rogue–South Coast Steelhead Validation* will be required to fish for winter steelhead in RSP basins and the neighboring Sixes River. The validation will allow ODFW to track total angler participation in the fishery, including catch-and-release-only anglers. Creel surveys (see **Research and Monitoring Actions**) will provide more detailed information about angler participation in individual fisheries, while the validation will provide an annual, comprehensive view of the fishery. A nominal fee for the validation will result in better information about fishery participation (compared to offering it for free), help cover costs of implementation, and potentially generate net proceeds for monitoring.

Second, a new *Rogue–South Coast Wild Steelhead Harvest Card* (WSHC) will be implemented in conjunction with the *Rogue–South Coast Steelhead Validation* to facilitate mandatory reporting of

[14] Estimate based on number of licensed anglers in the planning area and surrounding counties, Rogue–South Coast Angler Survey results, previous studies of the number of local and non-local anglers in RSP fisheries, and harvest card returns. Estimate depends on several key assumptions and actual proceeds may be substantially different.

wild steelhead harvest. The WSHC will be required to harvest wild steelhead in RSP basins and the Sixes River. Current voluntary Combined Angling Tag returns provide information about harvest, but expansion factors used to account for non-reporting may not be accurate at the scale of individual basins, particularly for small streams with relatively low fishery participation. Angler use of e-tagging in ODFW's Electronic License System (ELS) has improved reporting rates in recent years and will continue to do so as more anglers adopt this tagging method. However, many anglers continue to choose paper tagging and mandatory reporting from this group is needed to accurately determine wild harvest. Recording wild steelhead harvest on the WSHC, separate from the Combined Angling Tag, and requiring anglers to return the WSHC (or potentially report online) will accomplish this goal. Implementing a WSHC will also ensure that anglers purchasing daily or multi-day licenses comply with annual bag limits. Net proceeds from sales of WSHCs will be dedicated to winter steelhead monitoring in RSP basins.

Table 16. Description of new winter steelhead fishing authorizations.

Authorization	Proposed Cost [a]	Details
Rogue–South Coast Steelhead Validation	• residents: $2 • non-residents: $4	• Required for all anglers (resident and non-resident; annual and daily license holders) to fish for steelhead in RSP basins and Sixes R from Dec 1–Apr 30 • Issued by return year (Dec–Apr) • Net proceeds dedicated to winter steelhead monitoring
Rogue–South Coast Wild Steelhead Harvest Card (WSHC)	• residents: $10 • non-residents: $20	• Required to harvest wild winter steelhead in RSP basins and Sixes R (see **Table 17** for interim regulations) • Issued by return year (Dec–Apr) • Wild steelhead harvest recorded on WSHC and not on Combined Angling Tag • WSHC return is mandatory for anglers choosing paper tagging (reporting occurs automatically for e-tagging) • Net proceeds dedicated to winter steelhead monitoring

[a] Actual costs would ultimately be determined through a Legislative approval process.

New Winter Steelhead Angling Controls

The winter steelhead angling framework includes new controls that will act as management triggers for steelhead fishing (**Table 17**). The new controls will provide a structure for adaptively managing harvest impacts and implementing more protective regulations when needed.

Harvest rate limits for wild winter steelhead are one the new controls. Harvest rate limits vary based on population size (15% for the largest populations; 10% for other populations) and will be applied to individual populations in the Coastal Stratum, the Upper Rogue population, and the Rogue Stratum as an aggregate (**Table 17**). Harvest rates will be assessed as a multi-year average based on available data at the 5-year review, and as a 5-year running average thereafter. Changes to bag

limits, seasons, or other regulations will be made by fishery managers as needed to maintain harvest rates below limits set in the RSP.

Modeling for the Upper Rogue winter steelhead population using recent stock-recruit data (see **Appendix III – Current Status Methods and Results**) indicates that harvest rates below 20% have a very small effect on extinction risk (**Figure 16**). Assessments of winter steelhead populations outside the planning area have also concluded that harvest rates below 20% do not significantly increase extinction risk (ODFW 2014) and are very unlikely to result in overfishing (Scheuerell et al. 2021). Thus, proposed harvest rate limits are conservative, recognizing uncertainty about population dynamics in most RSP basins, as well as other potential sources of mortality, including catch-and-release angling. ODFW will track winter steelhead fishery participation and effort through the *Rogue–South Coast Steelhead Validation* and periodic creel surveys to assess whether significant changes in the overall impact of the fishery may be occurring.

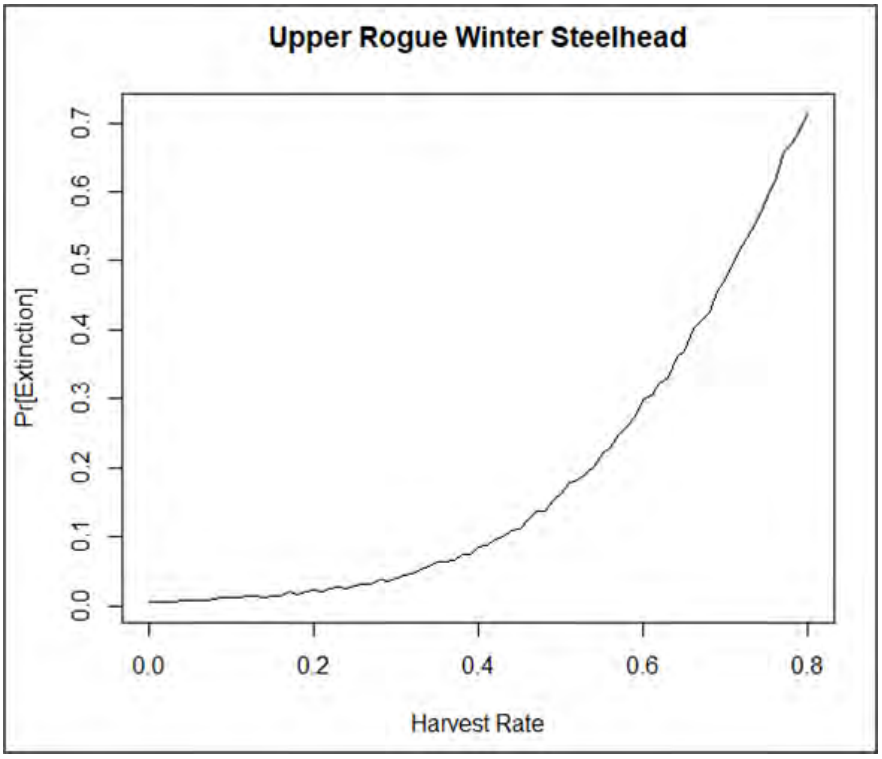


Figure 16. PVA model output of extinction risk (probability of extinction over a 100-year period) for Upper Rogue wild winter steelhead at various harvest rates. Modeling was based on recent stock-recruit data and does not account for proposed conservation restrictions during periods of low survival (new controls in the winter steelhead angling framework).

Another key control in the winter steelhead angling framework is the establishment of conservation status thresholds (**Table 8; Table 17**) that trigger changes in regulations to protect spawners when returns are expected to be low or if juvenile steelhead abundance or distribution appears to be contracting. If status metrics fall below conservation status thresholds based on a 2-year running average, angling regulations will be adjusted to reduce or eliminate fishing impacts on corresponding

adult returns (see **Table 17**); at a minimum, harvest will be temporarily suspended by implementing catch-and-release (CnR) or basin closure regulations (at ODFW's discretion, and excepting the Lower Rogue, where a 1/1 bag limit may also be considered). Other angling regulation changes or actions may be taken, as well. *This kind of control (scaling) is important to account for the typical fluctuations in population abundance, but is especially key in adapting to climate and ocean change. By establishing control levels, the RSP sets up harvest management rules that are responsive to any downturns in marine survival or freshwater productivity—ensuring harvest is at an appropriate level for the returning year class strength.*

Conservation status thresholds are based on ongoing monitoring of juvenile steelhead in the Coastal Stratum and half-pounders in the Rogue Stratum (**Table 17**). These metrics are available at least two years before cohorts return as adults, allowing for proactive, stratum-specific action to reduce harvest impacts. Historically, wild half-pounder returns in the Rogue Basin are strongly correlated with subsequent adult winter steelhead returns, making half-pounder counts a valuable predictor. ODFW will implement adult spawner monitoring in the Upper Rogue population area (see **Research and Monitoring Actions**) to confirm that this relationship continues to hold (Upper Rogue winter steelhead counts have not been available since the removal of Gold Ray Dam in 2010). For Coastal Stratum basins, the best available predictor of potentially low adult returns is the juvenile abundance index based on snorkel surveys, with additional consideration of marine indicators. As **Research and Monitoring Actions** described in the RSP are implemented, including monitoring of adult steelhead and marine productivity, additional forecasting tools may become available and new conservation status metrics and thresholds may be developed.

During RSP Stakeholder Team meetings, most participants expressed a preference for managing wild steelhead harvest primarily through bag limits and seasons, with the controls outlined in **Table 17**. Several Stakeholder Team members expressed a preference for a limited entry and/or quota-based approach to harvest management. ODFW does not believe these approaches are necessary at this time, but will continue to evaluate these options during plan implementation. The new steelhead fishing authorizations presented in this plan could be adapted to support a limited entry approach to steelhead harvest management.

Interim Winter Steelhead Angling Regulations

New interim winter steelhead regulations are presented in **Table 17**. The regulations maintain existing interim bag limits established by the OFWC in 2018 and set up a new season structure for winter steelhead fisheries. Variation in seasons among basins is based on run timing and protections for other runs of fish. Locations open to steelhead harvest (see **Figure 15**) would not change under the interim regulations. The interim angling regulations in **Table 17** will undergo review and potential revision five years after plan adoption. By this time, implementation of the new steelhead fishing authorizations, creel surveys, and adult spawner monitoring (see **Research and Monitoring Actions**) will allow ODFW to assess harvest rates and determine whether any changes in the angling framework are needed. If the 5-year review indicates that harvest rates are not consistent with the rates in **Table 17**, a public process will be initiated to revise angling regulations.

Table 17. Wild winter steelhead angling controls and interim angling regulations.

		Angling Controls [b]		Interim Angling Regulations [e]		
		Harvest Rate [a]	Conservation Status [c] (Metric: Threshold)	Bag Limit (daily/annual) [f]		
Stratum	Basin/Population Area			Aggregate [g]	Basin	Season
Coastal	Elk	<10%	• Juvenile abundance index: <30,000 **or** • Juvenile occupancy: <75% • Based on 2-year running average • Regulation changes apply in corresponding adult return year [d] • Marine indicators also considered (e.g., Huntley wild or hatchery ½-pounders)	1/3	1/3	Dec 1–Mar 31 Hunter Creek: Jan 1–Mar 31
	Euchre	<10%			1/3	
	Hunter	<10%			1/3	
	Pistol	<10%			1/3	
	Chetco	<15%			1/3	
	Winchuck	<10%			1/3	
	NADOTs (Brush Creek)	---			CnR	
	NF Smith	---			CnR	
Rogue	Lower Rogue	<15%	• Huntley wild ½-pounder index: <200 • Based on 2-year running average • Regulation changes apply in corresponding adult return year [d]		1/3	Dec 1–Apr 30
	Illinois					Dec 1–Mar 31
	Middle Rogue (CnR in Applegate River)					Feb 1–Apr 30
	Upper Rogue					Feb 1–Apr 30

[a] Harvest Rate (wild harvest/wild returns) measured annually (see **Research and Monitoring Actions**) and initially evaluated at 5-year review; in Rogue Stratum, harvest rate measured for entire stratum and Upper Rogue population.

[b] Additional within-basin regulations to address site-specific environmental conditions, angling practices, etc. can be considered (per **Action IV.A.1**).

[c] Note that new monitoring data may be used to develop new status metrics and thresholds, as well as forecasts. This will be formally considered at the 12-year assessment (see **Implementation**), but these data will be used prior to this for adaptive management purposes.

[d] If the 2-year running average falls below conservation status threshold, angling regulations will be modified as described in the text (page 85) to reduce or eliminate fishing impacts for the corresponding adult return year. Conservation status regulation changes will be applied using the following timing:
Coastal Stratum: Average of parr index or occupancy 3 and 4 years before adult return year (e.g., 2017 and 2018 average → 2020-21 return year).
Rogue Stratum: Average of wild ½-pounder index 2 and 3 years before adult return year (e.g., 2017 and 2018 average → 2019-20 return year); based on relationship with Gold Ray Dam count for adults.

[e] Interim angling regulations will be implemented for the first five years following plan approval.

[f] Bag limits apply to return year (Dec–Apr), not calendar year; CnR = catch and release.

[g] Aggregate bag limit applies across all locations in the Southwest Zone where wild steelhead harvest is allowed.

Harvest and Repeat Spawning

Iteroparity, the ability to spawn multiple times, is a key life history trait of steelhead that contributes to population productivity, resilience, and stability (Moore et al. 2013; Christie et al. 2018). Scale samples collected from adult winter steelhead in populations covered by this plan indicate that repeat spawning is common. In the Rogue Basin, ODFW (1990) found that repeat spawners accounted for 14.5% of wild winter steelhead spawners over a four-year period. In the Chetco River, 10–12% of wild winter steelhead sampled in creel surveys in the early 1990s were found to be repeat spawners (ODFW, unpublished data). These results are comparable to repeat spawning rates observed more recently at ODFW Life Cycle Monitoring sites on the Oregon coast (ODFW, unpublished data). Harvest has the potential to disproportionately affect repeat spawners because they are exposed to fisheries more than once. The low harvest rates established in this plan ensure that wild steelhead harvest has a minimal effect on repeat spawner abundance and does not select against iteroparity over the long term.

Summer Steelhead

The two populations of summer steelhead in this SMU (Middle Rogue/Applegate and Upper Rogue) exhibit life history diversity unique among Oregon steelhead populations and provide exceptional fishing opportunities. They are also considered a Sensitive Species. Whereas Rogue winter steelhead populations are anchored by intact habitat on federal forest land, summer steelhead spawning tends to be concentrated in small streams in watersheds where rural residential development is also concentrated. New residential development in rural areas may bring new risk through additional water use, reduction of riparian habitat, excessive nutrient input from poor stewardship with fertilizers and sanitation, and construction in streams like illegal dams and improper culvert construction. Summer steelhead specialize by spawning in streams that dry up naturally in summer, making this run even more susceptible to excessive water diversion and fish passage barriers that block movement between spawning tributaries and mainstem habitats (movement that is required to allow these fish to reach smolt size—a need for all Rogue steelhead). *These attributes also increase their vulnerability to climate change, highlighting the need for proactive management.*

Due to development threats and the need to protect and enhance Rogue summer steelhead populations, ODFW believes that stewardship is best accomplished by a mark-selective fishery at this time. Hatchery summer steelhead provide harvest opportunity throughout the Rogue River that is complemented by catch-and-release opportunity for wild summer steelhead. The Rogue summer steelhead hatchery program is primarily a mitigation program. Current release levels include additional production based on recommendations from the Rogue River Summer Steelhead Task Force in 1990 (ODFW 2016b). As noted in the **Hatchery Actions**, ODFW will review the 1990 Task Force recommendations to ensure that they are consistent with current management and conservation needs for Rogue summer steelhead. Monitoring in summer steelhead spawning areas (ODFW, unpublished data) and at Elk Creek Dam (ODFW 2016b) has indicated very low stray rates for the Rogue hatchery summer steelhead program. To further reduce risk of interactions between hatchery and wild summer steelhead, ODFW will truncate the period when hatchery summer steelhead captured at Cole Rivers Hatchery are recycled through the fishery. In addition, ODFW will promote the hatchery summer steelhead fishery and encourage harvest

of hatchery summer steelhead. These actions will increase utilization of hatchery production and decrease the number of hatchery summer steelhead that could potentially stray onto the spawning grounds.

Finally, there was consensus support in the Rogue Stakeholder Team for ODFW to review opportunity for limited wild summer steelhead harvest after the first full assessment (12 years after plan adoption). ODFW will consider limited wild harvest opportunity if threats to summer steelhead can be ameliorated, abundance increases, and monitoring indicates that wild harvest opportunity is consistent with maintaining population viability.

Coho Salmon

The coho salmon fishery on the Rogue has been a mark-selective fishery since 1994 (only adipose-clipped coho salmon may be harvested). A creel survey conducted in 1998 and 1999 verified that a mark-selective fishery would be consistent with NOAA requirements. Given the Sensitive-Critical status of the SMU, maintaining current regulations is the best way to support recovery of these populations at this time. However, if the status of these populations improves and critical uncertainties about population structure and abundance are resolved, limited wild harvest may be consistent with continued recovery. ODFW will begin a process working collaboratively with NOAA to identify a framework that would allow a limited opportunity for wild coho salmon harvest.

Currently, the mark-selective coho salmon fishery provides limited opportunity due to the reduction in hatchery releases (reduced by 62% beginning with the 2015 release) and low hatchery returns. To improve the fishery, the RSP calls for adding back a 25,000-smolt increase in hatchery production (see **Hatchery Actions**). In addition, renovations at Cole Rivers Hatchery (see **Facilities Actions**) are expected to improve incubation and rearing conditions, ensuring that production goals for hatchery coho salmon can be met on a regular basis. Together, these actions are expected to increase angling opportunity for hatchery coho salmon.

Coastal Cutthroat Trout

Current harvest regulations for wild trout in Coastal Stratum streams (2 trout per day, 8-inch minimum length) have been in place since 2001. Previously, the harvest fishery had been closed coastwide in 1997 as a precautionary response to declines in coastal basins outside the RSP area. In the Rogue Basin, harvest of wild trout has been prohibited in most streams (and most tributaries have been closed to all fishing) since the early 1990s to protect juvenile steelhead. There is no indication that current harvest regulations pose a risk to cutthroat trout, and additional fishing opportunity could be supported by these populations. To gauge public interest in modifying trout fishing regulations, ODFW's 2019 Rogue–South Coast Angler Survey included questions about 1) opening some tributaries of the Rogue currently closed to fishing; 2) increasing bag limits in Coastal Stratum streams currently open to trout fishing; and 3) changing cutthroat trout harvest size regulations to protect sea-run cutthroat trout. Opinions were split on these proposals, with slightly more opposition than support for all three. Angler survey results indicated that fishery participation is low, but fishing experience tended to be rated relatively high (although not for sea-run cutthroat specifically). Based on the angler survey response (see **Appendix VI**

– Rogue–South Coast Angler Survey) and consensus support in RSP Stakeholder Teams for maintaining current harvest regulations, no changes in trout fishing regulations are proposed.

In the middle and upper Rogue, fluvial cutthroat trout populations have shown increasing trends for a number of years based on angler reports and Elk Creek trap data. Mainstem dam removal now allows free passage of cutthroat trout throughout the mainstem as needed. Snorkel surveys in wadeable streams also indicate an increasing trend in cutthroat trout abundance in the Rogue Basin. An expanding cutthroat trout population may provide some control of non-local minnow populations. It is also possible that the population in the upper Rogue could reach a level that cutthroat trout predation will impact a spring Chinook salmon population that is trying to persist in artificially truncated habitat. As time and funding allows, ODFW may undertake a project to study food habitats of cutthroat trout within the range of spring Chinook salmon habitat. Based on the results, changes in harvest regulations for cutthroat trout in the mainstem Rogue may be warranted.

V. Research and Monitoring Actions

Management Strategies:

V-1. Identify and implement sustainable monitoring approaches that align with management and status determination needs.

V-2. Monitor appropriate metrics to document changing climate and ocean conditions and the impacts of those changes on plan species and their habitats.

V-3. Prioritize research that resolves critical uncertainties about SMU status and management strategy effectiveness.

V-4. Conduct research to reduce key uncertainties related to the response of plan species and their habitats to climate and ocean change.

Research and Monitoring Approach

ODFW's research and monitoring approach for SMUs covered by the RSP is guided by the NFCP and information needed to manage as called for in this plan. The NFCP states that conservation plans will include "specific, measurable criteria of species performance" and a "description of monitoring, evaluation, and research necessary to gauge the success of corrective strategies and resolve uncertainties." This section describes ODFW's research and monitoring plan, and presents actions needed to implement the plan (see **Table 20** below).

Monitoring

The RSP monitoring plan is intended to meet four primary needs: 1) provide information needed for harvest and hatchery management decisions, 2) track status of plan species based on specific, measurable criteria (see **Table 8**); 3) document changing climate and ocean conditions and the impacts of those changes on plan species; and 4) gauge the success of management strategies to address limiting factors. Ideally, biological and habitat attributes could be measured for all populations to meet these needs. In practice, the ability to monitor these attributes is limited. Therefore, this monitoring plan is structured to provide information about biological performance and habitat at several spatial and temporal scales (see overview in **Table 18** and **Table 19** below). In several cases, the method or spatial scale of monitoring is influenced by efficiencies of monitoring multiple species or populations. While the RSP monitoring plan reflects ODFW's current and planned efforts, the approach outlined below is dynamic and should be expected to change through time in response to monitoring and research results, implementation experience, adaptive management, and fluctuations in funding. When implementing the monitoring plan, new work is expected to be funded by a mix of shifts from current effort within and outside the RSP area, new funds generated by steelhead authorizations, and other yet-to-determined funding sources (see **Implementation**). ODFW will also consider using volunteers and citizen science to collect additional data that could augment or complement monitoring results described below. Note that some actions are tied to continued wild harvest opportunity and may be discontinued if that opportunity is no longer provided.

Table 18. Overview of proposed Coastal Stratum monitoring (see text below and Table 20 for details). New or improved monitoring is indicated in bold (see estimated costs in Table 23). Work is indicated at the designed scale of inference relative to populations. "Index surveys" are limited in scope and intended to track abundance trends in a population or at a specific site.

Population	Winter Steelhead		Coho Salmon		Cutthroat Trout	Habitat
Elk	**• Spawning Ground Surveys** **• Harvest Monitoring**	• Summer Snorkel Surveys	• Spawning Ground Index Surveys	• Summer Snorkel Surveys	• Summer Snorkel Surveys	• Physical Habitat Surveys **• Temperature and Flow Monitoring**
Euchre	**• Spawning Ground Surveys** **• Harvest Monitoring**		• Spawning Ground Index Surveys			
Hunter	**• Spawning Ground Surveys** **• Harvest Monitoring**		• Spawning Ground Index Surveys			
Pistol	**• Spawning Ground Surveys** **• Harvest Monitoring**		• Spawning Ground Index Surveys			
Chetco	**• Spawning Ground Surveys** **• Sonar Counting Station** [a] **• Harvest Monitoring** **• Creel Survey**		• Spawning Ground Index Surveys			
Winchuck	**• Spawning Ground Surveys** **• Harvest Monitoring**		• Spawning Ground Index Surveys			
NADOTs	–		–			
NF Smith	–		–		–	–

[a] Implementation will depend on a feasibility assessment (see **Action V.A.4**).

Table 19. Overview of proposed Rogue Stratum monitoring (see text below and Table 20 for details). New or improved monitoring is indicated in bold (see estimated costs in Table 23). Work is indicated at the designed scale of inference relative to populations. "Index surveys" are limited in scope and intended to track abundance trends in a population or at a specific site. Gray cells indicate there is no population present.

<table>
<tr><th>Population</th><th colspan="2">Winter Steelhead</th><th colspan="2">Summer Steelhead</th><th colspan="2">Coho Salmon</th><th>Cutthroat Trout</th><th>Habitat</th></tr>
<tr><td>Lower Rogue</td><td>–</td><td rowspan="4">• Harvest Monitoring [a]
• Lower River Creel Surveys [a]
• Adult Abundance Monitoring
• Huntley Park Seining (half-pounders)</td><td colspan="2"></td><td>• Spawning Ground Index Surveys</td><td rowspan="4">• Huntley Park Seining</td><td>–</td><td rowspan="4">• Physical Habitat Surveys
• Temperature and Flow Monitoring</td></tr>
<tr><td>Illinois</td><td>• Spawning Ground Index Surveys
• Fishing Effort Surveys</td><td colspan="2"></td><td>• Summer Snorkel Index Surveys</td><td>• Summer Snorkel Index Surveys</td></tr>
<tr><td>M Rogue/ Applegate</td><td>• Spawning Ground Index Surveys
• Creel Surveys</td><td>–</td><td rowspan="2">• Huntley Park Seining</td><td>• Summer Snorkel Index Surveys</td><td>• Summer Snorkel Index Surveys</td></tr>
<tr><td>Upper Rogue</td><td>• Spawning Ground Surveys
• Tributary Adult Count Station (Sonar or Trap)
• Harvest Monitoring</td><td>• Spawning Ground Index Surveys</td><td>• Spawning Ground Index Surveys
• Summer Snorkel Index Surveys</td><td>• Summer Snorkel Index Surveys</td></tr>
</table>

[a] Harvest monitoring and creel surveys will be used to estimate wild steelhead abundance and harvest for the Rogue Stratum.

Coastal Stratum Monitoring

The monitoring plan for Coastal Stratum populations includes ongoing long-term monitoring and new monitoring focused primarily on winter steelhead (**Table 18; Table 20**). Summer juvenile snorkel surveys will remain a key monitoring component, indicating status for steelhead and cutthroat trout through abundance and spatial structure metrics (**Table 18**, **Table A-V: 1**); and informing harvest management decisions for wild winter steelhead (see **Fishing Actions, Table 17**). ODFW will also continue to monitor adult coho salmon abundance in Elk River and other coastal populations with an index survey approach utilizing standard surveys that primarily target fall Chinook salmon. These surveys, combined with juvenile snorkel surveys discussed above, provide an efficient means for monitoring coho salmon presence in coastal basins.

New adult winter steelhead monitoring in Coastal Stratum basins (**Action V.A.2**) will provide population-scale spawner and harvest information needed to determine harvest rates, pHOS, and other steelhead management criteria (see **Hatchery Actions** and **Fishing Actions**). ODFW will implement spawning surveys that produce annual abundance estimates for Coastal Stratum populations. When an adequate time series is available, these estimates could be used to identify new status metrics for winter steelhead abundance. Survey design may vary among populations depending on basin size and access, and population estimates will depend on assumptions that will be validated through research (see **Table 20**). Implementation of new fishing authorizations with mandatory reporting (see **Fishing Actions**) will improve harvest estimates for all populations.

Several additional actions will focus specifically on winter steelhead in the Chetco Basin (**Table 20**). First, to improve pHOS monitoring, ODFW will conduct annual snorkel surveys in addition to spawning surveys (**Action V.A.3**). Second, ODFW will investigate the feasibility of using a sonar counting station as an alternative or complement to spawning surveys for winter steelhead (**Action V.A.4**). Finally, a statistical creel survey will be conducted in the Chetco within three years of plan adoption to validate harvest card information, recover coded wire tags from hatchery steelhead (see **Hatchery Actions**), and determine the current baseline for catch and effort (**Action V.A.6**).

In addition to biological monitoring, physical habitat surveys will continue in the Coastal Stratum. These surveys, which are conducted in conjunction with summer snorkel surveys, provide valuable habitat status and trend information, and will be augmented with new temperature and flow monitoring (**Action V.A.9**). ODFW will also explore opportunities to use data collected with remote sensing technologies to monitor habitat status and trend. *Together, these habitat monitoring approaches will indicate trends in freshwater habitat quantity and quality in relation to climate change or other factors affecting coastal basins.*

Rogue Stratum Monitoring

The monitoring plan for Rogue Stratum populations includes several long-term monitoring components, as well as new monitoring projects (**Table 19; Table 20**). Huntley Park seining will continue to be a critical monitoring tool, providing status metrics for adult summer steelhead, coho

salmon, and steelhead half-pounders (**Table 19**, **Table A-V: 1**); and informing harvest management decisions for wild winter steelhead (see **Table 17** in **Fishing Actions**).

New adult winter steelhead monitoring in the Rogue Basin (**Table 19**) will provide information needed to determine harvest rates, pHOS, and other steelhead management criteria (see **Hatchery Actions** and **Fishing Actions**). To facilitate this new monitoring, survey effort for winter steelhead in the Rogue Basin will shift from juvenile to adult steelhead. ODFW will estimate winter steelhead abundance in the Upper Rogue population and the Rogue Stratum as a whole, and conduct index surveys in other populations (**Action V.B.3; Action V.B.7**). Fixed counting stations (adult trap or Sonar station) in upper Rogue tributaries could provide additional abundance and/or pHOS information for specific watersheds if funding can be identified (**Action V.B.4; Action V.B.5**). ODFW considers adult trapping to be higher priority due to the potential to collect biological samples and lower cost compared to Sonar. When an adequate time series is available, abundance estimates from new monitoring could be used to identify additional status metrics for winter steelhead. Furthermore, abundance estimates will be used to validate the relationship between half-pounder counts and subsequent adult returns. Implementation of new fishing authorizations with mandatory reporting (see **Fishing Actions**) will improve harvest estimates for all populations. Additional fishery monitoring will be used to track catch, harvest, and/or effort in select locations (**Table 20**).

New adult monitoring is also proposed for coho salmon and summer steelhead (**Action V.B.2**). Targeted spawning surveys for these species would complement Huntley Park estimates by providing population-specific abundance and pHOS data. Additional funding will be needed to implement these surveys.

ODFW will continue to conduct juvenile snorkel surveys in the Rogue Basin, but the focus will shift to index surveys in core coho salmon rearing strongholds in each of the three interior Rogue populations (**Action V.B.9**). Targeted annual surveys in these areas will facilitate research on coho-habitat relationships and potential climate change impacts. Juvenile steelhead and cutthroat trout will also be enumerated in these surveys, but survey results will not be comparable to stratum-level estimates produced in the past.

Physical habitat surveys will continue in the Rogue Stratum with a new population-focused sampling design (**Action V.B.10**). These surveys will provide habitat status and trend information, and will be augmented with new temperature and flow monitoring (**Action V.B.11**). ODFW will also explore opportunities to use data collected with remote sensing technologies to monitor habitat status and trend. *Together, these monitoring approaches will indicate trends in freshwater habitat quantity and quality in relation to climate change or other factors affecting habitat in the interior Rogue Basin.*

Research

Research actions identified in this plan address the following needs: 1) reduce key uncertainties that limit ODFW's ability to assess status or management strategy effectiveness; 2) reduce key uncertainties related to the response of plan species and their habitats to climate and ocean change; and 3) investigate emerging monitoring techniques that can provide new or improved information compared to traditional methods. Research actions are listed in **Table 20** and are summarized below. Most actions are new research that will require additional funding to implement. The level of funding, staff, and external coordination needed to implement research actions differs substantially among projects, and research priorities will be re-evaluated regularly during plan implementation.

Coastal Stratum Research

In the Coastal Stratum, proposed research actions address key uncertainties related to population monitoring for winter steelhead (**Actions V.C.1**-**V.C.2**) and coho salmon (**Action V.C.4**), as well as uncertainty about coho salmon population structure (**Action V.C.5**). ODFW also proposes research concerning steelhead marine survival indicators and marine distribution (**Action V.C.3**; **Action V.C.8**) that could improve abundance forecast and our understanding of climate and ocean change effects on steelhead. Finally, ODFW proposes to investigate emerging genetic techniques (**Actions V.C.6**-**V.C.7**) that could potentially supplement or replace current abundance and pHOS monitoring.

Rogue Stratum Research

Proposed research for the Rogue Stratum includes several actions related to population monitoring and population structure. These actions focus on multiple species at Huntley Park (**Actions V.D.1-V.D.3; Action V.D.5**) and early-run summer steelhead in the upper Rogue (**Action V.D.6**). Similar to the Coastal Stratum, ODFW proposes research concerning marine survival indicators and marine distribution (**Action V.D.4**; **Action V.D.12**), as well as emerging genetic monitoring techniques (**Actions V.D.10**-**V.D.11**). In the Rogue Basin, these research topics would apply to winter steelhead, summer steelhead, and coho salmon. Additional actions for the Rogue include research on reintroduction of anadromous fish above large dams (**Actions V.D.8**-**V.D.9**), and research on the distribution and diet of sea-run cutthroat trout in the Rogue Basin (**Action V.D.13**).

Table 20. Research and Monitoring Actions. New proposed actions are in bold. Measurable criteria for desired and conservation status are in *italics*. Actions to implement the winter steelhead harvest framework are indicated by an asterisk (*). StW = winter steelhead, StS = summer steelhead, CCT = coastal cutthroat trout, ChF = fall Chinook salmon.

Actions (bold = new proposed action)	*Strategy*	*Species*	*Population*	*Metric/Target*
A. Coastal Stratum Monitoring				
V.A.1. Fall Spawning Ground Surveys Continue annual standard surveys in Coastal Stratum basins to monitor Elk River coho salmon abundance status metric, coho salmon spawner abundance in other coastal basins, and fall Chinook salmon status metrics for *Rogue Fall Chinook Salmon Conservation Plan*.	*V-1* *V-2*	*Coho* (ChF)	*Elk* Euchre Hunter Pistol Chetco Winchuck	*Abundance Index* pHOS
V.A.2. Winter Spawning Ground Surveys* Conduct spawning ground surveys in Coastal Stratum basins to annually estimate winter steelhead spawner abundance at the population scale. Due to access constraints, population estimates for the Chetco population will depend on assumptions that will be validated through research (see **Action V.C.2**) or other monitoring methods (see **Action V.A.4)**.	*V-1* *V-2*	StW	Elk Euchre Hunter Pistol Chetco Winchuck	Abundance
V.A.3. Chetco Winter Steelhead pHOS Surveys Conduct annual snorkel surveys on NF Chetco, Emily Creek, and SF Chetco, and potentially other sites. Use snorkel survey observations to estimate pHOS annually at the population scale. Estimates will depend on assumptions that will be validated through research (see **Action V.C.2**). Surveys will be conducted in other coastal basins as resources allow.	*V-1*	StW	Chetco	pHOS
V.A.4. DIDSON Sonar Counting Station in Lower Chetco River Use sonar to annually estimate winter steelhead abundance in the Chetco River. Identify and implement additional sampling needed to estimate the proportion of wild and hatchery fish passing the Sonar site. Implementation will require a feasibility assessment and will be considered in relation to other potential population estimation methods (see **Action V.A.2** and **Action V.C.2**).	*V-1* *V-2*	StW	Chetco	Abundance
V.A.5. Harvest Monitoring* Monitor annual harvest of wild winter steelhead (by run year) using ELS and new wild steelhead harvest card (see **Fishing Actions**). Continue to monitor harvest of hatchery steelhead and salmon using ELS and Combined Angling Tag returns. Use best available harvest data to monitor wild steelhead harvest rates annually for all populations.	*V-1*	StW	All	Harvest

Actions (bold = new proposed action)	*Strategy*	*Species*	*Population*	*Metric/Target*
V.A.6. Chetco Creel Survey Conduct statistical creel survey of Chetco winter steelhead fishery within three years of plan adoption to determine current baseline for catch and effort, validate harvest data collected through ODFW's Electronic Licensing System (ELS), recover coded wire tags from hatchery steelhead (see **Hatchery Actions**), and potentially collect scale and genetic samples. Additional creel surveys may be conducted in future years to validate and refine harvest estimates.	*V-1*	StW	Chetco	Harvest Fishing Effort
V.A.7. Summer Snorkel Surveys Continue GRTS-based (random) snorkel surveys to monitor juvenile (Age-1+) winter steelhead and cutthroat trout abundance and spatial structure status metrics annually at the stratum scale. Monitor juvenile coho salmon abundance and occupancy annually at the stratum scale. **Note:** sea-run cutthroat trout monitoring will be incorporated into snorkeling protocols (separate enumeration for sea-run and resident cutthroat trout); counts will be tracked as an index of abundance and potential status indicator.	*V-1* *V-2*	*StW* Coho *CCT*	*Coastal Stratum*	*Abundance Index* *Occupancy*
V.A.8. Summer Habitat Surveys Continue ODFW Aquatic Inventories (AQI) habitat surveys at GRTS snorkel sites to monitor status and trend in physical habitat in wadeable streams at the stratum scale.	*V-2*	All	Coastal Stratum	Physical Habitat (surface area, substrate, wood, shade, etc.)
V.A.9. Temperature and Flow Monitoring Improve annual temperature and flow monitoring in the Coastal Stratum with dedicated, representative sites maintained by ODFW or partners. Continue to document flow permanence in summer habitat survey sites (see **Action V.A.8**). Develop indices to track annual variation and long-term trends in freshwater rearing conditions, potentially in collaboration with other agencies or partners. Investigate relationships with juvenile abundance and adult returns to improve forecasts (steelhead and coho salmon) and/or trigger additional conservation measures.	*V-2*	All	TBD	Temperature Flow Flow Permanence
B. Rogue Stratum Monitoring				
V.B.1. Huntley Park Seining Project Continue Huntley Park seining to annually monitor late-run summer steelhead (abundance), coho salmon (abundance), and steelhead half-pounder (abundance index) status metrics at the stratum scale. Monitor status metrics for the *Rogue Fall Chinook Salmon Conservation Plan*. Collect tissue samples for genetic research projects, and scale samples from wild summer steelhead for age determination.	*V-1* *V-2*	*StS* *Coho* *Half-Pounders* (ChF)	*Rogue Stratum*	*Abundance* or *Abundance Index* Diversity

Actions (bold = new proposed action)	*Strategy*	*Species*	*Population*	*Metric/Target*
V.B.2. Fall Spawning Ground Surveys Conduct annual spawning ground surveys for coho salmon (with emphasis in Upper Rogue) and summer steelhead (M Rogue/Applegate and Upper Rogue) to monitor abundance and pHOS at index sites. Combine with survey positions that monitor status metrics for *Rogue Spring Chinook Salmon Conservation Plan* and *Rogue Fall Chinook Salmon Conservation Plan* to create contiguous 8–9 month seasonal positions. Continue annual standard surveys in the Lower Rogue to monitor Chinook and coho salmon spawner abundance.	*V-1* *V-2*	StS Coho (ChF)	Lower Rogue Illinois M Rogue/Applegate Upper Rogue	Abundance Index pHOS
V.B.3. Winter Spawning Ground Surveys* Conduct spawning ground surveys to annually estimate winter steelhead abundance and pHOS in the Upper Rogue; track relationship with Huntley Park half-pounder count to validate status metric. Conduct spawning ground surveys at index sites in the M Rogue/Applegate population area, including targeted surveys near acclimation sites (see **Hatchery Actions**) to monitor pHOS. Conduct index surveys in the Illinois Basin as time and resources allow.	*V-1* *V-2*	StW	Illinois M Rogue/Applegate Upper Rogue	Abundance or Abundance Index pHOS
V.B.4. Upper Rogue Adult Trapping Construct an adult trap in Little Butte Creek and evaluate efficacy as an abundance and pHOS monitoring tool. Collect scale and genetic samples.	*V-1* *V-2*	StW	Upper Rogue (Little Butte Cr)	Abundance pHOS Diversity
V.B.5. DIDSON Sonar Pilot Project for Upper Rogue Evaluate the efficacy of using sonar to estimate abundance of winter steelhead entering Upper Rogue tributaries through a three-year pilot project if funding available. If successful, may be applied to other Rogue tributaries and/or expanded to other species.	*V-1* *V-2*	StW	Upper Rogue (sites TBD)	Abundance
V.B.6. Harvest Monitoring* Monitor annual harvest of wild winter steelhead (by run year) using ELS and new WSHC (see **Fishing Actions**). Continue to monitor harvest of hatchery steelhead and salmon using ELS and Combined Angling Tag returns. Use best available harvest data to monitor wild steelhead harvest rates annually for Upper Rogue population and Rogue Stratum (see **Action V.B.7**).	*V-1*	StW	All	Harvest
V.B.7. Rogue Creel Survey* Conduct annual statistical creel survey of the Lower Rogue winter steelhead fishery to monitor harvest, effort, and proportion of wild and hatchery steelhead caught in the fishery (including steelhead caught and released). Use wild/hatchery ratio from the fishery, harvest data, and hatchery trap returns to estimate wild steelhead abundance for the Rogue Stratum. Validate harvest data collected through ELS and potentially collect scale and genetic samples. **Note:** Depending on funding availability, may be expanded to Applegate for abundance monitoring of wild steelhead.	*V-1* *V-2*	StW	Lower Rogue Rogue Stratum	Abundance Harvest Fishing Effort

Actions (bold = new proposed action)	*Strategy*	*Species*	*Population*	*Metric/Target*
V.B.8. Illinois Effort Survey Partner with the USFS and others to develop and implement protocol for estimating angler effort in the winter steelhead fishery between Briggs Creek and Pomeroy Dam. Compare to previous surveys and monitor trend. May include creel checks and/or collection of scale and genetic samples.	*V-1*	StW	Illinois	Fishing Effort
V.B.9. Summer Snorkel Surveys Conduct annual snorkel surveys at index sites in core juvenile coho salmon rearing areas to monitor abundance and occupancy. Prioritize sites with previous annual sampling by AQI/WORP when selecting index sites. Monitor abundance and occupancy trends for each Interior Rogue population. **Note:** Survey site selection will focus on juvenile coho salmon, but juvenile (Age-1+) steelhead and cutthroat trout will also be encountered and enumerated in surveys. Counts will not be representative of juvenile steelhead or cutthroat abundance in wadeable streams and will not be comparable to previous stratum-level estimates.	*V-1* *V-2*	Coho StW CCT	Illinois M Rogue/Applegate Upper Rogue	Abundance Index Occupancy
V.B.10. Summer Habitat Surveys Continue annual ODFW AQI habitat surveys at GRTS (random) sites to monitor status and trend in physical habitat in wadeable streams at the population scale. Develop and implement a sampling design to regularly rotate surveys among the three interior Rogue populations. Conduct AQI habitat surveys at coho salmon index sites (see **Action V.B.9**) annually.	*V-2*	All	Illinois M Rogue/Applegate Upper Rogue	Physical Habitat (surface area, substrate, wood, shade, etc.)
V.B.11. Temperature and Flow Monitoring Improve annual temperature and flow monitoring in the Rogue Basin with dedicated, representative sites maintained by ODFW or partners. Continue to document flow permanence in summer habitat survey sites (see **Action V.B.10**). Develop indices to track annual variation and long-term trends in freshwater rearing conditions, potentially in collaboration with other agencies or partners. Investigate relationships with juvenile abundance and adult returns to improve forecasts (steelhead and coho salmon) and/or trigger additional conservation measures.	*V-2*	All	TBD	Temperature Flow Flow Permanence
C. Coastal Stratum Research				
V.C.1. Winter Snorkel Surveys for pHOS Monitoring Continue investigating whether annual snorkel surveys in select holding and spawning reaches can provide more robust information about hatchery/wild ratios than traditional spawning surveys, which often result in few observations.	*V-3*	StW	Chetco	pHOS

Actions (bold = new proposed action)	*Strategy*	*Species*	*Population*	*Metric/Target*
V.C.2. Winter Steelhead Spawning Distribution Investigate winter steelhead spawner distribution in the Chetco Basin to verify abundance and pHOS estimation assumptions. A radio tagging study is likely the most feasible option, but other alternatives will be considered (see **Action V.A.4**). Conduct spawning surveys as needed in other coastal basins to verify assumptions about spawning distribution and calibrate population estimates.	*V-3*	StW	Elk Euchre Hunter Pistol Chetco Winchuck	Abundance pHOS
V.C.3. Marine Survival Indicators Identify and track environmental indicators of marine productivity (e.g. upwelling, marine heat waves) that can improve forecasts of adult returns (winter steelhead and coho salmon) and/or trigger additional conservation measures. Look for opportunities to collaborate with NOAA Fisheries and partners in California.	*V-3* *V-4*	StW Coho	All	Abundance Forecast Climate and Ocean Change Impacts
V.C.4. Elk River Coho Salmon Abundance Estimate total coho salmon spawner abundance in Elk River using a census or randomized survey design to evaluate accuracy of current abundance estimate based on standard surveys. Results could potentially be used to calibrate standard survey estimates.	*V-3*	Coho	Elk	Abundance
V.C.5. Coho Salmon Population Structure Investigate genetic relationships between coho salmon in Coastal Stratum basins, the Rogue Basin, and other populations to the north and south. Results could clarify status and identify donor populations for Elk River and dependent/ephemeral populations.	*V-3*	Coho	All	Population Structure
V.C.6. Genetic Status Monitoring Investigate emerging methods for measuring population size and diversity and determine if genetic monitoring can provide cost-effective alternatives to traditional population monitoring. Look for opportunities to share resources and data with partners in California.	*V-3*	StW Coho	All	Abundance Diversity
V.C.7. Genetic pHOS Monitoring Coordinate with research partners to investigate efficacy of genetic methods (e.g. parentage-based tagging) for measuring introgression between hatchery and wild fish.	*V-3*	StW	All	pHOS
V.C.8. Investigate marine distribution of steelhead Explore whether there are opportunities to learn more about ocean distribution of steelhead, which could help identify or refine marine survival indicators. Coordinate with partners in California.	*V-3* *V-4*	StW	All	Abundance Forecast Climate and Ocean Change Impacts

Actions (bold = new proposed action)	*Strategy*	*Species*	*Population*	*Metric/Target*
D. Rogue Stratum Research				
V.D.1. Huntley Park Hatchery Coho Salmon Marking Study Investigate key assumption about hatchery return rate that determines Huntley Park wild coho salmon estimate, and implement changes if applicable. Mark hatchery coho salmon captured at Huntley Park (e.g. opercle punch, floy tag) and record marked fish at Cole Rivers Hatchery.	*V-3*	Coho	Rogue Stratum	Abundance
V.D.2. Rogue Basin Population Structure Investigate genetic population structure of salmon and steelhead in the Rogue Basin. Results could potentially be used to assign summer steelhead, coho salmon, and fall Chinook salmon caught at Huntley Park to individual populations and support development of population-specific status metrics.	*V-3*	StS StW Coho (ChF)	Rogue Stratum	Population Structure Abundance
V.D.3. Half-Pounder Genetics Study Investigate potential use of genetic run-timing markers to determine contribution of summer- and winter-run steelhead to wild half-pounder abundance at Huntley Park. Preliminary work has begun on this project. If successful, could be monitored over time as a status indicator and/or harvest management trigger.	*V-3*	StW StS	Rogue Stratum	Abundance Diversity
V.D.4. Marine Survival Indicators Identify and track environmental indicators of marine productivity (e.g. upwelling, marine heat waves) that can improve forecasts of adult returns (winter steelhead and coho salmon) and/or trigger additional conservation measures. Look for opportunities to collaborate with NOAA Fisheries and partners in California.	*V-3* *V-4*	StW Coho	All	Abundance Forecast Climate and Ocean Change
V.D.5. Huntley Marking/Tagging Project If individuals captured at Huntley Park cannot be genetically assigned to populations, conduct a multi-year marking/radio tag study for summer steelhead and coho salmon that could be used to estimate contribution of each population to total abundance. Investigate changes in summer steelhead distribution compared to 1970s (Everest 1973).	*V-3*	StS Coho	Rogue Stratum	Abundance Spatial Structure
V.D.6. Early-Run Summer Steelhead Investigations Investigate pilot projects for monitoring early-run summer steelhead. Ideas include guide log books for CPUE in Upper Rogue June-September; tracking wild swim-in early-run summer steelhead at Cole Rivers Hatchery; and investigating spawning survey data for counts that historically correlated with the Gold Ray Dam count. Based on results, monitor one or more abundance metrics to track status.	*V-3*	StS	Upper Rogue	Abundance Diversity

Actions (bold = new proposed action)	*Strategy*	*Species*	*Population*	*Metric/Target*
V.D.7. Additional Abundance Index Surveys ODFW proposes to investigate the opportunity to add value to ongoing surveys (fry trapping, smolt trapping, spawning surveys) by adapting/improving for use in abundance monitoring. May include addition of PIT tagging, monitoring to meet KMP population health goals, and STEP volunteer assistance. Some of these surveys are conducted as part of long-term dam removal effectiveness monitoring.	*V-3*	StW StS Coho	Illinois M Rogue/Applegate Upper Rogue	Abundance
V.D.8. Steelhead Reintroduction Above Dams Continue investigating possibility of restoring natural production of summer and winter steelhead above large dams using releases of differentially marked hatchery fish. Pilot project is hatchery winter steelhead pre-smolt released above Applegate Dam, which is providing information about ability of smolts to successfully migrant downstream through dam and survive to adulthood. May be expanded to similar study with hatchery summer steelhead above Emigrant Dam. Releases are temporally-limited and specifically for research/reintroduction purposes. Utilization of cold water habitat remaining above dams may become a need under various climate scenarios.	*V-3*	StW StS	Upper Rogue M Rogue/Applegate	Survival Rate
V.D.9. Coho Reintroduction Above Dams If steelhead research indicates potential for restoring natural production above large dams, coordinate with federal partners to explore options for restoring coho salmon production above large dams.	*V-3*	Coho	Upper Rogue M Rogue/Applegate	Survival Rate
V.D.10. Genetic Status Monitoring Investigate emerging methods for measuring population size and diversity and determine if genetic monitoring can provide cost-effective alternatives to traditional population monitoring. Look for opportunities to share resources and data with partners in California.	*V-3*	StW StS Coho	All	Abundance Diversity
V.D.11. Genetic pHOS Monitoring Coordinate with research partners to investigate efficacy of genetic methods (e.g. parentage-based tagging) for measuring introgression between hatchery and wild fish.	*V-3*	StW StS Coho	All	pHOS
V.D.12. Investigate marine distribution of steelhead Explore whether there are opportunities to learn more about ocean distribution of steelhead, which could help identify or refine marine survival indicators. Coordinate with partners in California.	*V-3* *V-4*	StW StS	All	Abundance Forecast Climate and Ocean Change
V.D.13. Rogue Cutthroat Trout Distribution and Diet Study Investigate the extent of sea-run cutthroat trout distribution in the Rogue Basin with a marking/tagging study. Investigate the diet of cutthroat trout in the lower Rogue River and estuary to evaluate potential predation impacts on other salmonid species.	*V-3*	CCT	Rogue Stratum	Diversity Predation

VI. Outreach/Enforcement Actions

Management Strategies:

VI-1. Encourage angler stewardship to reduce impacts without adding layers of regulation, and increase cooperation with Oregon State Police (OSP) to help enforce existing regulations.

VI-2. Increase and diversify public participation in fishing and native fish conservation.

VI-3. Improve communication with the public; provide more information through more diverse avenues of communication and collect information to inform management.

VI-4. Encourage citizen involvement to help implement habitat protection and restoration actions, and encourage landowner participation in these critical actions

Given the number of strategies and actions necessary to conserve and manage native fish, outreach is a critical component for RSP implementation. Outreach will be used to both communicate outcomes as well as involve other entities and the public in actions that will have a real benefit to native fish and fisheries.

There is a long history of citizen involvement in work to benefit Oregon's fish and wildlife species. Volunteers have participated for years in the Salmon Trout Enhancement Program (STEP) and other ODFW programs. ODFW sees volunteers, especially in urban areas, as a resource that can utilized to make things better for Oregon's fish and wildlife resources. In the Rogue Basin particularly, we envision volunteers growing more wild fish by helping fish become survivors (reaching the smolt stage). We also want to tell the story of the Rogue and help keep our momentum for restoration going throughout the coming decade.

This section of the plan (along with other management actions) outlines how we plan to reach out to anglers, guides and the general public to foster people as a natural resource to make things better for plan species (see **Table 21**). Much of this involves sharing information and working harder to combat misinformation. Some actions encourage the public to step up to protect their fisheries by working more closely with the Oregon State Police to improve enforcement of existing regulations. Other actions encourage anglers and guides to practice stewardship while angling, without creating new regulations. Several actions involve reaching out to landowners directly, since plan species are dependent on landowner stewardship to meet all life history needs. No single agency or organization can meet all needs. Citizen involvement is required.

We see involvement in fishing as a gateway to involvement in and advocacy for stewardship. Some of the actions in this section relate to getting more people and more segments of the public out fishing, learning more about the resource in the process.

Table 21. Outreach/Enforcement Actions.

Actions	*Strategy*	*Population*
A. Angler Stewardship		
VI.A.1. Informational outreach to reduce catch-and-release stress and mortality. a. Develop and distribute video clips on proper catch-and-release techniques via social media. b. Work with agencies, cities, counties, and non-profit conservation organizations to place educational signage at popular angler access sites and seek funding opportunities to support initiatives. c. Encourage use of fish friendly landing nets. Consider seeking grant funding to provide rubber nets to the Port of Gold Beach for use on loan during the coho salmon fishery. d. Explore use of advisories during periods of low Rogue coho salmon abundance asking anglers to change practices, with a focus in the estuary fishery. e. Track research on fish handling impacts and best practices, and communicate relevant results to public through social media. f. Research best practices for changing angler behavior and revise informational outreach strategies to reflect methods proven to be effective. g. Update catch-and-release guidelines in ODFW Sport Fishing Regulations as conservation concerns develop.	*VI-1*	All
VI.A.2. Reduce disturbance of spawning salmon and steelhead. a. Partner with tackle shops, angling groups and guides to educate anglers on avoiding spawning fish (ODFW believes that disturbance of fish in the act of spawning may put production in mainstem habitats at more risk in some circumstances, compared to recreation activities after spawning is completed). i. Spring Chinook salmon spawning in the upper Rogue in September is a primary focal area. Explore use of advisories asking anglers to change practices in September between Dodge Bridge and Cole Rivers Hatchery. ii. Fall Chinook salmon in the middle Rogue near Grants Pass is another focal area. b. ODFW will work with Oregon State Marine Board to restrict motor use on Hunter Creek.	*VI-1*	All
B. Distribution of Fish Management Information to the Public		
VI.B.1. Provide link to Rogue and South Coast data (fish counts, etc) in ODFW Recreation Report and social media posts.	*VI-2* *VI-3*	All
VI.B.2. Investigate sending annual informational updates by email or social media to license holders.	*VI-2* *VI-3*	Rogue Stratum
VI.B.3. Implement Rogue District Update e-newsletter on monthly/quarterly basis.	*VI-2* *VI-3*	Rogue Stratum
VI.B.4. Provide staff at outreach events to host a booth to answer management questions and concerns, as resources allow	*VI-2* *VI-3*	All
VI.B.5. Utilize local Chamber of Commerce to help and encourage merchants and motels to allow informational fliers and pamphlets for anglers.	*VI-2* *VI-3*	Rogue Stratum

Actions	*Strategy*	*Population*
VI.B.6. Develop RSP messaging that makes key take-aways and important regulations understandable for a general audience.	*VI-2* *VI-3*	All
VI.B.7. Explore additional opportunities to provide information on fish and ODFW actions to produce more fish, including Rogue website development.	*VI-2* *VI-3*	Rogue Stratum
C. Promote Diversity in Native Fish Conservation and Fishing		
VI.C.1. To reduce racial and gender disparities within the fishing community, encourage participation and life-long involvement in native fish conservation and fishing activities by pre- and grade-schoolers; some examples of possible approaches that could be undertaken by STEP Biologists, STEP volunteers, other volunteers, or ODFW's Angler Education staff include the following: a. provide presentations, classes, or programs (e.g., Fish Eggs to Fry), giving priority to schools with a highly diverse student population, b. hold fishing events for schools with a highly diverse student population, c. continue rotating the library display that highlights where to fish, how to fish, and books in the library on fish and aquatic life, and d. explore and develop innovative outreach approaches.	*VI-2*	All
D. Improve Data Collection from ODFW's Electronic Licensing System		
VI.D.1. Encourage use of e-tagging through outreach to POS agents and the public.	*VI-3*	All
VI.D.2. Explore possible incentives to increase adoption of e-tagging.	*VI-3*	All
VI.D.3. Investigate options for using ELS to collect angler effort and catch data (fish harvested and released).	*VI-3*	All
VI.D.4. Align tag location codes with Management Areas where practical. a. ODFW will evaluate harvest within the planning area to simplify regulations, improve data collection, and align with management areas. b. An additional harvest tag code will be added to the Chetco River. The proposed new harvest code will be from Nook Creek to Headwaters. This will allow ODFW to monitor hatchery steelhead harvest and pHOS in the WFEA, and will provide insight into wild steelhead harvest in the WFEA (ODFW considered a management area/location code from SF Chetco to Headwaters, as proposed by several stakeholders, but based off historic creels, very few anglers fish in this area and the new harvest code would provide little information about hatchery and wild steelhead harvest).	*VI-3*	All
VI.D.5. Develop system for internet submission of paper tags.	*VI-3*	All
E. Outreach to Enlist Public Help with Enforcement		
VI.E.1. Work with guides and angling groups to thank prosecutors and judges for help with enforcement.	*VI-1*	All

Actions	*Strategy*	*Population*
VI.E.2. Encourage guides and angling groups to contact OSP with observations of illegal angling behavior and concerns about enforcement. a. Post signs at tackle stores. b. Social media outreach - observe, report, and be willing to testify if needed. c. Coordinate with OSP to develop materials that explain the reporting and investigation process.	*VI-1*	All
VI.E.3. Continue working with OSP to enforce snagging rules.	*VI-1*	All
VI.E.4. Continue annual inter-agency Cooperative Enforcement Program team meetings with ODFW and OSP to prioritize enforcement needs within the Coastal and Rogue strata.	*VI-1*	All
VI.E.5. Continue to support Oregon State Marine Board, Sheriff Departments, OSP, and fishing guides to monitor illegal guiding.	*VI-1*	All
F. Enforcement Expectations and Targets		
VI.F.1. ODFW will work with OSP on a plan to track compliance with angling regulations and authorizations identified in the RSP.	*VI-1*	All
G. Habitat Protection and Restoration Outreach		
See **Habitat Actions I.B.3, I.B.4, I.B.6, I.B.7, I.B.10, I.B.12; I.C.2, I.C.5, I.C.7, I.C.9, I.C.29**		
VI.G.1. Implement targeted outreach on fish needs and stewardship to planning and road department staff in all municipalities, landowners, as well as specific businesses. a. Examples where information sharing would be focused in the interior Rogue include arborists, culvert installers, irrigation suppliers, and well drillers. b. Partner with a variety of agencies and entities to direct outreach to private landowners.	*VI-4*	Illinois M Rogue/Applegate Upper Rogue
VI.G.2. Explore the development of agricultural stewardship symposium/publications. a. Cannabis/hemp or other agricultural stewardship – partner with Oregon Sungrowers Guild or similar organization. b. Continue working with Oregon State Extension Service on agricultural or land stewards outreach programs and/or symposia as a STEP project. c. Partner with soil & water conservation districts to direct outreach to private landowners. d. Look for opportunities to promote other existing programs that foster good stewardship practices.	*VI-4*	Illinois M Rogue/Applegate Upper Rogue
VI.G.3. Implement targeted outreach on habitat and habitat restoration planning to Rogue fishing guides on at least an annual basis. a. Many guides are not aware of the extent and variety of work being done to produce more fish, or how to get involved. In the interior Rogue the biggest need is to help juvenile fish survive 1-3 years in freshwater to reach the smolt stage, in order to have the best chance to survive in the ocean. The Rogue District has developed outreach signs to convey the message: "Want more fish? Help grow survivors!"	*VI-4*	M Rogue/Applegate Upper Rogue

Actions	***Strategy***	***Population***
VI.G.4. Coordinate with entomologists and consider ways to enhance aquatic insect production.	*VI-3*	All
H. Plan Implementation and Review		
VI.H.1. Complete annual reports and post them on the RSP website or other Rogue-specific website. a. Reports will consist of Wild Fish Monitoring Summaries (including metrics for desired and conservation status), Hatchery Program Summaries, and updates on implementation of management actions. b. Track and report status of proposed research and monitoring projects and completed management actions. c. Create an internal database to more efficiently aggregate status metrics and develop reports. d. First annual report will be completed within 24 months of plan adoption and every 12 months thereafter.	*VI-3*	All
VI.H.2. Consolidate annual reporting for all conservation plans covering Rogue or Rogue–South Coast SMUs.	*VI-3*	All
VI.H.3. Repeat online survey conducted in 2019 on a regular basis (approximately every 5 years) to understand angling practices and preferences, and gauge angler satisfaction with fishing opportunities. a. Consider ways to survey Oregon anglers outside of SW Oregon who travel to the Rogue–South Coast area to fish. b. Refine survey questions to better understand angling practices and preferences.	*VI-3*	All
VI.H.4. Explore opportunities to collaborate with social scientists and other partners to improve plan implementation efficiency and outcomes.	*VI-3* *VI-4*	All
VI.H.5. The first re-assessment of status and review of the plan will begin 12 years following plan adoption by the OFWC (evaluation and adaptive management will be ongoing); the assessment will be completed within one year.	*VI-3*	All

VII. Facilities Actions

Management Strategies:

VII-1. Invest in infrastructure that best supports ODFW's mission.

VII-2. Develop and maintain public access to increase fishing opportunity and improve angler experience.

Facilities Actions identified in this plan (see **Table 22** below) are primarily intended to foster and sustain fishing opportunity consistent with ODFW's mission and the NFCP. In this plan, facilities include infrastructure such as hatcheries and boat ramps, as well as sites that may have little or no development but provide access to fisheries. Many of the actions identified below require partnerships with other agencies or entities to implement, and most will require additional funding.

The most urgent hatchery infrastructure need in the Rogue watershed is repair and renovation at Cole Rivers Hatchery (CRH). This action is about ensuring that mitigation obligations associated with two large dams are met and continue to be met for all species, and that the mitigation hatchery programs continue to operate in a manner consistent with native fish conservation. The hatchhouse is a significant bottleneck for hatchery production at this facility. We think that water quality problems are affecting return rates for hatchery fish. ODFW will coordinate with the US Army Corps of Engineers (USACE) to identify key hatchery renovations needed to meet mitigation requirements and improve return rates, recognizing that USACE is responsible for implementing these renovations. Other hatchery needs include infrastructure for acclimation programs in the middle Rogue and upgrades at Elk River Hatchery. Minor renovations of the adult holding raceway at Elk River Hatchery could reduce pre-spawn mortality of adult winter steelhead broodstock from the Chetco River, resulting in more fish being released back into the Chetco after spawning.

Actions to increase angler access and opportunity are identified for population areas in both strata. Actions include upgrading several existing access sites and boat ramps, maintaining or improving bank fishing access, and pursuing opportunities to establish new access sites for the public. Several of these actions are also identified in the CMP (ODFW 2014).

Table 22. Facilities Actions.

Actions	*Strategy*	*Population*
A. Hatchery Infrastructure Improvements		
VII.A.1. Improve Rogue mitigation hatchery infrastructure. a. Renovate hatchhouse and hatchhouse water supply at Cole Rivers Hatchery. b. General repairs and renovation at Cole Rivers Hatchery. c. Upgrade collection facility at Applegate Dam; add ability to acclimate smolts and sort adults onsite. d. Improve infrastructure or support needed to grade summer steelhead. e. Purchase new liberation truck to improve handling of adults and juveniles.	*VII-1*	Upper Rogue
VII.A.2. Infrastructure improvement at Middle Rogue acclimation sites. a. Various actions are needed to facilitate acclimation at existing sites (Greens, Skunk) and potential new sites. b. May include signage or map of acclimation sites, and available access points to help anglers target returning fish (distribute to tackle shops).	*VII-1*	M Rogue/Applegate
VII.A.3. Elk River Hatchery upgrades. a. Refurbish adult holding raceway. b. Mark Chetco winter steelhead smolts with coded wire tags (CWT) prior to release. c. Purchase utility terrain vehicle (UTV) to transport supplies, spawning equipment, and steelhead eggs. d. Support innovative approaches and associated costs to improve rearing strategies for steelhead such as indoor rearing pond for fry, shade cloth, and egg treatments.	*VII-1*	Elk
B. Angler Access and Opportunity		
VII.B.1. As resources allow, improve existing middle and upper Rogue River access properties. a. Improve boat access and/or road surface at Doughten Falls and Sardine Creek ODFW properties. b. Work to facilitate development of Doughten Falls through agreement with Jackson County Parks. c. Investigate improvements at ODFW and other river access properties. d. Work with Marine Board and State Parks to improve boat ramp at Touvelle State Park. e. Develop partnerships with local groups to help with volunteer maintenance of river sites.	*VII-2*	Upper Rogue M Rogue/Applegate
VII.B.2 Develop new universal access sites as time and funding allows. a. River Bridge Campground on upper Rogue. b. Investigate improvements at other river access sites. c. Work with I&E to publicize sites.	*VII-2*	Upper Rogue M Rogue/Applegate
VII.B.3. Encourage acquisition of old Savage Rapids Park property by Oregon State Parks or Jackson County Parks, and develop bank fishing access.	*VII-2*	Upper Rogue

Actions	***Strategy***	***Population***
VII.B.4. Pursue land acquisition or easement on Pistol River.	*VII-2*	Pistol
VII.B.5. Develop new Elk River boat ramp; see CMP (ODFW 2014).	*VII-2*	Elk
VII.B.6. Develop Port of Port Orford recreational angler boat ramp; see CMP (ODFW 2014).	*VII-2*	Elk
VII.B.7. Bank access on the Chetco River. a. ODFW will continue to maintain and legally retain the right to current angling easements at Willow Bar and Piling Hole. b. ODFW will work with the city of Brookings to maintain angler access at the mouth of the NF Chetco. c. ODFW will partner with entities on any potential land acquisitions that would improve bank angling opportunity. d. ODFW will continue to support Oregon South Coast Fishermen on maintaining access at Ice Box.	*VII-2*	Chetco
VII.B.8. Bank access at the mouth of Indian Creek (Rogue estuary). a. ODFW will work to maintain access to the Rogue estuary for bank anglers near the mouth of Indian Creek. This is the only good bank angling area for anglers fishing for fall Chinook salmon and coho salmon. Indian Creek Hatchery fall Chinook salmon stage in this area in October and provide additional opportunity for bank anglers.	*VII-2*	Lower Rogue
VII.B.9. Work with Curry County to maintain and improve Ferry Hole boat ramp on the north bank of the Rogue.	*VII-2*	Lower Rogue
C. Infrastructure for Research and Monitoring		
VII.C.1. Pursue funding for facilities and equipment to facilitate Research and Monitoring.	*VII-1*	All

Implementation

This section describes logistical aspects of completing the strategies and actions identified in the RSP and tracking progress toward desired status. This includes coordination, evaluation of action effectiveness, and a process to adapt strategies or actions over time to ensure achievement of the desired status, funding, and the outlook for success.

Coordination

ODFW will be responsible for implementing the RSP. Specifically, the South Coast and Upper Rogue District Fish Biologists and the Rogue Watershed Manager will be integral in maintaining oversight and implementing the RSP. In addition, other ODFW staff will assist with implementation of the RSP, including completing annual reports and 12-year reviews. The agency is committed to implement those actions over which it has direct authority consistent with staffing and funding availability. For those actions related to hatcheries, harvest, and other species that involve current, ongoing programs, ODFW has either already implemented or will implement those actions as quickly as is practical. For those actions that are not able to be integrated into existing responsibilities or programs, funding will need to be secured to allow implementation (see **Table 23**).

In addition to those strategies and actions that ODFW can implement directly, coordination with other entities and members of the public will be required. ODFW will work cooperatively with STEP groups to help them implement the fish rearing, acclimation and trapping actions called for in this plan. ODFW will also work to coordinate actions related to habitat protection and enhancement by working cooperatively with tribes, other agencies, OWEB, watershed councils, SWCDs, STEP volunteers, local jurisdictions, non-profit organizations, landowners, and the public to help identify, fund and implement voluntary habitat protection and enhancement projects. The agency will also work cooperatively with other agencies and landowners to promote the protection of important habitats as land and water development actions occur.

Evaluation, Reporting, and Adaptive Management

ODFW has identified a comprehensive monitoring program (see **Research and Monitoring Actions**) to address some of the uncertainties identified in the current status assessment and measure the metrics identified for management and tracking status (in order to be able to assess the health of plan species). Monitoring information related to the metrics identified in the RSP will be reported annually through the completion of *Hatchery Program Summaries* and *Wild Fish Monitoring Summaries*. These will be made available to the public, along with updates on action implementation. The annual review of monitoring data necessary to produce annual reports will serve as an early warning system that will inform the need for additional or modified research, monitoring, evaluation, or management actions. If review of annually collected data or other information appears to show that measurable criteria as identified in **Appendix VII – Management Triggers and Actions** are not being met, ODFW will determine and implement necessary modified actions. The modification of management actions will be detailed in annual reports. Note that some actions are tied to continued wild harvest opportunity and may be discontinued if that opportunity is no longer provided.

In addition to annual reporting and updates, every 12 years (approximately three steelhead generations) the status of populations and SMUs will be re-assessed. This will entail more in-depth analyses of data than will be done annually. If the status assessment indicates deterioration of populations or SMUs, or a noticeable lack of progress toward desired status, ODFW will determine if the *strategies* being used to achieve desired status need to be substantively changed or modified. If so, a public process will be undertaken, with OFWC approval necessary for such changes.

Finally, modifications to RSP actions or strategies are required if listing status under the federal ESA changes for any species addressed in the Plan.

Cost

Many of the actions contained in the RSP can be integrated into on-going work by ODFW and partners, and will not require additional funding *per se*. For instance, a key component for habitat actions is to *do the right thing in the right place* – to focus the funding and efforts that are available[15]. However, some of the actions cannot be integrated into existing capacities and will require additional funding. **Table 23** shows the estimated costs for actions which require new funding.

There are a number of potential sources for new funding. Some of these include the new steelhead authorizations, shifting capacity from other programs or locations, money appropriated by the Legislature, ODFW's Restoration and Enhancement funding program, re-structuring of guide licenses and fees, and focusing on specialized funding opportunities. OWEB will likely be a significant source for habitat-related actions. In addition to new funding and as indicated in the **Outreach/Enforcement Actions** section, this planning area has a long history of volunteer involvement and engaging volunteers as a way to achieve new work should be utilized as much as possible, including for monitoring. Watershed councils and non-profit organizations could also help implement actions and partner on grants (e.g., match funding, co-author application).

[15] This is not to say that additional funding for habitat actions to increase the pace of habitat restoration and protection would not be beneficial.

Table 23. Additional, new ODFW costs associated with implementing RSP actions. Unless noted, other actions contained in the RSP that are not included in this table are currently part of, or can likely be integrated into, existing efforts, or funding would go to implementation partners. Amounts are estimates only and should be adjusted for cost of living and inflation increases for each year after plan adoption. Costs that help implement the winter steelhead harvest framework are indicated by an asterisk (*).

Action	Start-Up/One-Time		Annual	
	Description	Cost ($)	Description	Cost ($)
I. Habitat – *specific habitat restoration and protection projects and costs will be identified as part of RSP implementation with partners*				
II. Other Species				
II.A.2 – Expand Port of Gold Beach fish cleaning stations	supplies, construction	10,000	maintenance	500
II.B.2 – Genetic work on seal scat	sample collection and analysis	10,000	n / a	0
III. Hatchery Programs				
III.B.1, III.C.5, III.F.1 – Increase coho production	n / a	0	feed, marking	25,000
III.C.3 – Genetic testing of steelhead	sample collection and analysis	10,000	n / a	0
III.D.1 – Chetco acclimation site	supplies, construction	20,000	feed, maintenance	1,000
III.D.2 – Increase Chetco StW production based on pHOS	n / a	0	feed, marking	10,000
III.D.4 – Jump Off Joe acclimation site	supplies, construction	20,000	feed, maintenance	1,000
III.D.5 – Additional StW pHOS monitoring (*see V.A.2 and V.B.3*)	---	---	---	---
IV. Harvest				
IV.B.1 – Create new winter steelhead fishing authorizations*	modify ELS	25,000	authorization fees collected	(80,000)
V. Research and Monitoring				
V.A.2 – S Coast winter spawning ground surveys*	n / a	0	personnel, services/supplies	125,000
V.A.4 – Chetco DIDSON counting station	equipment, site development	200,000	personnel, services/supplies	80,000
V.A.5 – S Coast winter steelhead harvest monitoring (*see IV.B.1*)*	---	---	---	---
V.A.6 – Chetco creel survey	personnel, services/supplies	50,000	n / a	0
V.A.9 – S Coast temperature and flow monitoring	equipment, site development	7,500	n / a	0
V.B.2 – Rogue fall spawning ground surveys	n / a	0	personnel, services/supplies	40,000
V.B.3 – Rogue winter spawning ground surveys*	n / a	0	personnel, services/supplies	45,000
V.B.4 – Upper Rogue adult trap	equipment, site development	35,000	n / a	0
V.B.5 – Upper Rogue DIDSON counting station pilot project	equipment, site development	200,000	personnel, services/supplies	40,000

Action	Start-Up/One-Time		Annual	
	Description	Cost ($)	Description	Cost ($)
V.B.6 – Rogue winter steelhead harvest monitoring (*see IV.B.1*)*	---	---	---	---
V.B.7 – Rogue creel survey*	n / a	0	personnel, services/supplies	90,000
V.B.8 – Illinois surveys	n / a	0	personnel, services/supplies	45,000
V.B.11 – Rogue temperature and flow monitoring	equipment, site development	7,500	n / a	0
V.C & D – Programmatic uncertainty and management research	n / a	0	personnel, equipment, services/supplies	800,000
VI. Outreach / Enforcement				
VI.A.1 – Outreach to reduce catch-and-release impacts	personnel, contracts, products	10,000	n / a	0
VI.D.3, 4, & 5 – Adjustments and alternatives to ELS	modify ELS, develop ancillary reporting	10,000	n / a	0
VI.I.1 – Reporting assistance (compile, maintain data)	n / a	0	personnel, supplies	115,000
VII. Facilities – *specific facility project costs will be identified as part of RSP implementation*				
TOTAL		**$615,000**		**$1,337,500**

Outlook

The RSP describes what is needed to conserve several native salmon, steelhead, and trout species. It focuses habitat actions, provides relative management certainty for hatchery programs and harvest options, and considers what is needed for resilience to climate and ocean change. It is also intended to be a living document that evolves as more is learned about the fish and the effectiveness of the strategies and actions outlined in the plan for improving the health of the SMUs and the fishery opportunities they provide; it is important to observe how the actions work and how the fish respond to the actions. Based on those observations, ODFW and others will be able to better address the needs of the fish and ensure desired status is achieved, with the first big "check-in" period at re-assessment in 12 years.

The desired status for each species is ambitious, especially given climate and ocean change. Achieving desired status will require improvements in habitat, vigilance in the promulgation of fisheries and hatchery programs, and management of other risks that the fish face. It will require cooperation and dedication from all parties interested in salmon, steelhead and trout to reach these goals. Fortunately, there is a long track record of citizens in Oregon, and the Rogue–South Coast area in particular, working together to restore fish and their habitats. If this can be maintained and increased, the ambitious goals in this plan can be achieved, and Oregonians for many generations can benefit from all that healthy salmon, steelhead, and trout populations provide.

Appendices

Appendix I – Additional Background Information

Appendix I: Planning Area Background

The plan provides examples of how watersheds and populations in the RSP planning area differ from other watersheds and populations on the Oregon coast. This section provides additional details.

Federal Designations

Steelhead and coho salmon from the RSP planning area are grouped by the National Marine Fisheries Service (NMFS) with evolutionary aggregates that include northern California populations, but not other coastal populations in Oregon (**Figure A-I: 1**). Comparisons of population, habitat and trends in the RSP are most appropriately made with rivers in Northern California. Analyses completed as part of Rogue Basin Fisheries Evaluation Project, funded by the US Army Corps of Engineers (USACE) to evaluate dam impacts and make recommendations for dam operation, provide the only exception. Project completion reports for winter and summer steelhead utilized in part a comparison of upper Rogue (Gold Ray Dam count) abundance to the combined abundance of upper Rogue and North Umpqua counts (Winchester Dam count) over time to evaluate changes post-dam. As time, resources and available data allow, ODFW would like to use a similar approach to report on trends in RSP populations relative to Klamath populations (possibly North Umpqua) moving forward.

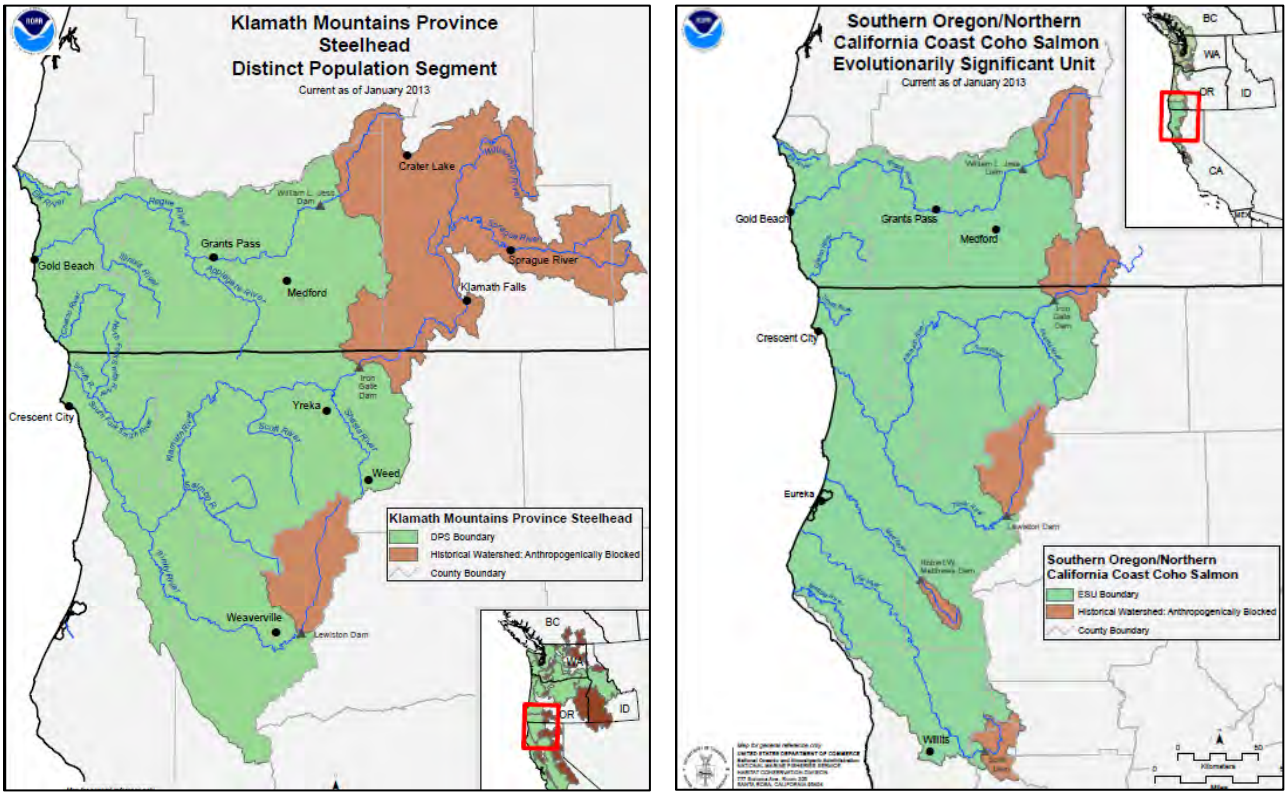


Figure A-I: 1. Maps showing boundaries of the Klamath Mountains Province (KMP) Steelhead Distinct Population Segment (left panel) and Southern Oregon/Northern California Coast (SONCC) Coho Salmon Evolutionarily Significant Unit (right panel).

Climate and stream temperature

The plan refers to the hotter, drier climate in the Rogue compared to other coastal watersheds in Oregon, watershed conditions to which plan species have evolved and adapted. Weather extremes and fish loss have also been documented. The worst conditions in recorded history may have been the "Dust Bowl" years of the 1930s. The drought years of 1930 and 1931, according to Rivers (1964), created havoc with fish life, and very few tributaries were not dry at the mouth by early summer. Fish loss was reported from almost every part of the basin. Flow in the Rogue River at Gold Ray dropped to 616 cubic feet per second (cfs) in the summer of 1931 (Rivers 1957). The river temperature rose 1°F every six miles through the middle section of the Rogue, and heating in the reservoirs at Gold Ray (3.5°F) and Savage Rapids (2.5°F) dams was documented. These observations highlight one of the benefits of recent mainstem dam removal projects and the importance of proactively addressing water quality and quantity issues in a changing climate.

Disease outbreaks have taken place in the Rogue due to the bacterial pathogen *Flexibactor columnaris*, and fish present in the mainstem in summer (mostly Chinook salmon, as well as summer steelhead) have died in large numbers during extreme conditions. Almost all of the pre-spawning mortality occurs downstream of Grants Pass (river mile 103), and the estimated rates of pre-spawning mortality are highly correlated with water temperature (ODFW 2007). Releases from Lost Creek Reservoir are used to reduce the risk of pre-spawning mortality for adult Chinook salmon and steelhead, and improve summer conditions for juvenile steelhead rearing in the mainstem.

Land ownership and population

Table A-I: 1 shows the percentage of private, state, and federal land ownership in the basin/population areas covered by the RSP. A majority of land is federally owned in all population areas except some of the smaller Coastal Stratum basins.

Table A-I: 1. Land ownership in Rogue–South Coast basins/population areas.

Stratum	Basin/Population Area	Land Ownership (% acres in watershed)		
		Private	State	Federal
Coastal	Elk	21.0	0.0	78.9
	Euchre	79.0	0.0	20.7
	Hunter	62.1	0.0	37.8
	Pistol	42.9	0.0	56.9
	Chetco	16.7	0.1	83.2
	Winchuck	14.0	0.0	86.0
	NADOTs	88.4	3.1	4.9
	North Fork Smith	1.0	0.0	99.0
Rogue	Lower Rogue	39.5	0.0	58.7
	Illinois	17.6	0.4	81.5
	Middle Rogue/Applegate	38.0	0.6	60.7
	Upper Rogue	44.8	0.1	54.8

The magnitude of development in the Rogue is unique compared to other coastal watersheds in Oregon, and an example mentioned in the plan is the size of the human population. Using data from the Oregon Blue Book (2020), below is an estimate of population size by coastal watershed. The Siuslaw is not included because of the need to separate Lane County data among two watersheds (Siuslaw and Willamette). Far more people live in the Rogue watershed than any other coastal watershed in Oregon. Almost by definition, more people means a higher level of human development in the Rogue watershed. In contrast, the population in the lower Rogue and Coastal Stratum watersheds is lower than most other coastal watersheds in Oregon.

Table A-I: 2. Population in coastal watersheds based on 2020 Oregon county census data.

Watershed	County	Population
Rogue	Jackson	223,240
	Josephine	86,560
	Total	305,595
Coastal Stratum rivers	Curry	23,005
Coos, Coquille	Coos	63,315
Umpqua	Douglas	112,530
Siletz, Yaquina, Alsea	Lincoln	48,305
Wilson, Trask, Nestucca	Tillamook	26,530
Nehalem, Necanicum	Clatsop	39,455

Migratory nature of Rogue steelhead and barriers

The plan highlights the importance of restoring fish passage in the Rogue watershed. Most Rogue barriers are partial barriers, but environmental extremes increase the severity of partial barriers, often preventing production in miles of fish habitat in some streams of the Rogue watershed. An example of the impact of barriers on fish production is Jones Creek in Grants Pass. **Figure A-I: 2** shows the lowermost barrier on Jones Creek, a railroad culvert near the mouth.

Figure A-I: 2. Photos of the railroad culvert near the mouth of Jones Creek (left) and an adult summer steelhead that died attempting to pass the culvert (right). Right photo credit: Mike Cooley, Middle Rogue Steelheaders.

Cole Rivers reported that during winters with low flows, the distribution of steelhead on the spawning grounds was limited by barriers of less than 30 inches in height. Truncated distribution was observed in Jones Creek following the low flow winter of 2008-2009. In spring 2009, juvenile fish were observed only in the lower 1/10th of a mile of the creek below the railroad culvert. Fish production was blocked in most of over four miles of steelhead habitat. In addition, this culvert was a complete block to upstream passage of juvenile fish at most if not all flows. An ODFW survey in January 1971 found a density of 425 juvenile steelhead per 1,000 feet of stream below the culvert and only 3 juvenile steelhead per 1,000 feet above the culvert.

Passage has been restored or improved at this culvert (**Figure A-I: 3)** and other barriers on Jones Creek. Monitoring of steelhead fry production in the forks of Jones Creek by STEP volunteers has documented wild steelhead production every year since passage was restored, including years that were declared droughts. The passage projects have kept many miles of Jones Creek producing wild steelhead, miles that were formerly blocked during dry years.

Figure A-I: 3. Railroad culvert on Jones Creek after passage project.

Based on accumulated empirical evidence, juvenile steelhead in the Rogue have evolved to move around extensively during freshwater rearing. In his report titled *Steelhead of the Rogue River System*, Cole Rivers (1957) included observations on juvenile steelhead migration from tributaries into mainstem reaches: “The studies to date have found the bulk of the juvenile steelhead leaving the upper Rogue River in May, June and July of their second summer to move down into the middle section of the river between Gold Ray and Galice (RM 126-76) where the river is graced with good wide, food-producing riffles. “They do not smolt for this inter-basin shift.”; and “Few juvenile steelhead over three or four inches in length can be found in the upper parts of the (Illinois) drainage. A good wave of these small fish can be found leaving in early spring of their second year and they are rarely found in any other time of the year. A few concentrations can be found in the lower few miles of the Illinois before its

confluence with the Rogue, so it is believed that they back out of their drainage in early life and spend the remaining part of their freshwater period in the lower extremities of the Illinois and the lower thirty miles of the Rogue."

During a research project on summer steelhead, Everest (1973) documented a clear downstream migration of juveniles out of spawning tributaries in late spring, followed by migration back up into tributaries with fall rains. Everest reporting that by June "…most fry move from spawning areas to the mainstem Rogue where rearing occurs…The natal streams are generally unsuitable for rearing and nearly all summer steelhead juveniles have to rear in the mainstem Rogue or large tributaries… The streams which are not intermittent become inhospitable for salmonids in summer by virtue of high water temperatures and low streamflows."

As part of the project, steelhead fry trapped while migrating downstream out of Kane Creek were marked and released. Marked fish were recaptured later that summer in a 22-mile reach of the Rogue River, ranging from 3 miles upstream to 19 miles downstream of Kane Creek. With winter rains, some marked fish swam back upstream into eight different tributaries of the Rogue, including Kane Creek. In a similar project, yearling steelhead migrating downstream out of Sams Creek were marked. Most re-entered Sams Creek when the rains returned the following winter, while one swam upstream into Galls Creek (Everest 1973).

During multiple years of freshwater rearing, juvenile steelhead in the Rogue migrate repeatedly between tributaries and mainstem reaches. This freshwater migration is an important adaptation to the hot and dry climate of the Rogue. Unfortunately, barriers on tributaries block upstream migration by juvenile steelhead, causing high juvenile densities below barriers, similar to what was observed on Jones Creek. Predation risk increases due to unnaturally high densities of fish struggling to pass barriers, and predators are often observed fishing at barriers. Videos of juveniles jumping at some Rogue barriers can be viewed at https://www.dfw.state.or.us/news/2013/february/021013.

Requirement for fishery provisions with Rogue Basin dams built by the US Army Corps of Engineers (USACE)

No provisions were made for fish passage around William Jess Dam/Lost Creek Reservoir or Cole M. Rivers Hatchery, which is located immediately downstream from Lost Creek. Applegate Dam was authorized by Congress with a fish ladder to provide passage. Prior to construction, the USACE requested and received approval from the US Fish and Wildlife Service and ODFW to drop the fish ladder from the final design, and instead increase the mitigation production for winter steelhead.

While passage was not provided, Congress did authorize dam construction on the Rogue with fish needs as a primary purpose. Any review of fishery provisions associated with USACE dams must acknowledge all three parts: 1) fish enhancement through an allocation of stored water and safe operation of the dams for fish (except during flood operations); 2) research to identify how to best release water and operate dams consistent with fish needs (Rogue Basin Fisheries Evaluation Project); and 3) mitigation for the loss of fish production in the habitat blocked by the dams.

Planners projected that reservoir operation would also result in the enhancement of anadromous salmonid resources in downstream areas. Fishery benefits were expected to accrue by operating the dam to: 1) decrease peak flow in winter; 2) increase flow in summer (probably best described as replacing water that has been appropriated for out-of-stream uses over decades); and 3) decrease water temperature in summer, at least in part to restore conditions closer to pre-development levels.

To regulate the outflow temperatures, the USACE designed an intake structure capable of withdrawing water from five different levels of the reservoirs. Selective opening of intake ports allows for mixing of water from various temperature strata in the reservoir. Choice of outflow temperature is greatest in early summer when the reservoir is full and is thermally stratified. Control of release temperature diminishes in late summer as reservoir level decreases and the highest intake ports become dewatered. Control of release temperature becomes minimal in autumn after the reservoirs de-stratify (USACE 1983).

Guidelines for the release of stored water were intended to be flexible, reflecting annual variations in water yield and user demand. The authorizing document also outlined minimum outflow and maximum water temperature to be released, but clearly stated these guidelines should be modified as additional information became available: "It should also be noted that project operation plans must be sufficiently flexible to permit desirable modifications in scheduled fishery releases, within the limits of storage provided therefore, if experience and further study indicates such action to be desirable for overall project benefits" (United States Congress 1962). Uncertainty related to the scheduling and efficacy of releases to meet fishery allocations lead the USACE to fund the Rogue Basin Fisheries Evaluation Project. This project was conducted by ODFW during the period of 1974–96, with field sampling terminated in 1994. Reports completed as part of the Rogue Basin Fisheries Evaluation Project, along with other sources of data on the Rogue River and its fish, are available at: https://www.dfw.state.or.us/fish/local_fisheries/rogue_river/index.asp

ODFW credits the USACE with doing a good job meeting fish needs during reservoir operation, through communication and coordination that expanded under the leadership of ODFW researcher Tom Satterthwaite and USACE Rogue River Basin Project Manager Jim Buck. Coordination continues to this day. Unfortunately, winter release temperatures remain warmer than desired, a factor of heating in the reservoir pools, and this may not be correctable.

Dam mitigation was defined by USACE in the report to Congress as facilities for restitution of loss of spawning and rearing areas: “Restitution facilities would consist of fish-production facilities such as a fish hatchery or possibly spawning channels and related works, as might be found necessary upon completion of detailed studies in cooperation with federal and state fish and wildlife agencies following project authorization. The hatchery also would be used to provide trout for the reservoir fishery.” Production at Cole Rivers Hatchery is intended to replace the loss of and fishery value provided by the following numbers of wild fish: 13,020 spring Chinook salmon, 500 coho salmon, 500 summer steelhead, and 2,000 winter steelhead. These mitigation goals are generally described as returns to the hatchery.

During RSP Stakeholder Team meetings, one stakeholder questioned whether required fishery provisions are being met following dam construction, and whether the mitigation goals accurately reflect the true impact to salmon and steelhead following the loss of spawning and rearing areas. An effort led by local county governments seeks additional funding to help the USACE take action to address these concerns.

Unfortunately, fish production in the high quality habitat above Lost Creek may never be fully understood. Salmon and steelhead of the upper Rogue faced migration challenges as soon as dams began to be built on the mainstem Rogue around Grants Pass in the late 1800s. Dams were built on the South Fork and Middle Fork Rogue River by the early 1930s. As stated in the plan, fish surveys that make up the primary data source used to estimate dam impacts and mitigation goals were conducted in the 1940s through 1950s, with some additions in the 1960s—after dam construction. Still, ODFW believes the array of mitigation goals for hatchery returns are adequate, but that improvements are needed to ensure that goals are achieved for all species, and improvements are needed at the hatchery to reduce losses during fish culture and improve smolt to adult return rates (see **Action VII.A.1**).

In addition to repairs and renovation of the hatchery and hatchhouse, the USACE has a responsibility to restore spawning gravel below the dams. Changes have been documented below Lost Creek by USACE biologists and restoration is needed. Artificial spawning channels, mentioned as a potential mitigation action in early USACE documents, were brought up as a recommendation in the RSP Habitat Work Group. Channels would facilitate spawning (a potential big benefit for spring chinook salmon), but could also create new summer rearing habitat to address limiting factors for plan species. Similar to floodplain restoration and other engineered projects, high cost means any consideration of a spawning channel would be limited to a small number of ideal sites, such as locations where the diversion of streamflow can be done in way that results in a net increase in fish habitat. Depending on details, ODFW would support spawning channel construction.

Harmful algae blooms (HABs) in Lost Creek Reservoir were brought up as a concern in the RSP Habitat Work Group. HABs occur regularly in the reservoir and were observed the first year of dam operation. The USACE has conducted water tests to look for a cause without success. ODFW is not aware of any management technique to eliminate HABs at Lost Creek Reservoir other than dam removal.

Appendix I: Species Management Units

Fish surveys, a long-term dam counting station, and fish research projects conducted over several decades provide a solid background for fish management in the Rogue watershed. Long-time researcher Tom Satterthwaite contributed extensively to the knowledge of Rogue fish and recommendations for fish management. Several stakeholders requested that previous ODFW estimates of abundance for plan species be included in the RSP. In response, ODFW has included several references to the Gold Ray Dam count, a measure of abundance for upper Rogue fish populations. In a response to a specific request, the table of status elements includes criteria for upper Rogue coho salmon based on the Gold Ray Dam count, although this count is no longer available and ODFW does not currently plan to track this metric.

Previous Steelhead Population Estimates

ODFW (1990) estimated an average return of 43,300 wild winter steelhead in the Rogue for three years between 1978 and 1980. The Gold Ray count was found to account for an average of 18% of freshwater returns. The same report used the 18% figure to develop a "rough average" of 44,000 wild winter steelhead entering the Rogue annually between 1970-71 and 1986-87, which would make the Rogue return the largest on the coast of Oregon.

In a 2001 update on status in the Oregon portion of the KMP steelhead DPS, ODFW estimated that the abundance of wild steelhead ranged from a low of 69,000 to high of 83,000. Even the low estimate of 69,000 represents a very large number of steelhead relative to other parts of Oregon both at present or historically. ODFW concluded that not only are steelhead in the KMP self-sustaining, their total numbers suggest that the KMP contains the healthiest wild steelhead populations in Oregon. A description of the four methods used to make these abundance estimates follows.

Method 1. Estimate abundance based on smolt production rates.
Smolt-to-adult survival rates have been estimated for some populations of wild steelhead in the Pacific Northwest. Survival rates of smolts produced in Snow Creek, Washington during the 1978-83 ranged between 2.4% and 12.4%, and averaged 7.3% (cited in Bley and Moring 1988). Raymond (1988) estimated that smolt-to-adult survival rates averaged 6% at Ice Harbor Dam on the Columbia River during the mid-1960's. Survival rates of wild steelhead produced in the Keogh River, British Columbia, averaged 15% in 1976-89, but then decreased to an average of 3.5% in 1990-1995 (Ward 2000). Based on these publications smolt-to-adult survival rates for wild steelhead appear to average about 5%. ODFW estimated that smolt production rates in Klamath Mountain Province streams averaged 538 smolts/km in 1998 and 464 smolts/km in 1999 (**Table A-I: 3**). The following assessment assumed a smolt production rate of 500 smolts/km.

As there is 2,502 km of steelhead habitat in the Rogue River Basin, and 661 km of steelhead habitat in the remaining basins, then about 1,600,000 smolts are produced annually. Assuming a 5% smolt-to-adult survival rate, the number of wild adult steelhead in the Oregon portion of the Klamath Mountains Province would be about 83,000 fish.

Table A-I: 3. Production rates (fish per kilometer of habitat) of wild steelhead smolts migrating from coastal streams in the Oregon portion of the KMP steelhead DPS.

Year	Stream					
	Elk River	Hunter Creek	Lobster Creek	Winchuck River	Euchre Creek	Average All Sites
1985	224					
1986	144					
1987	--*					
1988	116					
1989	124					
1990	229					
1991	178					
1992	--*					
1993	115					
1994	308					
1995	172					
1996	254	725		237		405
1997	--*	814	464	382		553
1998	--*	901	568	146		538
1999	305	806			281	464

*Sample judged to be insufficient or biased.

Method 2. Estimate abundance based on adult production rates.

Freshwater returns of adult steelhead to the Rogue River are known for some years. ODFW (1990) estimated that freshwater returns of wild winter steelhead averaged 43,000 adults during the 1977-78 through 1979-80 return years. In addition, ODFW (1994) estimated that freshwater returns of wild summer steelhead in the late 1970s through the early 1990s averaged about 21,000 adults (2,000 early-run adults and 19,000 late-run adults). Annual returns of both races thus averaged about 64,000 wild adult steelhead. As there is 2,502 km of steelhead habitat in the Rogue River Basin, the production rate is about 25.6 adults/km. Assuming a similar rate of production in the 661 km of steelhead habitat in the other stream basins, then the number of wild adult steelhead in the Oregon portion of the Klamath Mountains Province would be about 79,000 fish.

Method 3. Estimate abundance based on adult production rates in the area upstream of Gold Ray Dam.

Passage of adult steelhead at Gold Ray Dam was estimated starting in 1942. Gold Ray Dam was located at river kilometer 204 on the Rogue River. ODFW estimated that the annual returns during the period of record averaged 4,996 wild summer steelhead and 7,775 wild winter steelhead. These figures assume that summer steelhead pass the counting station from 16 May through 31 January, while winter steelhead pass the counting station from 1 February through 15 May (ODFW 1990, ODFW 1994).

As there is 589 km of steelhead habitat upstream of Gold Ray Dam, the average production rate from 1942–2000 was about 21.7 adults/km. Assuming a similar rate of production for all steelhead habitat

within the Oregon portion of the Klamath Mountains Province (2,502 km in the Rogue River Basin and 661 km in other basins), then the number of wild adult steelhead in the Oregon portion of the Klamath Mountains Province would be about 69,000 fish.

Method 4. Estimate abundance from the number of subyearling fish.

ODFW estimated that, within the area that was sampled to estimate the densities of juvenile steelhead, that the abundance of subyearling steelhead in 1999 and 2000 averaged about 1,800,000 fish in streams of the Rogue River Basin and about 1,400,000 fish in the other Oregon streams of the Klamath Mountains Province. These estimates include only those fish present in 1st to third order streams that could be sampled effectively with backpack electrofishers. Pools were assumed to compose 19% of the aquatic habitat (Thom et al. 1999). The sampling frames included an estimated 1,546 km of streams in the Rogue River Basin and an estimated 437 km of streams in other Oregon basins of the Klamath Mountains Province. These estimates represent 70.3% of the steelhead habitat in the Rogue River Basin and 72.8% of the steelhead habitat in the other basins.

Assuming that the densities (fish/km) of subyearling steelhead were similar in areas of larger streams that could not be sampled, then the abundance of subyearling steelhead averaged about 2,900,000 fish in the Rogue River Basin, and about 2,100,000 fish in the other basins, during the years 1999–2000. A total population of 5,000,000 subyearling steelhead in late summer suggests that the parental spawning escapement was about 83,000 fish. This estimate assumes that (1) the survival rate between the time of emergence and the time of sampling in late summer was 20% (Bley and Moring 1988), (2) the survival rate between eggs and emergent fry was 20% (Bley and Moring 1988), (3) that steelhead fecundity was 3,000 eggs per female (ODFW unpublished data for winter steelhead in the Rogue River), and (4) that females composed 50% of the parent spawners.

Appendix I: Populations

In addition to the identified population areas which were assessed for viability, other locations in the planning area produce steelhead, coho salmon, and cutthroat trout. These areas are collectively referred to as "non-assessed direct ocean tributaries" (NADOTs). Although these areas were not assessed, they contain an important resource and will be managed consistent with the actions identified in the RSP, as identified in those sections. **Table A-I:4** lists the species present in each NADOT and **Figure A-I:4** identifies where the NADOTs are located.

Table A-I: 4. List of coastal direct ocean tributaries which were not assessed in the RSP but contain steelhead, coho salmon, and/or cutthroat trout. These areas are collectively referred to as "non-assessed direct ocean tributaries" (NADOTs). "●" indicates consistent presence. "□" indicates periodic presence. "?" indicates presence is unknown.

Non-Assessed Direct Ocean Tributaries	Stream KM	Winter Steelhead	Summer Steelhead	Coho Salmon	Cutthroat Trout
Mill Cr	9.5				●
Gold Run Cr	1.5				●
Hubbard Cr	24.3	●		●	●
Rocky Point Cr	0.3				●
Retz Cr	3.0				●
Brush Cr	26.7	●		●	●
Mussel Cr	24.2	●		□	●
Greggs Cr	8.3	?			●
Riley Cr	3.8	?			●
Egans Cr	1.0				●
Meyers Cr	11.0	●			●
Sand Cr	3.9				●
Burnt Hill Cr	2.6				●
Hooskanaden Cr	4.7				●
Thomas Cr	3.7	●			●
Whalehead Cr	9.5	●			●
Bowman Cr	3.4				●
Lone Ranch Cr	7.4				●
Taylor Cr	5.1				●
Shy Cr	5.9	?			●
Harris Cr	4.8	?			●
Ransom Cr	3.4				●
McVay Cr	2.0				●

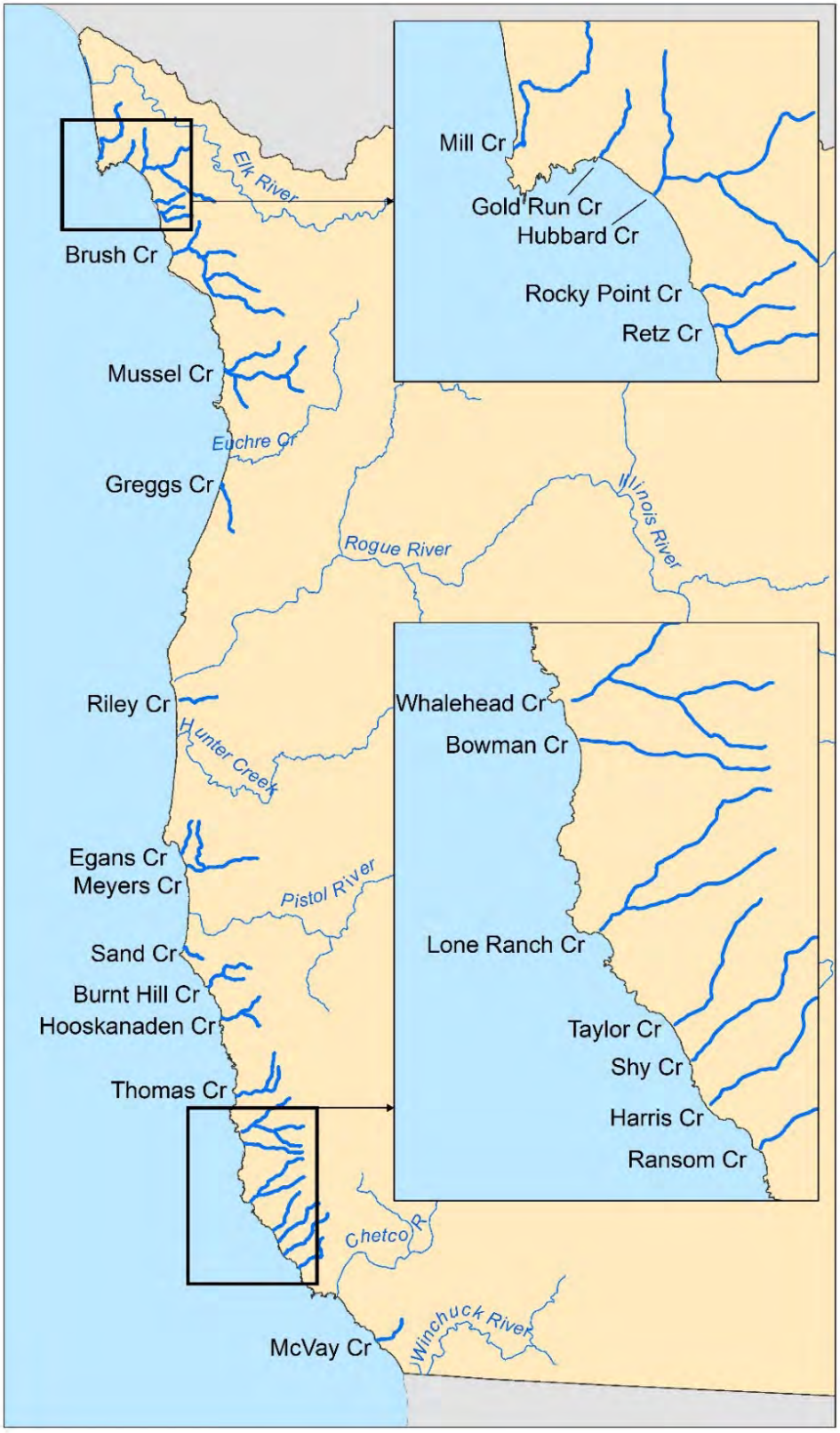


Figure A-I: 4. Map of coastal direct ocean tributaries which were not assessed in the RSP but contain steelhead, coho salmon, and/or cutthroat trout. These areas are collectively referred to as "non-assessed direct ocean tributaries" (NADOTs).

Appendix I: Fishing Actions – Winter Steelhead

Figure A-I: 5 and **Table A-I: 5** supplement **Figure 15** in the RSP, providing additional detail about the percentage of winter steelhead habitat open to wild harvest opportunity in Coastal Stratum basins. Areas with limited or no access for anglers due to roadless areas, topography, land ownership, or other constraints are highlighted in **Figure A-I: 5. Table A-I: 6** below presents harvest rate estimates for wild winter steelhead.

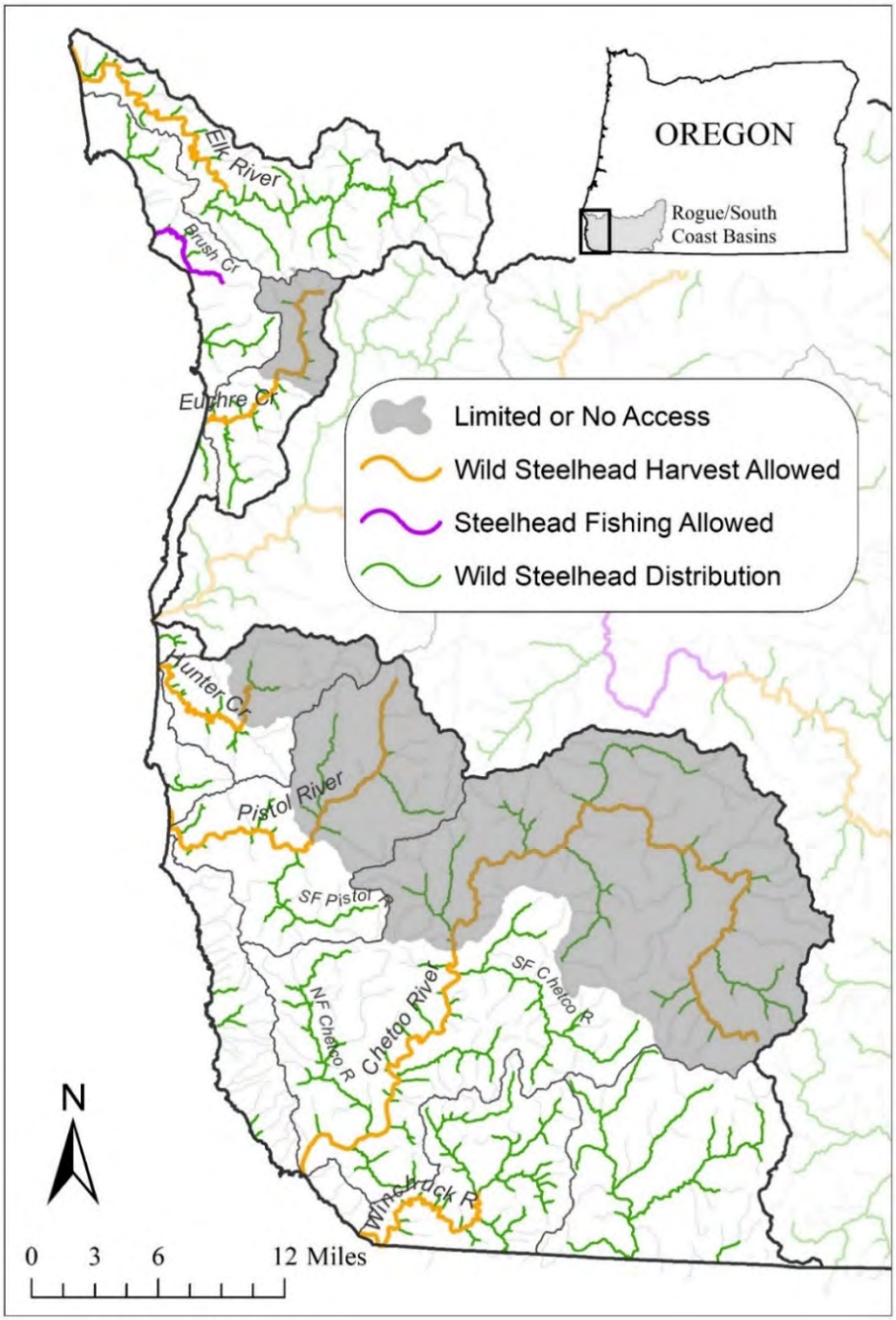


Figure A-I: 5. Locations open to wild steelhead harvest (orange) or steelhead fishing without wild steelhead harvest (purple) relative to winter steelhead distribution (green) in the Coastal Stratum at the time of plan development. Locations with very limited or no access are highlighted in gray.

Table A-I: 5. Kilometers of winter steelhead habitat in Coastal Stratum basins, the percentage open to wild harvest opportunity, and the percentage open to wild harvest opportunity and accessible to anglers for winter steelhead fishing.

Population	Winter Steelhead Distribution (km)	% Open to Wild Harvest	% Open to Wild Harvest and Accessible
Elk	111	25%	25%
Euchre	45	50%	22%
Hunter	33	55%	43%
Pistol	87	40%	20%
Chetco	317	29%	10%
Winchuck	92	21%	21%

Table A-I: 6. Estimated wild winter steelhead harvest rates in RSP basins with a bag limit of 1 fish per day/5 fish per year based on best recent information available (see footnotes). Harvest rate estimates for the Rogue Basin were calculated using two methods, both of which rely on extrapolation and assumptions.

Stratum	Population	km StW Habitat	Average Post-Harvest Wild Spawners (range)	Average Wild StW Harvest (range)	Average Harvest Rate (range)
Coastal	Elk	111	**1,839** (1,178-2,899)	**150** (22-232)	**9%** (1%-16%)
	Euchre	45	**803** (572-1,176)	**3** (0-8)	**<1%** (0%-1%)
	Hunter	33	**560** (370-820)	**26** (4-42)	**5%** (1%-8%)
	Pistol	87	**1,518** (1,057-2,220)	**41** (20-70)	**3%** (1%-4%)
	Chetco	317	**4,844** (3,240-7,580)	**829** (547-1,258)	**15%** (9%-19%)
	Winchuck	92	**1,606** (1,136-2,367)	**43** (4-91)	**2%** (0%-4%)
	Coastal Stratum Total	684	**11,170**[a] (7,535-17,063)	**1,093**[d] (821-1,591)	**9%** (5%-13%)
Rogue	Lower Rogue	116	-	-	-
	Illinois	741	-	-	-
	M Rogue/Applegate	1,147	-	-	-
	Method 1[b]				
	Upper Rogue	534	**5,678** (2,982-7,780)	**562** (211-917)	**9%** (7%-11%)
	Rogue Stratum Total	2,538	**18,440** (13,834-23,984)	**1,196**[d] (952-1442)	**6%** (4%-8%)
	Method 2[c]				
	Upper Rogue	534	**5,678** (2,982-7,780)	**431** (293-610)	**7%** (5%-8%)
	Rogue Stratum Total	2,538	**27,894** (14,645-38,512)	**1,196**[d] (952-1442)	**4%** (3%-6%)

[a] Coastal Stratum wild winter steelhead spawner estimates (after harvest) are based on redd counts (converted to adult abundance based on ODFW 2013) in a limited number of randomly selected spawning surveys in 2005-2008, 2010, and 2013-2014. Abundance estimates have large confidence intervals (high uncertainty) in all years due to low survey effort. Estimates for 2009, 2011-12, and 2015 were excluded due to small sample size, very low precision, or both. Wild steelhead spawner estimates for populations are based on annual return for the stratum and the proportion of total stratum steelhead habitat (stream km) in each basin.

[b] Method 1: Rogue Stratum wild winter steelhead spawner estimates based on Gold Ray Dam counts and redd counts (converted to adult abundance based on ODFW 2013) in a limited number of spawning surveys in the Rogue Basin below Gold Ray Dam in 2005-2009. **NOTE: Survey-based wild abundance estimates have large confidence intervals (high uncertainty) due to low survey effort and Gold Ray Dam counts were consistently below the long-term average in these years.** Spawner estimates (post-fishery) for the Upper Rogue are based on Gold Ray Dam counts and harvest estimates above Gold Ray Dam.

[c] Method 2: Rogue Stratum wild winter steelhead spawner estimate using Gold Ray Dam count (2005-2009) extrapolated based on the percentage of Rogue Basin winter steelhead habitat in the Upper Rogue population area. This percentage (21%) is similar to the average contribution of the Upper Rogue population to total wild winter steelhead abundance in the Rogue (18%) in ODFW (1990). **NOTE: Gold Ray Dam counts were consistently below the long-term average in these years.**

[d] Wild winter steelhead harvest estimates are based on harvest card expansions for return years corresponding to wild spawner estimates. Harvest estimates for the Upper Rogue include harvest in the lower and middle Rogue, and assume that fish are harvested roughly in proportion to abundance (using km of steelhead habitat as a relative abundance indicator). Harvest card estimates for the Chetco River in the 2011-12 and 2012-2013 run years were within 30% of harvest estimates determined through creel surveys, with no clear positive or negative bias.

Appendix II – Genetic Structure and Diversity Summary

Introduction

Demography and selection shape the genetic architecture of natural populations. Footprints of both can be found in genetic data, which in turn can be used to delineate populations and describe how heritable diversity is distributed within and among groups (Funk et al. 2012). Genetic diversity is the basis for evolutionary potential, contributes toward population resilience and adaptation (Dawson et al. 2011; Sgro et al. 2011) and is a fundamental component of biodiversity (Laikre et al. 2010).

Various methods can be used to collect and analyze genetic data to inform conservation and fisheries management. Early efforts to characterize Oregon's Rogue–South Coast fish populations focused on allozyme diversity. These studies used gel electrophoresis to quantify protein structure variants that roughly reflect sequence diversity of DNA. Advances in molecular genetic tools allowed more direct characterization of DNA, with considerable attention to polymorphic simple sequence repeats (e.g. mini- and microsatellites), as well as haplotype diversity in both mitochondrial and nuclear DNA sequence. These techniques have improved the resolution of information used to assess diversity, delineate populations, and perform genetic stock identification (GSI). Most recently developed techniques, such as genotyping-in-thousands (GTseq; Campbell et al. 2015), genome-wide association studies, environmental DNA analyses and transcriptomics may further advance understanding of Rogue–South Coast fish populations, but have only been applied in a few cases.

Genetic diversity may be characterized within and among individuals and groups. Common statistical approaches include estimation of heterozygosity, hierarchical analyses of variance through Wright's F-statistics (Wright, 1965), sample size-adjusted diversity estimates (i.e., allelic richness; see Kalinowski 2004), estimates of Nei's genetic diversity (Nei 1973) and distance (Nei 1972), and variants or extensions of these. Inferences developed from these metrics must consider whether subject genetic diversity is effectively neutral or influenced by natural selection, because variance at neutral genetic loci can be expected to reflect demographic processes, whereas markers under selection confer or carry signals of genetically-based adaptation (see Luikart et al. (2003)). Diversity estimates can also be affected by inherent species differences, the life stage sampled and the spatial scale of study. Accordingly, comparisons of genetic diversity across species and regions may be inappropriate or hindered by incomparable datasets. Nevertheless, careful comparisons among species carries potential to reveal important differences in behavior or evolutionary history, while intraspecific analyses can help to identify population boundaries, diversity hotspots, genetic bases to adaptive variation and demographic processes relevant to management.

Here, we review genetic information for Rogue–South Coast populations of steelhead (*Oncorhynchus mykiss*), coho salmon (*O. kisutch*), and cutthroat trout (*O. clarkii*) from primary literature sources and associated datasets. Where possible and appropriate, we compare genetic metric values from Rogue–South Coast populations with those from other west coast regions. Finally, we identify information gaps that could be addressed through future genetics-based research of Oregon's fish populations.

Existing genetic information

Steelhead

O. mykiss express diverse life history types throughout their range. Multiple life history variants co-occur within some watersheds and this diversity can contribute to population stability (Moore et al. 2014; Van Doornik et al. 2013). The Rogue River, especially, includes noteworthy steelhead diversity with respect to migration behavior and associated freshwater residence timing. Summer-run steelhead, which return from the ocean as adults in the late spring through late summer/early fall, are native to the Rogue River, where more ubiquitous winter-run steelhead also occur. Although spawn timing of winter and summer steelhead partially overlap in the Rogue River, their distinct seasons of river entry affect the duration and distance of subsequent freshwater migrations, thereby generating spatial separation of spawning populations (Everest 1973).

Several studies have investigated population structure and patterns of genetic diversity for steelhead along the Pacific Coast of North America. Arciniega et al. (2016) used 12 microsatellites to characterize steelhead populations from the Columbia River in the north to Big Sur in the south, and observed higher heterozygosity in more southerly populations. They also reported a pattern of isolation by distance (Arciniega et al. 2016), previously described in coastal California populations (Garza et al. 2014; Pearse et al. 2011). Arciniega et al. (2016) included samples of winter steelhead from Lobster Creek and Lawson Creek, tributaries in the Rogue Basin, which presented relatively high allelic richness (mean AR = 7.9 and 8.0 alleles per locus v. coastwide range AR 5.9–8.4), despite low heterozygosities (Hobs = 0.360 and 0.361). They found that most genetic variance was contained within populations, whether defined by run type (88.16% of total variance) or river basin (84.93% of total variance).

In their allozyme study of steelhead trout, Reisenbichler et al. (1992) included samples from the Elk River, Hunter Creek, and seven locations of the Rogue River: Saunders Creek, Shasta Costa Creek, Big Windy Creek, Galice Creek, Slate Creek, and the lower and upper Rogue River mainstem. They also included three hundred steelhead from Cole Rivers Hatchery in their analyses. Results from their study revealed a genetic clade that included steelhead from Hunter Creek and most Rogue River sites. Reisenbichler et al. (1992) reported no significant genetic difference among steelhead sampled at different Rogue River sites, and found no significant evidence for genetic difference between hatchery and wild steelhead in the Rogue River—in contrast with results from six of seven other hatchery-wild comparisons in other river basins. Steelhead sampled from the Elk River curiously grouped with Oregon Central Coast populations. Similar to the microsatellite-based findings of Arciniega et al. (2016), Reisenbichler et al. (1992) reported that most gene diversity was contained within samples (98% variance within sites), leaving little variance to partition among sites and regions.

Reisenbichler et al. (1992) found no significant genetic difference between summer- and winter-run steelhead of the Oregon south coast. Their result is consistent with numerous other studies that have tested for genetic differences between steelhead run types within rivers, but found little or no structure between them (Arciniega et al. 2016; Chilcote et al. 1980; Nielsen and Fountain 1999). However, recent discoveries of single nucleotide polymorphisms (SNPs) that confidently discriminate between steelhead run types have now begun to lend insight to the genetic underpinnings and evolutionary history of adult

run timing in this species (Hess et al. 2016; Micheletti et al. 2018; Prince et al. 2017). These and other trait-associated markers may serve to inform steelhead conservation and management in Oregon, but their discovery also introduces a host of new questions (Waples and Lindley, 2018). Moving forward, it will be important to understand the spatial and temporal distributions of important adaptive genetic variation, and assess whether existing management frameworks adequately protect it. Genetic variation underlying other adaptive traits, such as thermotolerance and age of maturation, may also be discoverable through genome-wide association studies and are deserving of research.

In addition to summer- and winter-run types, the presence of "half-pounders" further contributes to the diversity of steelhead life histories in the Rogue River. Half-pounders are sub-adult steelhead that temporarily return to freshwater during the late summer and fall (peak in August), after having spent only a few months at sea (Hodge et al. 2014; Kesner and Barnhart 1972). Male half-pounders may, in some cases, spawn with older adult steelhead (Everest 1973). The half-pounder life history is common in some steelhead populations of southern Oregon and northern California (Rogue, Klamath, and Eel rivers), but is otherwise rare in their North Pacific range (Hodge et al. 2014). Scale analyses indicated that 97% of wild adult summer steelhead sampled from the Rogue River in 1969 had expressed the half-pounder life history (Everest 1973) and most adult winter steelhead returning to Cole Rivers Hatchery during a three-year study were found to have been half-pounders (Evenson and Ewing 1992). No genetic basis for this life history has yet been identified, though in some populations expression appears to be positively associated with smaller size at time of first ocean entry (Peterson et al. 2017), which may be related to smolt age and growth rates.

Coho salmon

The rivers along the coast of Oregon and California likely served as a glacial refugium for coho salmon (*O. kisutch*) during the more severe ice ages of the early Pleistocene, and the relatively high genetic diversity contained within southern populations, relative to those of Canada and Alaska, now represent an important evolutionary legacy for the species (Smith et al. 2001).

Genetic studies of coho salmon along the Oregon Coast have primarily focused on populations north of Cape Blanco. Currens (1997) included samples from several Rogue–South Coast rivers (Elk, Rogue, Illinois, Winchuck and Smith rivers) in his mitochondrial (mtDNA) study of coho salmon, but found no relationship between genetic and geographic distance. Because of its maternal mode of inheritance, smaller effective population size, and exacerbated effects of drift, mtDNA diversity often does not reflect biogeographic processes as well as some nuclear markers (Smith et al. 2001) such as microsatellites.

Accordingly, in contrast with the finding of Currens (1997), Ford et al. (2004) found weak geographic structure among coastal Oregon and Washington coho salmon populations with data from seven microsatellites; though 97.5% of total variance was present within populations. But their analyses did not include any populations from the Rogue–South Coast SMU. Johnson and Banks (2008) also found weak population structure for Oregon coastal coho salmon with microsatellites (overall FST = 0.021; i.e. 98% of total variance contained within populations), and described a hyperbolic trend in allelic richness

that peaked near the Yaquina River and bottomed out in Rogue River populations. Natural-origin Rogue River coho salmon were the only Oregon South Coast samples examined by Johnson and Banks (2008), and, as expected, these fish appeared to be distinct from Oregon populations that spawn north of Cape Blanco. Interestingly, in a microsatellite survey of northern California and southern Oregon coho salmon populations, Garza (unpublished) found that coho salmon from the Rogue and Klamath rivers were highly similar, and distinct from nearby coastal populations, including coho salmon from the Chetco and Elk rivers, which most closely resembled small northern California populations surrounding Humboldt Bay. Taken together, the findings of Johnson and Banks (2008) and Garza (unpublished) suggest that a distinct coho salmon population complex occupies the relatively montane Klamath-Rogue habitats, and that coho salmon from as far north as the Necanicum River to as far south as the Eel River could comprise another relatively connected population complex. Alternatively, Cape Blanco could represent a significant boundary between coastal populations, consistent with current ESU delineations, and the Rogue-Klamath group exists as a clade nested within the Southern Oregon/Northern California Coast ESU. These competing hypotheses could be tested with a dataset including populations across the coastal expanse or Oregon and northern California, though a simple merger of existing microsatellite data from these two studies would be limited to only four common loci (Ocl8, p53, One13, and Ots3).

Coastal Cutthroat Trout

Coastal cutthroat trout (*O. clarkii clarkii*) are the most basal subspecies within the diverse *O. clarkii* species clade (Wilson and Turner 2009). This subspecies includes anadromous and fluvial life history forms, and in some cases may be the only salmonid present above waterfalls and other barriers common to its range.

Using data from 41 allozyme loci, Griswold (1996) described the genetic diversity of coastal cutthroat trout from above and below potential barriers of the Elk River, Oregon, and compared those results to her findings from a smaller stream in southeast Alaska. She found that cutthroat trout above a natural barrier on China Creek, a tributary of Elk River, presented low heterozygosity (mean H = 0.037) and a deficiency of rare alleles (mean 1.16 alleles per locus). She hypothesized that genetic drift, which can have greatest effect on small, isolated populations, may have been responsible for lower-than-average heterozygosity and allele diversity in China Creek, relative to Elk River means (H = 0.047; 1.25 alleles per locus). She also found that cutthroat trout sampled above a waterfall on Anvil Creek presented relatively few rare alleles. However, cutthroat trout sampled above and below the Anvil Creek waterfall were more similar to one another than to cutthroat trout from other Elk River locations, suggesting at least some gene flow between them or recent isolation. Overall, the level of genetic divergence observed among cutthroat trout from Elk River, Oregon sites (FST = 0.095) was notably higher than that observed among populations from Vixen Inlet, Alaska (FST = 0.015) (Griswold 1996).

Also examining allozyme diversity (30 loci from 13 enzymes), Williams (2004) described the population structure of coastal cutthroat trout from Bosewell Bay, Alaska, to Widow White Creek, California, including populations from Iron Creek (Rogue River) and Wheeler Creek (Winchuck River) of the Rogue–South Coast SMU. Of the 54 populations examined, Williams (2004) found Rogue and Winchuck river cutthroat trout to be more genetically similar to one another than to other populations of

his study, consistent with an isolation-by-distance pattern revealed by the data. Interestingly, these two populations did not cluster with neighboring populations to the north or south, suggesting that cutthroat trout in the Rogue–South Coast SMU may be isolated from other coastal cutthroat trout populations.

Using data from microsatellites, Guy et al. (2008) found Oregon Coast Range populations of coastal cutthroat trout to be more diverse than populations occupying rivers of the Cascade foothills. Their analysis included above-barrier populations from 27 Oregon watersheds, including individuals from three tributaries in the Rogue Basin: lower (RF) Salt Creek (n = 86), upper Salt Creek (n = 83), and Little Stratton Creek (n = 32). As might be expected, genetic differentiation between the two Salt Creek collections (FST = 0.09) was lower than observed between these and the Little Stratton Creek population (both pairwise FST = 0.34). Pairwise FST values from different tributaries of the Rogue River narrowly exceeded the average FST observed among all populations of their study (mean pairwise FST = 0.33), reflecting strong genetic structuring within this species at local scales (Guy et al. 2008). This overall level of population differentiation from Oregon (FST = 0.33) exceeded estimates reported from Washington (FST = 0.09; Wenburg and Bentzen 2001) and Alaska (FST = 0.28; Whiteley et al. 2010) that examined microsatellite diversity for coastal cutthroat trout across similar geographic scales.

Synopsis

Genetic data for RSP species vary with respect to both spatial resolution and marker type, limiting opportunities for interspecific comparisons. Notwithstanding some inconclusive mtDNA data (Currens 1997), the genetics of coho salmon are perhaps the most sparsely described of the species considered here. Within the Rogue–South Coast SMU, coho salmon from the Rogue, Elk and Chetco rivers have been characterized with microsatellites, revealing relatively low diversity of Rogue River coho salmon (Johnson and Banks, 2008), which appear similar to Klamath River coho salmon, but are otherwise distinct from all other populations to the north and south. Whether low genetic diversity of Rogue River coho salmon is an artifact of early colonization or symptomatic of recent bottlenecks is an outstanding question. Although coho salmon from Oregon's Chetco and Elk rivers appear genetically similar to some coastal California populations (e.g. Eel and Mad rivers; C. Garza, unpublished), their relationships with more northerly Oregon populations have not been described.

Steelhead populations in Rogue–South Coast basins have been characterized with microsatellites, allozymes and SNPs. Steelhead in these basins present relatively high levels of allelic richness, yet exhibit little within-basin genetic structure (Arciniega et al. 2016; Reisenbichler et al. 1992). Neither microsatellites nor allozymes have provided evidence for genetic structure between summer- and winter-run steelhead from the Rogue River (Arciniega et al. 2016; Reisenbichler et al. 1992), though recently developed SNP tools (Hess et al. 2016; Micheletti et al. 2018; Prince et al. 2017) offer promise to discriminate between run types for this species. These tools may further prove useful to estimate the contribution each run type makes to the half pounder life history and, perhaps, generate new forecasting tools for winter- and summer-run steelhead.

Appendix III – Current Status Methods and Results

Appendix III: Abundance and Productivity

Wild animals are difficult to completely census at useful spatial and temporal scales. Instead, imperfect observations of abundance are typically made over a subset of places and times, and then inference is applied to transform these observations into estimates of total abundance at the desired spatial and temporal scale. Observation protocols vary across SMUs, populations within SMUs, and ODFW's history, and there is no single method available to estimate abundance across all SMUs and populations. Similarly, uncertainty in the estimates of abundance is not constant across SMUs or even populations within an SMU. The following sections describe the different data sources and methods used to estimate adult and juvenile fish abundance in each SMU. Where available, these estimates were used to assess the current abundance and productivity parameter for populations or strata. Other potential data sources (e.g. spawning surveys for coho salmon and steelhead; smolt trap data collected as part of KMP steelhead studies) were not used in the assessment because they were not collected consistently over time, did not have adequate accuracy or precision, or were not collected recently enough (within the last 10–15 years) to be considered current status. These data had value at the time they were collected and can provide context for understanding status, but were not used formally in our analysis.

Monitoring data needed to determine VSP parameters at the population scale are limited in the RSP planning area, and we relied heavily on juvenile salmonid abundance and distribution data in our assessment. Juvenile salmonid metrics are less direct indicators of population performance and viability than adult spawner abundance, but still have considerable value for assessing biological status. Although juvenile salmonids move among streams during their freshwater rearing period (see **Appendix I – Additional Background Information),** they are an indicator of the distribution and abundance of the adult spawners that produced them (Foldvik et al. 2010; Flitcroft et al. 2014). Juvenile salmonid abundance is also a direct indicator of the productive capacity of stream habitats, and how this capacity may be changing over time. A large number of juvenile salmonid surveys have been conducted in the RSP planning area, but the annual number of surveys for a given population was small, so metrics derived from these surveys were generally assessed at the stratum level to ensure greater precision of the assessments.

Data Sources and Field Methods

Gold Ray Dam Counts (Rogue Stratum)

Winter steelhead in the Upper Rogue population were counted by ODFW staff at Gold Ray Dam (river mile 126) between 1942 and 2010. Fish counts from 1942–1968 were conducted from an outside viewing platform, with fish identified and counted as they passed over a "flash board" (bright aluminum plate) on the bottom of the fish ladder. This early counting station was subject to high water damage, and frequently had to be removed during the winter. A fish trap, holding pond, and viewing chamber with two 5'x 5' windows were built in the fall of 1968, and fish counts were subsequently conducted from inside the chamber. From 1948–1992, counts were conducted on a 40-hour/week sub-sample schedule (five days per week). The partial counts were designed to estimate biweekly passage with an

average error of less than 10% (Li 1948). Fish count data from the five 8-hour shifts were extrapolated to arrive at a 7-day fish passage estimate.

In October 1992, video-recording of fish passage began on a 24-hour, 7-day/week basis, a procedure assumed to have minimal uncertainty. Video counts continued until the dam was removed in 2010. Video cameras equipped for time lapse recording were operated within the counting chamber. Flood lights located inside the count station provided illumination for both diurnal and nocturnal counts. Cameras ran continuously over a two- or three-day period depending on the speed setting of the camera. When the video tape was retrieved, the glass and surrounding walls of the fish ladder were cleaned to assure maximum visibility. Tapes were read by technicians at the Rogue Watershed District office. Except when high concentrations of fish were passing the viewing window, tapes could be fast-forwarded and scanned for fish, saving considerable counting time. The technicians recorded the species and relative size of all anadromous species observed on the tape. Hatchery fish were recognized by missing fins. In earlier years only a portion of the hatchery fish were marked and it was therefore necessary to estimate the total number of hatchery fish in the run. At Gold Ray Dam the number of fin-clipped fish counted was expanded using the observed marked to unmarked ratio of fish returning to Cole Rivers Hatchery (CRH). This expansion method assumed no differential mortality due to marking. Winter steelhead counts after 2010 were modeled based on a historical relationship with half-pounder abundance. Winter steelhead counts at Gold Ray Dam from February 1 to May 15 (ODFW "Research Counts") were used for the spawner-recruit analysis described below.

Huntley Park Seining Data (Rogue Stratum)

The Oregon Game Commission (now ODFW) began beach seining near the mouth of the Rogue River at Huntley Park (river mile 8) in 1974 to capture adult salmonids (fall Chinook salmon, coho salmon, late-run steelhead, and steelhead half-pounders) that entered the Rogue River. While adult winter steelhead are not monitored at Huntley Park, a proportion of the half-pounders are winter steelhead. Wild fish are distinguished from hatchery fish by the presence of an intact adipose fin on wild fish. Since 1976, seining has been routinely conducted three times per week from mid-July through October.

Initially, the sampling was designed to collect fish to obtain life history information and to estimate freshwater escapement through the use of mark-recapture methods. Mark-recapture efforts were terminated after 1976 when it became apparent that mortality rates of tagged Chinook salmon resulted in biased estimates of freshwater escapement (Cramer 1979). Establishment of a run of hatchery coho salmon in the 1970s afforded an opportunity to generate annual estimates of seining efficiency. Available data indicated that few coho salmon died during upstream migration and few hatchery fish strayed to spawn naturally. Seining efficiency on coho salmon of hatchery origin was estimated, compared to flow at time of seine capture, and a catch efficiency model was developed (ODFW 1989). This flow-based model was used to estimate freshwater escapement for late-run summer steelhead (ODFW 1994). Steelhead half-pounder abundance trends were assessed for the RSP based on raw seine counts from Huntley Park, which had a stronger correlation with subsequent adult steelhead returns than flow-based expansions.

For coho salmon, ODFW has used Huntley Park seining data and CRH returns to estimate freshwater escapement in the Rogue Basin with a modified mark-recapture technique since 1980 (Jacobs et al. 2002). The procedure estimates the population of wild and hatchery fish in the Rogue by applying the Lincoln-Peterson mark-recapture equation. No mark-recapture experiments are actually conducted to complete the calculation. Instead, the parameters associated with re-capture are informed from returning adult salmon collected in beach seines at Huntley Park (H), compared to fish collected at Cole Rivers Hatchery (CRH). The total number of fish recaptured by beach seine at Huntley Park (C_H) is assumed to be the total number of recaptures for the purposes of the Lincoln-Peterson estimator, while the subset of fish that contain an adipose clip are considered to be the re-captured marked individuals (R_H).

The initial number of fish released with marks is estimated retrospectively from the adult fish that return to CRH. The total number of marked individuals that appear at the hatchery are increased by 10% to account for any straying, harvest, or other mortality that may occur between Huntley Park and CRH, with the resulting value assumed to be the initial release occurring prior to the recaptures. Using this factor assumes straying and mortality between the two locations is known and stationary across years. The full Lincoln-Peterson estimator for the population size at Huntley Park, $\widehat{N_H}$, becomes:

$\widehat{N_H} = \frac{(C_H+1)(\widehat{m}_H+1)}{R_h+1}$, $\widehat{m}_H = 1.1A_{CRC}$, where

A_{CRH} is the observed number of marked adipose clipped fish observed at Cole Rivers Hatchery

$\widehat{m}_H$ is the estimated number of marked individuals initially available for recapture at Huntley Park

During development of the RSP, ODFW staff conducted a review of Huntley Park population estimation methods and identified methodological issues in the way that unmarked hatchery fish were accounted for in the Huntley estimates. We reviewed smolt release information and made revised abundance estimates based on observed mark rates (including hatchery fish that received a coded wire tag [CWT] but no fin clip) using a more direct approach with fewer assumptions.

First, the estimated number of unmarked individuals at Huntley Park, $\widehat{U}_H$, was calculated by multiplying the ratio of unmarked fish to marked fish in the beach seine data with the adjusted number of marked individuals that appear at Cole Rivers Hatchery ($\widehat{m}_H$):

$\widehat{U}_H = \frac{p_w}{(1-p_w)}\widehat{m}_{CRH}$, where p_w is the proportion of fish observed at Huntley that are unmarked.

Unmarked hatchery coho salmon were expanded by 5% from the total number of CWT-only recoveries at CRH and then subtracted from the unmarked adults to estimate the total population of wild fish.

$\widehat{N'}_{w_H} = \widehat{U}_H - 1.05CWT_{CRH}$

Using a value of 5% assumes that the 10% loss of adipose-clipped fish is due in equal parts to straying and harvesting. Non-clipped fish are not harvested because they appear wild, thus they should have half

the loss rate of their clipped counter-parts (i.e., only loss occurring to stray rates). Note that stray rates refer here to the proportion of fish that do not return to the hatchery, not the proportion of hatchery fish on the spawning grounds (pHOS). The values of 10% and 5% both rely on assumptions that need to be tested (see **Research and Monitoring Actions**).

The combined total at Huntley Park becomes the summation of wild, expanded coded-wire tag, and adjusted adipose-clipped fish:

$$\widehat{N'}_H = \widehat{N'}_{w_H} + 1.05CWT_{CRH} + \hat{m}_{CRH} \ .$$

The new estimation method was applied backwards through spawn-year 1996 to estimate Rogue Basin coho abundance (revised estimates for years prior to 1996 will require additional data analysis and verification). The effect of the revision was typically a small, but not insignificant, increase in wild coho abundance compared to estimates reported by ODFW in Sounhein et al. (2019).

Juvenile Snorkel Surveys (Rogue and Coast Strata)

Snorkel survey counts of juvenile steelhead, coho salmon, and cutthroat trout have been conducted by ODFW at randomly-selected sites in wadeable western Oregon streams since 2002 (since 1998 for coho salmon) to monitor their status and trends.

Survey sites are selected using a Generalized Random Tessellation Stratified design (GRTS; Stevens 2002), which produced a random, spatially balanced survey sample from within the rearing distributions of coho salmon and steelhead in the RSP planning area. To asses both status and trend, site selection was incorporated with a rotating panel design; 25% of selected sites are surveyed annually, 25% are surveyed on a three-year survey rotation, 25% are surveyed on a nine-year survey rotation, and the remaining 25% are surveyed only once (Stevens 2002). Selected sites (1 km in length) are surveyed by field crews using daytime snorkeling during the base flow period (mid-July to mid-October) (Rodgers 2000). Initially only pools that were ≥40 cm in maximum depth were snorkeled. In 2010, this criterion was expanded to include pools ≥20 cm in maximum depth based on a verification study in the Smith River, Oregon that indicated the ≥20cm criterion would allow surveyors to sample larger and more consistent portions of coho salmon and steelhead summer rearing distributions. Counts are made of coho salmon parr regardless of length, juvenile steelhead ≥90 mm in fork length (FL, visually estimated), and cutthroat trout ≥90 mm FL. Juvenile steelhead and cutthroat trout ≥90 mm FL are typically age-1+ fish. Due to difficulties distinguishing steelhead from cutthroat trout at sizes <90mm FL, all presumptive *Oncorhynchus mykiss* and *O. clarkii* in this range are assumed to be age-0 trout and are not identified to species. Similarly, steelhead cannot visually be classified as summer or winter run.

Elk River spawning surveys (Coast Stratum)

Annual spawning ground surveys for Chinook and coho salmon are performed by ODFW in Elk River. These “standard surveys” have varied in number over time, but have been conducted annually from October to January since 1969. Using peak counts of coho salmon in these surveys and a habitat-based expansion, coho salmon abundance can be estimated for the population. The estimate is best

viewed as an index of abundance because survey frequency varies among sites, and sampling does not occur in all areas where coho salmon spawn.

Current Status of Abundance and Productivity

Abundance and productivity are key indicators of population health and are two of four metrics commonly used to assess the conservation status of Pacific salmonid populations (McElhany et al. 2000). Here, abundance and productivity are assessed in conjunction with one another for two reasons. First, both of these parameters are estimated from spawner-recruit time series data (where this data is available). Second, abundance and productivity are related to one another with respect to a population's risk of extinction. A hypothetical relationship between abundance, productivity, and the probability of extinction is given in **Figure A-III: 1**. The figure illustrates that the effect of abundance on the probability of extinction critically depends on the population's productivity. Conversely, the effect of productivity on the probability of extinction critically depends on the population's abundance. Thus, abundance and productivity are jointly assessed through analysis of extinction risk (see section below on population viability analysis).

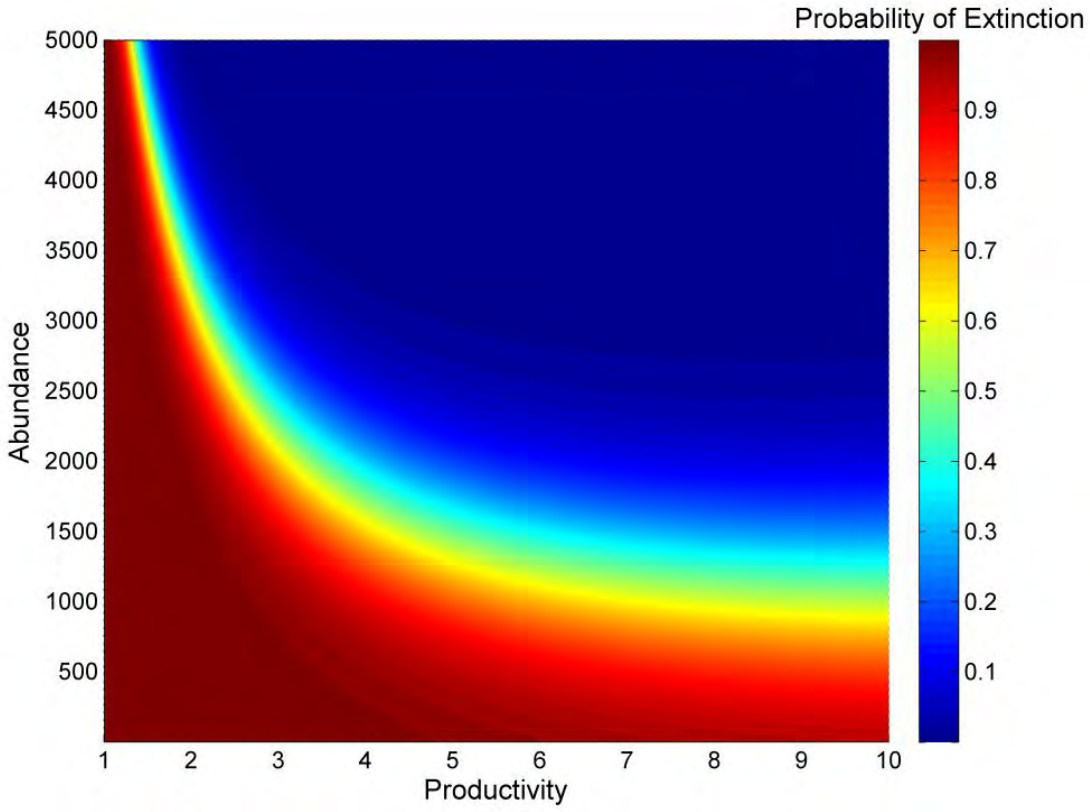


Figure A-III: 1. Hypothetical example of the 3-way relationship between abundance, productivity, and the probability of extinction.

Spawner-Recruit Analysis

Spawner-recruit analysis is a well-known technique among fisheries scientists (Ricker 1954; Hilborn and Walters 2013; Haddon 2011). The purpose of a spawner-recruit analysis is to quantify the relationship between the abundance of spawning fish in a given stock (or population) and the

abundance of their progeny that is expected to "recruit" into (i.e., survive until) a predefined age or size class. If recruits are defined as fish that are old enough or large enough to be caught in a fishery, then spawner-recruit analysis can be used to identify optimal harvest rates that result in the maximum sustained yield (MSY). However, attempting to maintain a population at MSY can be problematic (Walters and Martell 2004; Finley 2011), and will therefore not be attempted here. Instead, spawner-recruit analysis is used to:

1. estimate population productivity,
2. estimate spawner population carrying capacity,
3. estimate uncertainty and covariance in (i) and (ii), and
4. derive an analytical model of density-dependent population regulation (with parameter uncertainty and covariance) useful for population viability analysis (see next section).

It is possible to associate each year's spawner abundance with the abundance of their recruit progeny. A plot of these data should reveal information about the effect of spawner abundance on the abundance of their adult progeny. This relationship can be modeled with the logistic hockey stick model (Barrowman and Myers 2000):

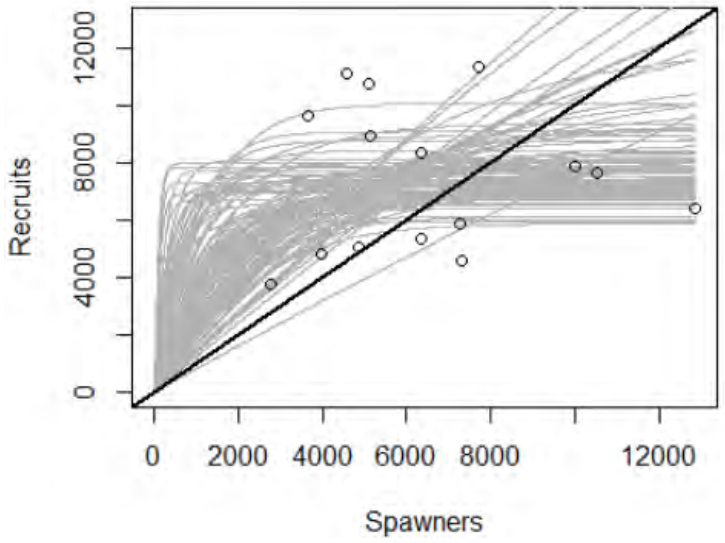
$$R_t = \alpha\theta\gamma(1 + e^{-1/\theta})\left(\frac{S_t}{\theta\gamma} - \log\left(\frac{1+e^{(S_t-\gamma)/(\theta\gamma)}}{1+e^{-1/\theta}}\right)\right)e^{\epsilon_t}$$

Where R_t is the abundance of recruits associated with spawners at time t (S_t), α, θ, and γ are parameters defining the shape of the recruitment curve, and ϵ_t are normally distributed errors with mean 0 and standard deviaiton to be estimated. A further refinement of the spawner-recruit anlayis can accommodate potentially reduced productivity of hatchery-origin spanwers. This is needed to ensure that estimates of the productivity of the natural-origin component of the spawning population is disentangled from the relative reproductive success of co-spawning hatchery-origin fish. This is done by replacing S_t in the equation above with ($W_t + \psi H_t$), where W and H are abundances of natural and hatchery-origin spawners, respectively, and ψ is a parameter representing the relative reproductive success of hatchery-origin spawners.

For the status assessment, ODFW conducted the spawner-recruit analysis described above for the Upper Rogue winter steelhead population, and for Rogue Basin coho salmon in aggregate. Historical summer steelhead counts at Gold Ray Dam (GRD) and late-run summer steelhead estimates at Huntley Park were also considered for analysis, but both data sets had limitations that precluded their use. GRD summer steelhead counts ended in 2009, and ODFW had less confidence in modeling these counts forward compared to winter steelhead. In addition, age composition data critical to accurately assigning recruits to specific brood years was lacking. Summer steelhead are known to have highly variable life histories, and a lack of age composition data has precluded spawner-recruit analysis for Upper Rogue summer steelhead in the past (ODFW 1994). The same limitation applies to summer steelhead estimates at Huntley Park. Furthermore, Huntley Park estimates only include the late portion of the summer steelhead run. ODFW considered these data unsuitable for spawner-recruit analysis because they do not cover the full breadth of returns and would fail to adequately reflect overall population dynamics.

For the spawner-recruit analysis, winter steelhead counts were adjusted for harvest above GRD and broodstock collection at CRH to estimate spawner escapement. Hatchery spawners were estimated based on the proportion of hatchery spawners at the Elk Creek trap (winter steelhead) or assumed stray rates above Huntley Park (coho salmon). Pre-harvest recruits were determined using freshwater harvest estimates below GRD for winter steelhead and ocean fishery impacts for Rogue Basin coho salmon. Winter steelhead recruits were associated with spawners using a fixed age composition (ODFW, unpublished data). Spawner-recruit relationships for Upper Rogue winter steelhead and Rogue Basin coho salmon are given in **Figure A-III: 2**. Grey lines are 100 random draws from the joint posterior distribution. Variation among these lines depicts the parameter uncertainty in recruitment dynamics, while preserving the covariance structure among recruitment parameters.

A) Upper Rogue Winter Steelhead



B) Rogue Basin Coho Salmon

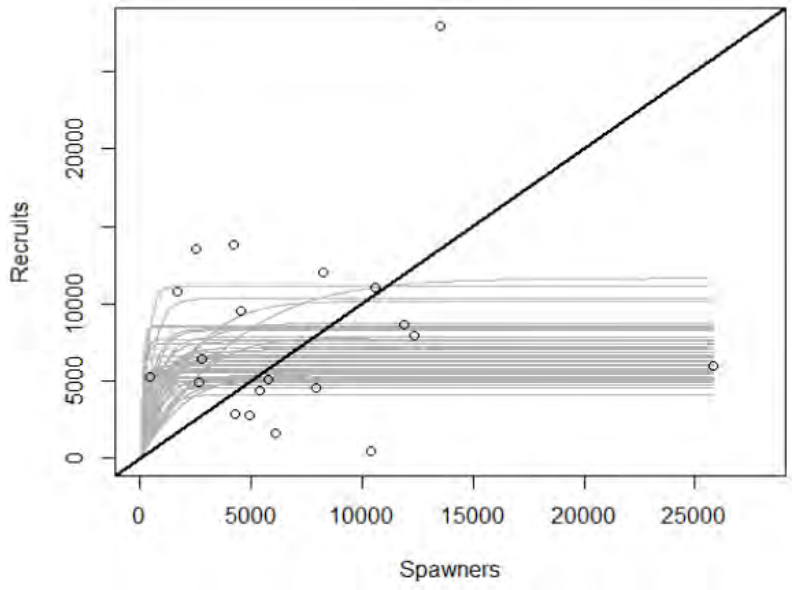


Figure A-III: 2. Spawner-recruit relationships for: A) Upper Rogue winter steelhead (1998-2017); and B) Rogue Basin coho salmon (1996-2018). The black line shows equivalence between spawners and recruits.

Population Viability Analysis

Population viability analysis (PVA) is a cornerstone of conservation biology (Beissinger 2002; Morris and Doak 2002). Here, a PVA is a computer model that uses information from the spawner-recruit analysis (see previous section) to project/simulate population abundances into the future. 100,000 repetitions of a 100-year simulation of annual spawners and their recruits are conducted, and the fraction of these that result in an extinction event yields the probability of extinction. Since the spawner-recruit function uses data from the last several decades, the extinction probability estimated from the PVA is used as one component to assess the "current status" of the population. It is important to note that the word "extinction" refers to a population (i.e., "local extinction", or "extirpation"), not a species.

It is also important to note that the PVA models developed here were created for the existing data. An opposite modeling philosophy begins with a more detailed life-cycle model and then uses professional opinion to infer necessary values that are not estimable from existing data. The existing data are adult estimates at a mainstem monitoring site. These data can be used for spawner-recruit analysis, but they cannot be used to estimate the values needed in elaborate life-cycle models. Thus, the PVA models developed here are relatively simple because anything else would require inference with unquantifiable uncertainty. Not only is this a sound modeling approach, but more elaborate life-cycle models would not necessarily result in more accurate PVAs. The most important form of variability in a PVA occurs at the across-generation scale, not within a generation. A life-cycle model would be useful for evaluating future scenarios or prioritizing restoration, but it would not necessarily ensure better assessment of across-generation variation than the spawner-recruit models used here.

The recruitment function fitted to each population is the model of intergenerational population dynamics used within the PVA to simulate spawner abundances through time. However, in the spawner-recruit analysis, "recruits" are defined as mature-run-equivalents. The very same inland and ocean harvest estimates used to estimate mature-run-equivalent recruits from spawner abundances are also used by the PVA to convert mature-run-equivalent recruits back into spawners. Indeed, the analytical steps used to estimate recruits for the spawner-recruit analysis are reversed inside the PVA. Thus, the PVA:

1. takes a given spawner abundance on year t,
2. uses the recruitment function to estimate recruits,
3. uses the age-structured cohort expansion factor (CEF) to deflate the result of step 2 down to the inland return on year t+2, t+3, t+4, …m t+7 years later (because steelhead mature between 2, 3, 4,… 7 year olds), and
4. takes the sum across age classes of inland return on year t+1and deflates it by an inland harvest rate to generate spawner abundance on year t+1.

A critically important aspect of all PVAs is the incorporation of stochasticity ("randomness"). Indeed, if stochasticity is neglected, then the steps outlined above would quickly result in static population and extinction risk would be zero. Stochasticity enters the PVA in several ways. First, the spawner-recruit data are ambiguous with respect to the parameters of the recruitment function. Thus, uncertainty in the estimates of recruitment parameters α, θ, and γ are simulated within the PVA by repeating simulations

with different values of α, θ, and γ. Different values of α, θ, and γ are selected in proportion to the probabilities of different values and their covariance. This is accomplished by fitting the logistic hockey stick spawner-recruit model with Markov chain Monte Carlo (McMC) methods in a Bayesian context. Samples of the Markov chain are saved, and the PVA randomly selects parameter values out of this pool.

The spawner-recruit data are not fully explained by the logistic hockey stick recruitment function, even though parameter uncertainty is acknowledged. This can be seen as the vertical distances between spawner-recruit "points" and the line(s) representing the recruitment function(s). These "residual" deviations must also be simulated in the PVA. These residuals are lognormally distributed (note that the errors, ε, are exponentiated in the recruitment functions described above) and contain temporal autocorrelation. After the PVA receives a set of values for α and β, the variance of the errors is computed as well as the lag-1 autocorrelation of the errors. A 100-year time series of residual errors is then simulated using:

$$\varepsilon_t = \rho\varepsilon_{t-1} + \sqrt{\sigma^2}\sqrt{1-\rho^2}z_t \ ,$$

where ρ is the lag-1 autocorrelation of the errors, σ^2 is the variance of the errors, and z_t is a standard normal random deviate (Morris and Doak 2002, p. 139).

The inland harvest rates also induce stochasticity in spawner abundances. This is included in the PVA by randomly drawing inland harvest rates for each simulated year from the time series of numbers used to estimate recruits.

Extinction in the PVA model occurs when spawner abundance for three consecutive years falls below a "quasi-extinction threshold" (QET). A separate process called "reproductive failure threshold" (RFT) is used to zero-out recruitment at critically low spawner abundances. Both of these thresholds are implemented because processes like inbreeding depression, genetic drift, mate finding, and increases per-capita juvenile mortality will drive the population into extinction at critically low abundances. These negative density-dependent processes are very infrequently observed in nature, so they cannot be explicitly modeled. Collectively, both QET and RFT represent the boundary of an "extinction vortex" from which real populations are irrecoverable (Gilpin and Soulé 1984; Courchamp et al. 2008; Jamieson and Allendorf 2012). The specific values of the threshold depend on the historical size of the populations, which were determined *a priori* by ODFW staff based on stream kilometers and likely historical differences among populations in productivity and habitats. Threshold values are the same as those used in the CMP (ODFW 2014):

- For "small" populations, RFT=QET=50
- For "medium" populations, RFT=QET=150
- For "large" populations, RFT=QET=250

In our analysis, we considered Upper Rogue winter steelhead a medium size population and Rogue coho salmon an aggregate of three medium size populations. Our approach for the Rogue results in a high RFT and QET that may overestimate extinction risk based on empirical information from the Upper Rogue, where coho salmon have persisted through periods of very low abundance. Nevertheless, we considered this approach appropriate given uncertainty about coho salmon population structure in the Rogue and the difficulty of assessing extinction risk for putative populations that likely differ in abundance and productivity, but are monitored in aggregate.

The PVA model uses past abundances to infer extinction risk. Thus, the interpretation of the result is couched in the assumption that the conditions that were present when the data were collected will persist for 100 years. The model is not intended to capture effects of global climate change, human population growth, or other anticipated future change. Of course, the future will not be like the past. Future food webs are uncertain, as is the adaptive potential of these fish. The purpose of the PVA is not to forecast the future; rather, the PVA is an assessment of current status.

PVA Model Results

The mean extinction risk (ER) from the PVA model determined the abundance and productivity (A&P) viability risk score as follows:

A&P Score	Results
1	ER<1%
2	ER<5%
3	ER<25%
4	ER<60%
5	ER≥60%

Upper Rogue Winter Steelhead Harvest Tolerance

The mechanics of the PVA are well suited to address the effects of hypothetical harvest regimes on population extinction risk. The computations within the PVA that convert recruits into spawners can be manipulated to reflect any desired level of harvest. For Upper Rogue winter steelhead (the winter steelhead population with the least uncertainty in abundance estimates), inland harvest rates up to 80% were simulated in a PVA model and the resulting extinction risk was recorded (see **Figure 16** in **Fishing Actions**).

Juvenile Rearing Density

Few populations had adult abundance data sufficient to conduct the stock-recruit and population viability analyses described above. Juvenile abundance data provided an alternative measure of abundance and productivity to indicate viability risk for steelhead, coho salmon, and cutthroat trout. Snorkel survey methods used in the RSP planning area (described above) are the same as those used to monitor populations in the Lower Columbia and Coastal SMUs to the north where viability of salmon, steelhead, and trout populations has been assessed (ODFW 2007, ODFW 2010, ODFW 2014). Average density in snorkeled pools is calculated the same way across SMUs, providing a common

currency for comparison. Comparisons among SMUs were based on monitoring results from 2012–2019 (**Figure A-III: 3**). This is not the full time series for juvenile surveys, but corresponds to the period when the current sampling frame and pool sampling criteria were used in the Rogue–South Coast SMU.

Viability risk scoring was determined on a case-by-case basis for each stratum or population based on density comparisons and the viability status of neighboring SMUs. The underlying assumption is that juvenile densities are indicative of habitat quality, adult escapement, and juvenile production, all of which influence population productivity.

Average juvenile (age 1+) steelhead density in the Rogue–South Coast SMU was comparable to (Rogue Stratum) or considerably higher than (Coastal Stratum) density in the neighboring Coastal SMU, where steelhead are considered viable (ODFW 2014). Based on these comparisons, the Coastal Stratum was assigned a viability risk score of 1 (very low risk) and the Rogue Stratum was assigned a score of 2 (low risk).

For coho salmon, comparisons of rearing density with neighboring SMUs indicated moderate viability risk for the Interior Rogue Stratum and high viability risk for the Elk River population. Both had average densities far below those observed in the Coastal SMU to the north, where most populations are considered viable (ODFW 2007). Average densities were more comparable to those observed in the Lower Columbia SMU, where most populations have moderate to high extinction risk. When making comparisons, it is important to note that habitat with high intrinsic potential is naturally more limited in the Rogue–South Coast SMU compared to neighboring SMUs, which contributes to lower densities across the sampling frame.

Finally, coastal cutthroat trout density in both strata of the Rogue–South Coast SMU was comparable to density in neighboring SMUs, and viability risk is assumed to be very low.

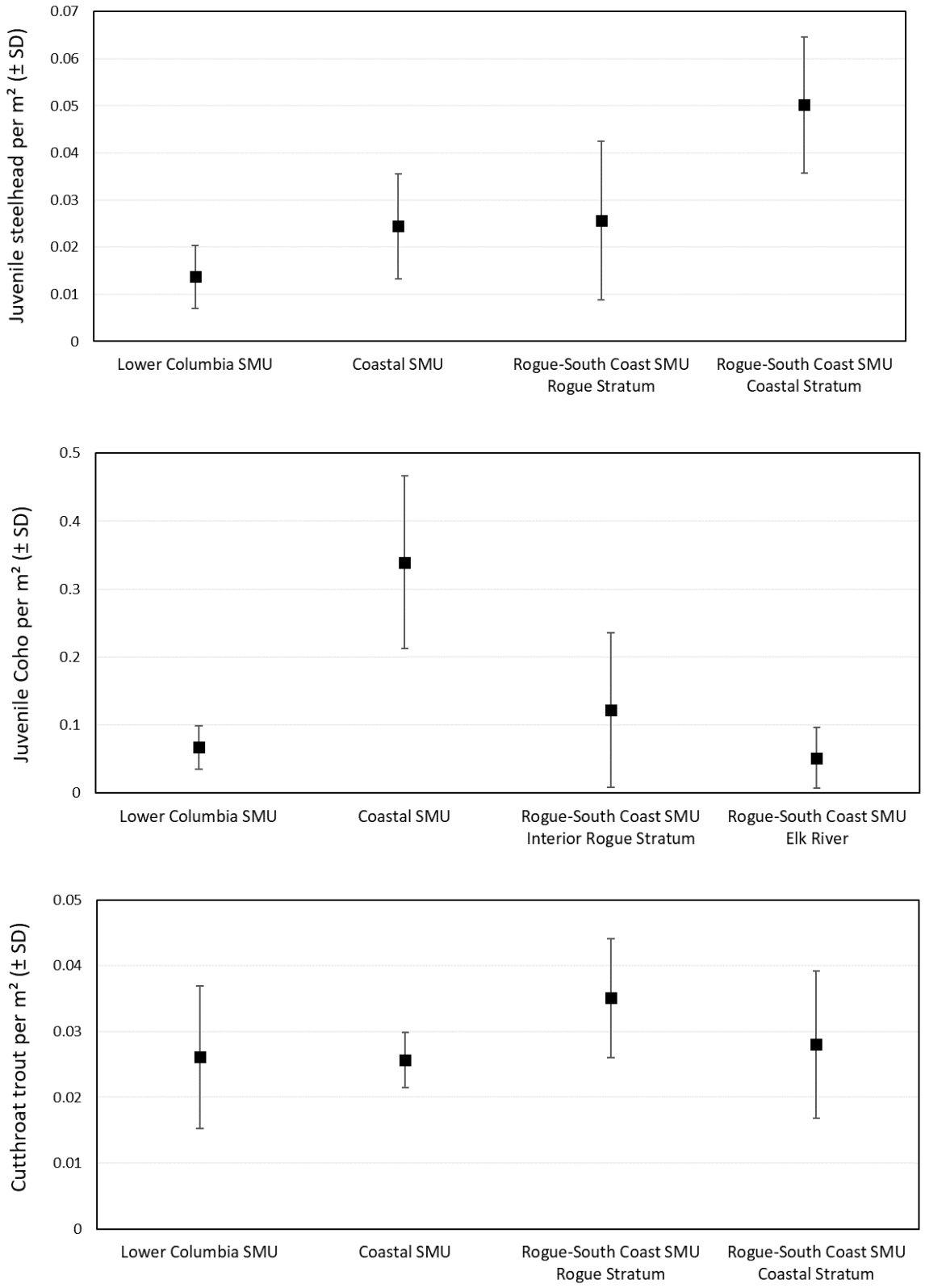


Figure A-III: 3. Density estimates in the Lower Columbia, Coastal and Rogue–South Coast SMUs for juvenile (age-1+) steelhead (top panel); juvenile coho salmon (middle panel); and coastal cutthroat trout (bottom panel). Values shown are averages ± standard deviation for 2012–2019.

Appendix III: Spatial Structure

Spatial structure is an important component of a viable salmonid population (McElhany et al. 2000). Spatial structure refers to the distribution of a species and the mechanisms or processes affecting its distribution. The spatial structure of a population is thought to affect the risks from localized catastrophes and determine re-colonization potential of vacant habitats both within and outside of the source population. A well distributed population utilizing a diversity of habitats can also ensure life-history diversity and population resilience to a changing environment (McElhany et al. 2000).

The mechanisms that translate spatial structure into population health are not well understood and difficult to measure. Having members of a population spread throughout the boundaries of potential habitat theoretically lessens the chance that a catastrophic event (flood, landslide, wildfire, volcanic eruption) can eradicate an entire population, and thus increases the likelihood that the population will persist over time. The distribution of individuals in a population may also serve other functions that allow the population to persist. Because the specific qualities and mechanisms of spatial structure are difficult to quantify, criteria that seek to measure the actual distribution of individuals are usually developed to assess this aspect of population health (McElhany et al., 2000). The criteria developed here for spatial structure make the assumptions that; 1) the historical (pre-settlement) distribution of individuals ensured the most viable and persistent populations and should be considered optimum, and 2) historical distribution was likely to have resulted in individuals occupying all historically accessible habitats.

To assess the spatial structure of a population, data are needed that describe where fish are currently distributed and a way to compare that distribution to the presumed historical distribution. Considering and comparing the distribution of fish under current and historical conditions is challenging, but can be evaluated if the extent of historically accessible habitat is assumed to represent historical distribution and accessibility is assumed to depend on the gradient of the streams and the location of natural barriers to upstream migration of adults. This approach, with its assumptions, was used in this plan to assess population spatial structure.

Two criteria were used in the status assessment to assess spatial structure: 1) the loss of access to historic habitat, and 2) the probability of occurrence in accessible habitat. Each criterion is described in more detail below. Scores for the two criteria were derived for each population and then averaged to assess overall spatial structure risk.

Loss of Access to Historical Habitat (Spatial Structure Criterion 1)

A criterion was developed to assess the proportion of historical stream habitat that is no longer accessible due to artificial barriers. The criterion is based on methods used by federal Technical Recovery Teams that assessed the status of listed salmon and steelhead in the Lower and Middle Columbia Evolutionarily Significant Units/Distinct Population Segments (WLC-TRT 2007, ICTRT 2007). The historical distribution of each species was based on known natural barriers to fish migration and professional opinion on potential gradient barriers for individual species (ODFW's Natural Resources Information Management Program: https://nrimp.dfw.state.or.us/nrimp/default.aspx?p=259).

The number of stream kilometers lost due to artificial barriers was calculated and compared to the total stream kilometers of historical distribution. In the Rogue Basin, there are many partial barriers that affect fish passage at some life stages or under some flow conditions. For our analysis, we focused on major barriers that completely block upstream passage. The percentage of historical habitat lost to these barriers was used to score the current status (**Table A-III: 1**).

Table A-III: 1. Scoring for the proportion of historical habitat lost due to artificial barriers by population size. Scoring and categories are the same as those used by the Willamette/Lower Columbia Technical Recovery Team (WLC-TRT 2007).

	Population Size		
Risk Score	Small	Medium	Large
1 – Very low	0-<5%	0-<10%	0-<15%
2 – Low	5-<15%	10-<20%	15-<25%
3 – Moderate	15-<25%	20-<40%	25-<50%
4 – High	25-<50%	40-<60%	50-<75%
5 – Very high	≥50%	≥60%	≥75%

This criterion looks at the loss of access to habitat and does not consider if fish are currently distributed throughout all or a portion of the accessible habitat. The current distribution of fish in accessible habitat is addressed in the second criterion.

Probability of Occurrence in Accessible Habitat (Spatial Structure Criterion 2)

Current distribution in accessible habitat was assessed by estimating probability of occurrence for juvenile fish using species distribution models. The distribution of juvenile steelhead, coho salmon, and coastal cutthroat trout were modeled separately using geographic occurrence data and landscape and climatic variables in the planning area. Occurrence probabilities of each species were predicted for stream reaches throughout the study area. Predictor variables were chosen based on their hypothesized influence on salmonid occurrence in the region. Each species was modeled separately, and their distribution was examined both with and without passage barriers.

Species Distribution Models

Species distribution models (SDMs) are models that relate species distributional data (e.g. occurrence, abundance) at a particular location with information on the environmental conditions at the same location (Elith and Leathwick 2009). Unlike current distribution maps that only convey where we expect a species to occur under current conditions, SDMs can be used a) to explain relationships between species and habitat, b) for prediction to locations without species data, or c) for predictions of distribution under different conditions (e.g. future climate, see **Appendix IV – Climate and Ocean Change Assessment**). The probability of occurrence is obtained from the models and can be

interpreted as habitat suitability or habitat availability depending on whether the habitat is accessible to the species. Like all modeling approaches, there are a number of assumptions and uncertainties. Some of the more prominent uncertainties specific to SDMs are: species occurrence data are always incomplete, there is imperfect knowledge of the factors driving occurrence, species-environment relationships are plastic, and if considering scenarios of future climate, there is uncertainty among model predictions based on emission assumptions (Wenger et al. 2013). Given these limitations, SDMs should be treated as hypotheses to test and validate. Additional sampling and modeling should be conducted to improve the model, making the process of developing SDMs iterative (Jarnevich et al. 2015). With that in mind, SDMs can be useful to guide future field survey and monitoring efforts, identify restoration or protection opportunities and help inform management decisions.

Data Sources for SDMs

Juvenile salmonid occurrence data was compiled from several sources. A large percentage of the data originated from the ODFW juvenile sampling program (Aquatic Inventories/Western Oregon Rearing Project [WORP]). This project has been collecting abundance and distribution data on juvenile salmonids since 1998. For this dataset, all observations from 1998–2018 were used for coho salmon, while only data from 2002–2018 were used for steelhead and cutthroat trout (these species were not identified or enumerated consistently until 2002). Additionally, only presence data was used from the ODFW-WORP datasets given that only a subsample of habitats (pools) were sampled. The second-most abundant dataset originated from the Klamath Mountains Province Steelhead Project, which were randomly-selected sites sampled in 1999–2001. Juvenile steelhead observations in the Upper Rogue and Middle Rogue/Applegate population areas may include both juvenile winter- and summer-run steelhead, which cannot be differentiated during surveys. However, most surveys were conducted during summer in wadeable streams, where juvenile winter steelhead are expected to be the predominant run type because summer steelhead often rear in larger mainstem habitats (Everest 1973). For cutthroat trout specifically, additional data was compiled by the Pacific States Marine Fisheries Commission (PSMFC). We established a rule set for these data given the disparate sources from which the data came: 1) included only data sampled from years 1998 to present and 2) included only sites sampled with a defined methodology (**Table A-III: 2**).

Table A-III: 2. Data sources, programs, and methods for species distribution modeling.

Source	Program	Sampling Method	Species
ODFW	Western Oregon Rearing Project (WORP)	Snorkeling/ Electrofishing	All
ODFW	Klamath Mountain Province Steelhead Project	Electrofishing	All
ODFW	ODFW Observations Database		All
ODEQ	ODEQ	Electrofishing	Cutthroat
USFS	Rogue River-Siskiyou National Forest	Electrofishing	Cutthroat
USFS	Aquatic Surveys (AqS)	Snorkeling	Cutthroat
USFS/BLM	Aquatic Riparian Effectiveness Monitoring Program (AREMP)	Electrofishing	Cutthroat
USGS	Basin Surveys	Electrofishing	Cutthroat

Stream hydrography and predictor variables

All occurrence sites were georeferenced on a stream layer derived from 10-m digital elevation models (DEMs) developed by TerrainWorks (NetMap 2016). The 10-m DEM is derived from 1:24,000 scale USGS topographic maps. NetMap is a suite of hydrogeomorphic data, models and software. The data is represented at a reach scale, with reaches delineated by confluences or by 100 m segments. A large suite of attributes were calculated, many generated from NetMap models and tools with detailed definitions available at http://www.terrainworks.com/. For descriptions of the attributes used in these analyses, see **Table A-III: 3**.

Geospatial attributes were used as predictor variables in the modeling process and were selected based on hypothesized effects on salmonid occurrence. One of the objectives of our approach was to understand the spatial distribution of species occurrence. We consulted with local district biologists to identify areas that were impassable to each species and excluded these areas when appropriate to represent current distribution. Potential habitat above these barriers is displayed to identify areas of potential habitat if these barriers were made passable.

We used the Variance Inflation Factor (VIF) in R to evaluate collinearity among the predictor variables considered. In an iterative process, VIF value was calculated for each covariate; the variable with the highest VIF value was removed until no variables had a VIF value greater than 5. The variable importance statistic was used to further reduce the subset of predictor variables to consider. Variable importance for each covariate was calculated within the *biomod2* R package platform initially using all covariates that remained after the iterative removal of covariates via the VIF calculation as described above. Variable importance is calculated as 1 – (Pearson's correlation between the model's prediction with real covariate data and prediction with "shuffled" covariate data). Importance values were standardized as % contribution to the sum of the variable importance for each model, then averaged across all models. Variables with importance values greater than 0.05 (indicating they contributed at least 5% of overall model importance) were included in the model. Because some variables were considered biologically important, they were retained in models even if variable importance did not exceed the 0.05 limit. Variables that were retained in all models included the percent conifer land cover, mean streamflow permanence, mean August stream temperature, mean annual precipitation, and at least one substrate covariate.

Table A-III: 3. Covariates considered in species distribution modeling.

Variable name	Variable description (units)	Data source
Drainage area	The drainage area of the watershed located above each channel segment (km2)	NetMap; NetMap 2016
Beaver habitat	The potential locations of beaver habitat is predicted based on an empirical model of beaver dams based on data from the Stilliguamish River basin, Washington (Pollock et al. 2004) (binary 1 or 0)	NetMap; NetMap 2016
Hydrologic Landscape	Unique number assigned to each of the 81 different hydrologic landscape codes.	Hydrologic Landscapes; Wigington et al. 2013
Flow velocity	Stream flow velocity predicted using Manning equation (m/s)	NetMap; NetMap 2016
Floodplain width	The width of the floodplain, as mapped as contiguous polygons two bankfull depths above the channel (m)	NetMap; NetMap 2016
Gradient	Channel gradient (rise/run, m/m)	NetMap; NetMap 2016
Mean summer stream flow	Average summer flow of a stream reach (cfs)	VIC; Liang et al. 1994
Mean August Temperature	Average August temperature of the stream reach (degrees C)	NorWeST; Isaak et al. 2017
Sinuosity	Channel sinuosity (dimensionless)	NetMap; NetMap 2016
Solar radiation: Current shade	Current shade thermal energy (to streams) (Watt-hours/m^2)	NetMap; NetMap 2016
Streamflow Permanence	Average probability of streamflow permanence summarized at the watershed area across all available years (2004-2016)	PROSPER; Jaeger et al. 2018
Stream order	Stream order (Strahler) (classes)	NetMap; NetMap 2016
Stream power	Energy of channel to transport sediment (watts/m)	NetMap; NetMap 2016
Valley width	The width of the floodplain, as mapped as contiguous polygons five bankfull depths above the channel (m)	NetMap; NetMap 2016

Modeling

We used the *biomod2* package in R to develop ensemble SDMs and predict occupancy probabilities to unsampled locations based on the resulting model. Ensemble modeling reduces the inherent bias in a single modeling approach by combining the results of several models to yield a more accurate estimate of occupancy. Several modeling approaches were used to generate the final ensemble model for each species: CTA (Classification Tree Analysis), GLM (Generalized Linear Model), GBM (Generalized Boosting Model), MARS (Multiple Adaptive Regression Spline), RF (Random Forest), and MAXENT (Phillips Maximum Entropy). The MAXENT model is a presence-only model and was only incorporated in the steelhead species SDM as there was an extreme bias to presence records in the observation data pool. Twenty models of each modeling type were generated with a separate 80%/20% split of the data to be used as training and testing datasets respectively. Area under the curve (AUC) and cross-validation statistics were used to assess model accuracy.

Steelhead

Juvenile steelhead were modeled across the entire Rogue–South Coast region. Observations for steelhead were derived from WORP surveys, the Klamath Mountain Province Steelhead Project, and the ODFW Observations Database. No absence records recorded above barriers considered impassable to steelhead were included in the models so as to not falsely exclude suitable habitat that is simply inaccessible. In total 1,723 records were used for the model with 1,541 of these observations recording steelhead present and 182 records representing steelhead as absent in surveyed locations (**Figure A-III: 4**).

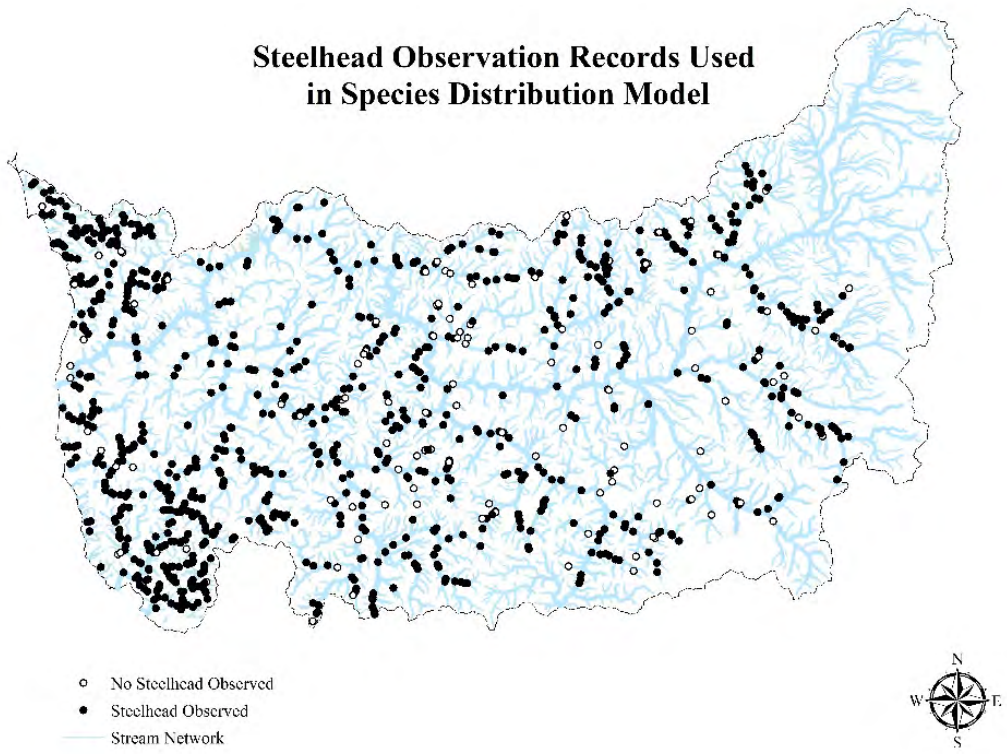


Figure A-III: 4. Location of steelhead observations included in the SDM. Open circles represent absent records while black circles represent present records. The stream network is represented by light blue lines with larger order streams represented by thicker blue lines.

Individual Model Performance

Six modeling approaches were selected for steelhead species distribution modeling: GLM, GBM, CTA, MARS, RF, and Phillips MAXENT. MAXENT is a presence-only model and was included in the steelhead model because of the unbalanced dataset for steelhead, which is heavily skewed toward presence records. Twenty individual models were run for each model type for a total of 120 individual models. For each modeling effort the data were randomly split without replacement into an 80% training and a 20% testing dataset. Individual models were evaluated using an area under the receiver operating curve (AUC) value which ranges from 0.5 to 1. AUC values of 0.5 indicate a model that performs no better than random choice while values approaching 1.0 indicate a more perfect model. To generate the ensemble model only individual models meeting an AUC

threshold of 0.75 were included (**Table A-III: 4**). Individual models included in the ensemble model were weighted by their AUC value with more accurate models contributing more weight to the final ensemble model.

Ensemble Model Performance and SDM Maps

The ensemble model was assessed by three diagnostic statistics: the AUC value, sensitivity (the true positive rate), and specificity (true negative rate). The steelhead model, composed of 82 individual model predictions had an AUC score of 0.943, a sensitivity of 86.576, and a specificity of 88.95. Maps of steelhead probability of occurrence were generated across the planning area to represent occurrence probability below barriers to movement (**Figure A-III: 5**).

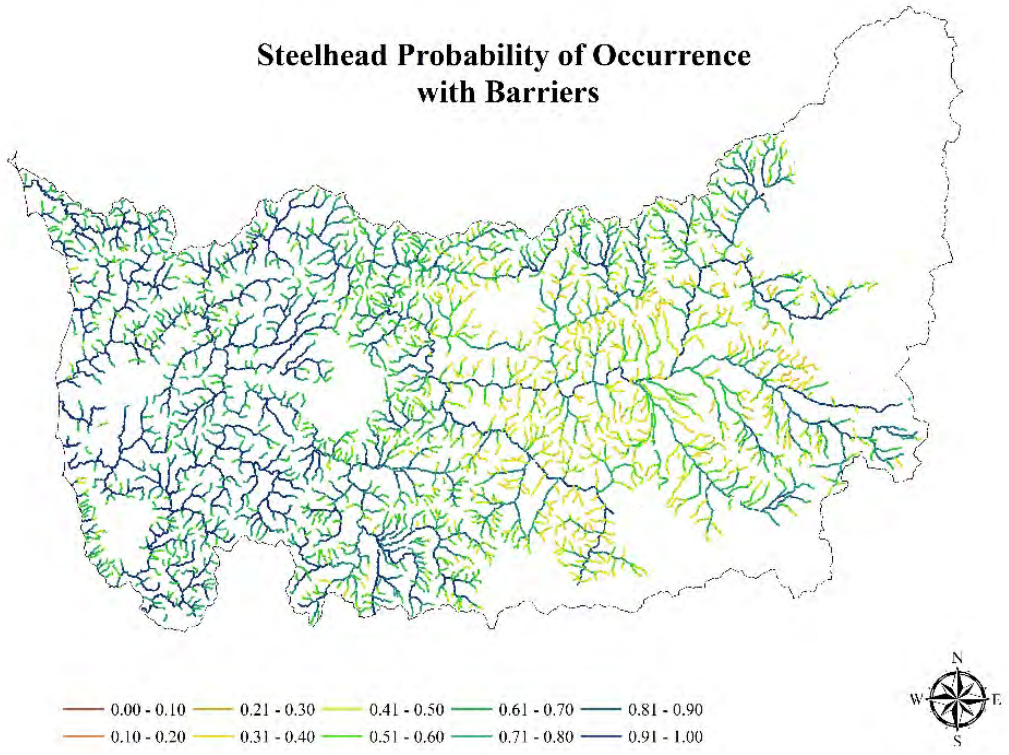


Figure A-III: 5. Probability of occurrence for steelhead with barriers considered. Warmer colors in the map indicate lower probabilities; cooler colors indicate greater probabilities.

Environmental Covariate Influence

SDMs can identify landscape features that influence species distribution. After the variable selection process (described in the introduction), models were run and variable importance metrics were standardized and reported for each (**Table A-III: 5**).

Table A-III: 4. Single model evaluations (AUC scores) for the 100 individual steelhead, coho salmon, and cutthroat trout SDM models. AUC scores range from 0.0 – 1.0; values closer to 1.0 indicate more perfect model. Shaded cells indicate the models were included in the final ensemble model because the model run met the defined 0.75 AUC score threshold.

Steelhead

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
GLM	0.75	0.70	0.69	0.69	0.72	0.66	0.73	0.71	0.76	0.67	0.66	0.72	0.68	0.71	0.68	0.67	0.72	0.70	0.72	0.71
GBM	0.79	0.80	0.80	0.77	0.81	0.82	0.85	0.86	0.85	0.80	0.75	0.83	0.79	0.82	0.83	0.80	0.82	0.83	0.82	0.87
CTA	0.73	0.72	0.73	0.75	0.77	0.76	0.77	0.78	0.79	0.70	0.71	0.69	0.75	0.74	0.78	0.72	0.68	0.75	0.76	0.72
MARS	0.78	0.77	0.80	0.75	0.77	0.78	0.82	0.82	0.85	0.80	0.74	0.80	0.80	0.81	0.81	0.81	0.78	0.81	0.80	0.83
RF	0.82	0.82	0.85	0.80	0.83	0.84	0.86	0.87	0.85	0.81	0.77	0.84	0.83	0.84	0.85	0.83	0.84	0.83	0.82	0.88

Coho Salmon

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
GLM	0.69	0.70	0.68	0.71	0.69	0.69	0.69	0.66	0.69	0.68	0.69	0.70	0.68	0.69	0.70	0.71	0.71	0.71	0.69	0.68
GBM	0.82	0.79	0.78	0.80	0.82	0.82	0.80	0.79	0.81	0.81	0.82	0.80	0.82	0.81	0.82	0.80	0.81	0.83	0.82	0.80
CTA	0.77	0.76	0.78	0.82	0.82	0.82	0.81	0.79	0.79	0.79	0.80	0.79	0.78	0.80	0.79	0.81	0.79	0.78	0.81	0.80
MARS	0.74	0.74	0.73	0.73	0.74	0.75	0.72	0.71	0.75	0.75	0.75	0.72	0.73	0.74	0.74	0.75	0.74	0.75	0.75	0.74
RF	0.85	0.83	0.83	0.86	0.86	0.86	0.84	0.84	0.85	0.85	0.87	0.85	0.86	0.86	0.85	0.85	0.86	0.86	0.85	0.85

Cutthroat Trout

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
GLM	0.76	0.69	0.77	0.71	0.85	0.78	0.75	0.73	0.78	0.71	0.79	0.76	0.77	0.70	0.76	0.70	0.75	0.76	0.76	0.69
GBM	0.85	0.80	0.84	0.76	0.87	0.84	0.87	0.78	0.82	0.81	0.84	0.81	0.85	0.81	0.80	0.81	0.79	0.79	0.84	0.82
CTA	0.67	0.65	0.64	0.57	0.64	0.66	0.65	0.64	0.62	0.62	0.68	0.68	0.77	0.68	0.64	0.76	0.59	0.62	0.76	0.64
MARS	0.82	0.73	0.81	0.72	0.87	0.80	0.84	0.75	0.80	0.78	0.82	0.82	0.78	0.74	0.80	0.79	0.73	0.77	0.79	0.74
RF	0.87	0.82	0.83	0.78	0.86	0.86	0.89	0.82	0.82	0.83	0.86	0.82	0.82	0.82	0.84	0.81	0.84	0.78	0.85	0.80
MAX.P	0.78	0.78	0.80	0.73	0.82	0.70	0.78	0.73	0.78	0.77	0.81	0.72	0.85	0.73	0.77	0.78	0.71	0.75	0.74	0.79

Table A-III: 5. Importance of variables included in the steelhead juvenile models. These variable importance metrics were averaged across all model types whether or not they were included in the final ensemble model. Standardized importance values greater than 0.05 (5%) are highlighted in green.

Variable	CTA	GBM	GLM	MARS	MAXENT	RF	Average
Historical Streamflow	0.604	0.384	0.266	0.372	0.305	0.254	0.364
Hydrologic Landscape	0.063	0.100	0.262	0.134	0.178	0.140	0.146
Floodplain Width	0.191	0.186	0.000	0.121	0.142	0.154	0.132
Drainage Area, km^2	0.038	0.120	0.178	0.140	0.150	0.144	0.128
August mean stream temperatures for 1993-2011	0.032	0.098	0.086	0.193	0.087	0.116	0.102
Gradient	0.051	0.046	0.170	0.014	0.057	0.090	0.071
Streamflow Permanence	0.021	0.066	0.038	0.027	0.081	0.102	0.056

Although ensemble models are often more accurate than using a single model approach, interpretation of the influence of each variable on the distribution of the species of interest can be challenging. Thus, response plots were created to display each variable's general pattern of influence on the species' distribution (not shown). The paucity of absence records for steelhead contributed to responses with little variation in predicted probability of occurrence, but broadly, average annual precipitation, drainage area, and streamflow permanence had a positive effect on probability of occurrence while drainage area, slope, and % sand in catchment had negative influence on probability of occurrences.

Coho Salmon

Juvenile coho salmon were modeled across the entire Rogue–South Coast region. Observations for coho salmon were derived from WORP surveys, the Klamath Mountain Province Steelhead Project, and the ODFW Observations Database. No absence records recorded above barriers considered impassable to coho salmon were included in the models so as to not falsely exclude suitable habitat that is simply inaccessible. In total 1,079 records were used for the model with 373 of these observations recording coho salmon present and 706 indicating absence in surveyed locations (**Figure A-III: 6**).

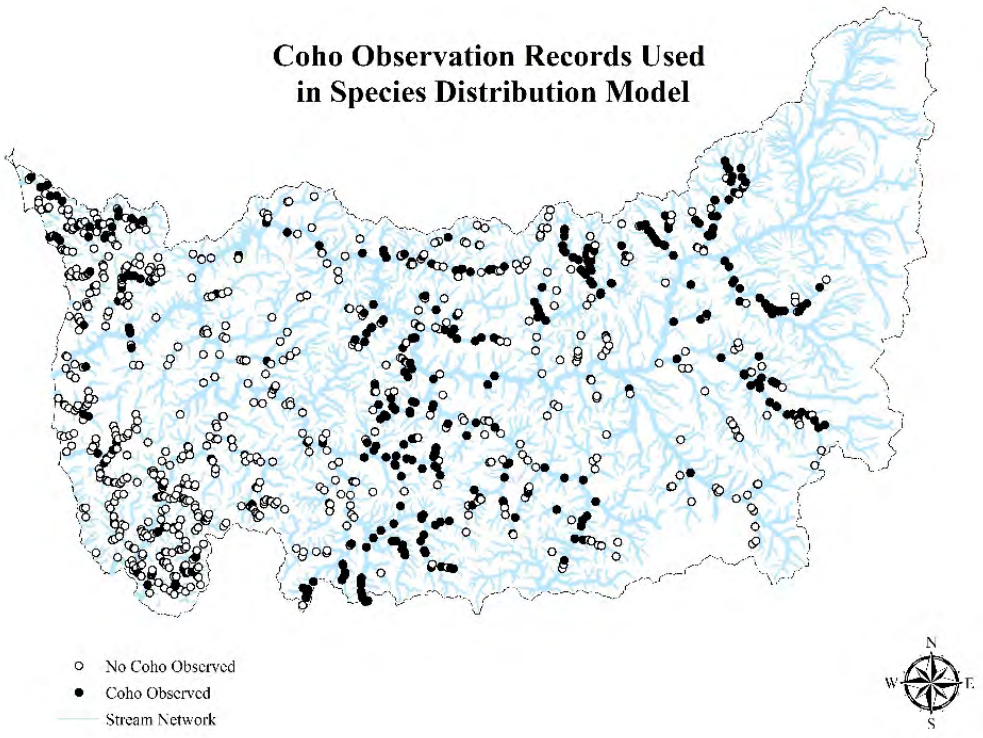


Figure A-III: 6. Location of coho salmon observations included in the SDM. Open circles represent absent records while black circles represent present records. The stream network is represented by light blue lines with larger order streams represented by thicker blue lines.

Individual Model Performance

Five modeling approaches were selected for coho salmon species distribution modeling: GLM, GBM, CTA, MARS, and RF. Twenty individual models were run for each model type for a total of 100 individual models. For each modeling effort the data were randomly split without replacement into an 80% training and a 20% testing dataset. Individual models were evaluated using an area under the receiver operating curve (AUC) value which ranges from 0.5 to 1. AUC values of 0.5 indicate a model that performs no better than random choice while values approaching 1.0 indicate a more perfect model. To generate the ensemble model only individual models meeting an AUC threshold of 0.75 were included (**Table A-III: 4**). Individual models included in the ensemble model were weighted by their AUC value with more accurate models contributing more weight to the final ensemble model.

Ensemble Model Performance and SDM Maps

The ensemble model was assessed by three diagnostic statistics: the AUC value, sensitivity (the true positive rate), and specificity (true negative rate). The coho salmon model, comprising of 66 individual model predictions had an AUC score of 0.936, a sensitivity of 90.786, and a specificity of 78.693. Maps of coho salmon probability of occurrence were generated across the regions to represent occurrence probability with existing barriers to movement (representative of current distribution; **Figure A-III: 7**).

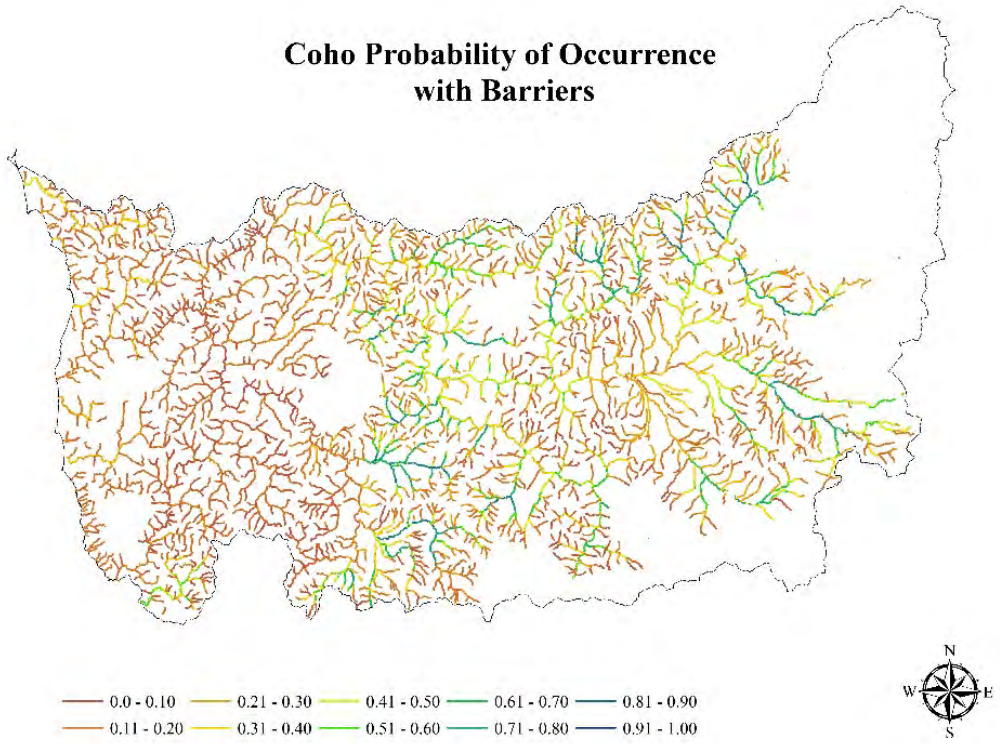


Figure A-III: 7. Probability of occurrence for coho salmon with barriers considered. Warmer colors in the map indicate lower probabilities; cooler colors indicate greater probabilities.

Environmental Covariate Influence

SDMs can identify landscape features that influence species distribution. After the variable selection process (described in the introduction), models were run and variable importance metrics were standardized and reported for each (**Table A-III: 6**).

Table A-III: 6. Importance of variables included in the juvenile coho salmon models. Variable importance was averaged across all model types whether they were included or not in the final ensemble model. Standardized importance values greater than 0.05 (5%) are highlighted in green.

Variable	CTA	GBM	GLM	MARS	RF	Average
Hydrologic Landscape	0.481	0.584	0.030	0.606	0.421	0.424
Stream Order	0.117	0.085	0.399	0.192	0.087	0.176
Valley Width	0.129	0.117	0.176	0.044	0.141	0.122
Streamflow Permanence	0.135	0.076	0.095	0.031	0.108	0.089
Historical Streamflow	0.053	0.038	0.241	0.002	0.064	0.080
August mean stream temperatures for 1993-2011	0.060	0.066	0.000	0.087	0.106	0.064
Gradient	0.024	0.034	0.059	0.039	0.073	0.046

Coastal Cutthroat Trout

Cutthroat trout were modeled across the entire Rogue/South Coast region. Observations for cutthroat were derived from WORP surveys, the Klamath Mountain Province Steelhead Project, ODFW Observations Database, Oregon Department of Environmental Quality, the Rogue River-Siskiyou National Forest surveys, Aquatic Surveys Inventory, Aquatic Riparian Effectiveness Electrofishing Cutthroat Monitoring Program (AREMP), and basin surveys. Cutthroat trout were recorded above all barriers in the region; therefore, all records were included in this modeling effort. In total 3,913 records were used for the model with 2,118 of these observations recording cutthroat trout present and 1,795 records representing cutthroat trout as absent in surveyed locations (**Figure A-III: 8**).

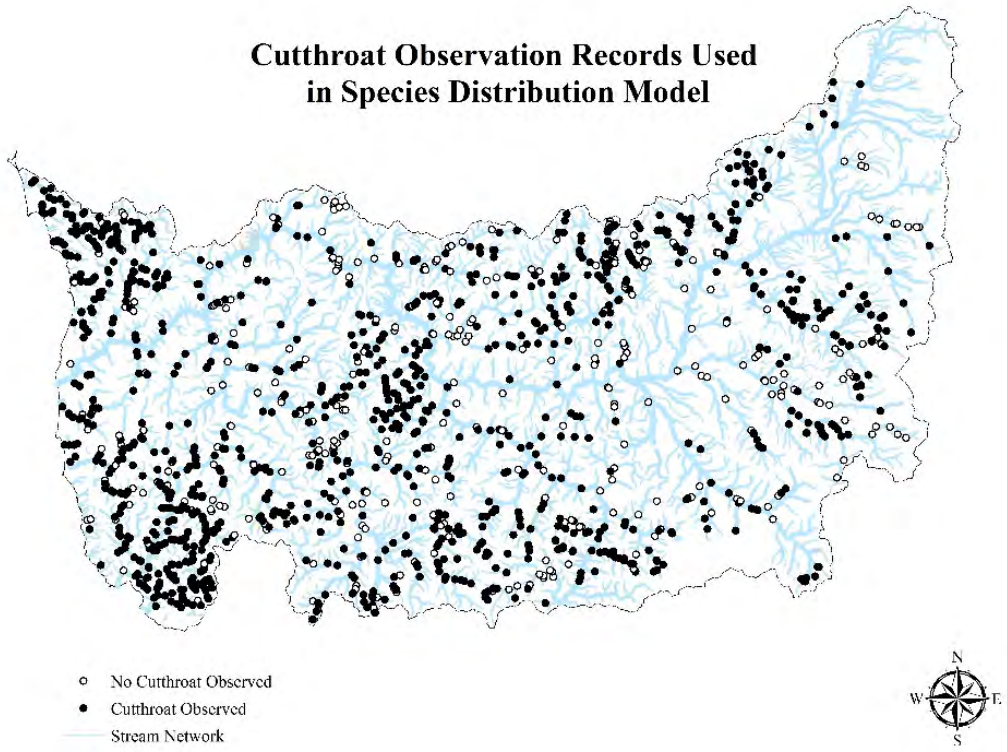


Figure A-III: 8. Location of cutthroat trout observations included in the SDM. Open circles represent absent records while black circles represent present records. The stream network is represented by light blue lines with larger order streams represented by thicker blue lines.

Individual Model Performance

Five modeling approaches were selected for cutthroat trout species distribution modeling: GLM, GBM, CTA, MARS, and RF. Twenty individual models were run for each model type for a total of 100 individual models. For each modeling effort the data were randomly split without replacement into an 80% training dataset and a 20% testing dataset. Individual models were evaluated using an area under the receiver operating curve (AUC) value which ranges from 0.5 to 1. AUC values of 0.5 indicate a model that performs no better than random choice while values approaching 1.0 indicate a more perfect model. To generate the ensemble model only individual models meeting an AUC threshold of 0.75 were included (**Table A-III: 4**). Individual models

included in the ensemble model were weighted by their AUC value with more accurate models contributing more weight to the final ensemble model.

Ensemble Model Performance and SDM Maps

The ensemble model was assessed by three diagnostic statistics: the AUC value, sensitivity (the true positive rate), and specificity (true negative rate). The cutthroat trout model, composed of 61 individual model predictions, had an AUC score of 0.909, a sensitivity of 74.646, and a specificity of 92.702. Maps of probability of occurrence for cutthroat trout were generated across the regions to represent occurrence probability with existing barriers to movement (**Figure A-III: 9**).

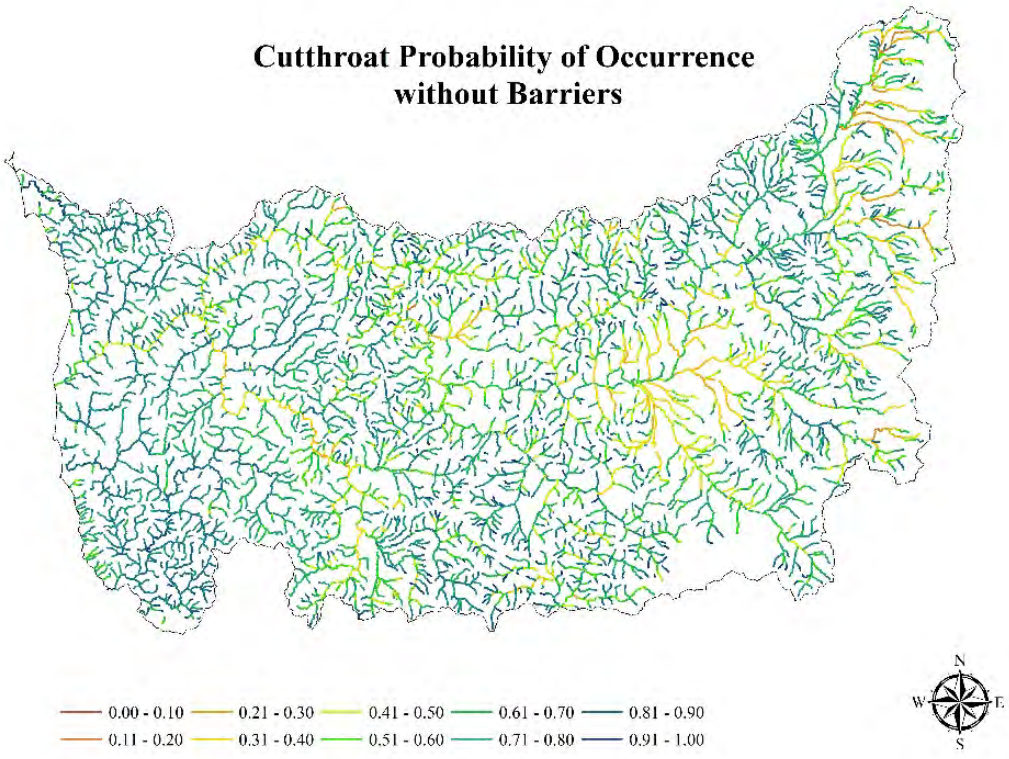


Figure A-III: 9. Probability of occurrence for cutthroat trout. Warmer colors in the map indicate lower probabilities; cooler colors indicate greater probabilities.

Environmental Covariate Influence

The SDMs can identify landscape features that influence species distribution. After the variable selection process (described in the introduction), models were run and variable importance was standardized and reported for each (**Table A-III: 7**).

Table A-III: 7. Importance of variables included in the cutthroat trout models. Variable importance was averaged across all model types whether they were included or not in the final ensemble model. Standardized importance values greater than 0.05 (5%) are highlighted in green.

Variable	CTA	GBM	GLM	MARS	RF	Average
Historical Streamflow	0.265	0.487	0.017	0.092	0.287	0.230
Hydrologic Landscape	0.109	0.166	0.215	0.465	0.133	0.218
Streamflow Permanence	0.218	0.120	0.191	0.115	0.214	0.172
August mean stream temperatures for 1993-2011	0.210	0.129	0.069	0.081	0.156	0.129
Stream Order	0.024	0.021	0.343	0.164	0.022	0.115
Solar Shading	0.082	0.034	0.097	0.066	0.078	0.071
Drainage Area, km^2	0.092	0.044	0.067	0.016	0.110	0.066

Results

The overall average probability of occurrence for juvenile steelhead, juvenile coho salmon, and juvenile and adult cutthroat trout are presented in **Table A-III: 8**, with associated risk categories in **Table A-III: 9**.

Table A-III: 8. Average probability of occurrence for juvenile fish (juveniles and adults for cutthroat trout) within currently accessible habitat for all populations assessed for viability.

Population	Steelhead	Coho Salmon	Cutthroat Trout
Elk	0.91	0.25	0.79
Euchre	0.91	-	0.79
Hunter	0.94	-	0.79
Pistol	0.94	-	0.76
Chetco	0.92	-	0.77
Winchuck	0.89	-	0.83
Lower Rogue	0.90	-	0.71
Illinois	0.88	0.33	0.68
Middle Rogue/Applegate	0.76	0.46	0.66
Upper Rogue	0.75	0.51	0.62

Table A-III: 9. Risk score categories for probability of occurrence of juvenile fish in accessible stream reaches based on species distribution modeling.

Risk Score	Average Probability of Occurrence
1 – Very low	81-100%
2 – Low	61-80%
3 – Moderate	41-60%
4 – High	21-40%
5 – Very high	0-20%

Appendix III: Diversity

A population's genetic diversity, as expressed through life-history characteristics, determines how flexible, or resilient, a population is to changing environmental conditions. Populations that have a diversity of life-history characteristics are more likely to be able to withstand extended periods of atypical environmental conditions (flood, drought, fire) than populations that have less variable characteristics (McElhany et al. 2000) - in essence, the greater a population's diversity, the greater the likelihood that the population will persist in the face of changing future environmental conditions.

To accurately assess diversity in salmon, steelhead and trout within the SMUs covered by this plan it is necessary to understand the historical suite of life-history characteristics expressed within each population. Such data do not exist for any of these populations except for major run timing variations in steelhead. For this reason, it was necessary to develop diversity criteria based on limited information. One criterion was developed to assess the diversity of populations in each SMU: the loss of, or reduced variation in, life-history traits. This criterion was based on methods used to assess diversity of Interior Columbia Basin salmon and steelhead (ICTRT 2007) and is described below.

Lost or Reduced Variation of Life-History Traits (Diversity Criterion 1)

The diversity contained within a population is best expressed by the life-history traits adopted by individuals within that population (McElhany et al. 2000). Traits such as migration timing, age at migration, and spawn timing are adopted in response to the habitats and environment in which the fish have evolved. A population will have a greater likelihood of persisting through a range of environmental conditions if it has a greater range in expression of these traits. A population that loses life-history traits, or has the variation of traits reduced, is at risk of not being able to respond to certain environmental or anthropogenic situations which could lead to population decline.

Assessing if a population has lost historical life-history traits requires being able to catalog all of the historical traits and documenting which of those traits are currently being expressed. While there is some information available for coastal salmon, steelhead and trout populations to suggest some life-histories that likely were historically present, the complete inventory of historical traits will never be known. In addition, current monitoring of these populations is not adequate to document all life-history traits being expressed. As a result, the approach to assessing the loss or alteration of life-history diversity blended available population-specific information, inferred from studies conducted outside of the SMUs, and used professional judgment to determine the likelihood that life-history traits had either been lost or their variation reduced. The available information was considered for each population and the number of lost traits, or traits whose variation had been reduced, were tallied and scored for risk (**Table A-III: 10**).

Table A-III: 10. Risk scoring for the loss/reduced variation of life-history traits within a population.

Description	Score
No evidence of loss, reduced variability, or change in any trait	1
Evidence of change in pattern of variation in 1 trait (e.g., migration timing, age structure, size-at-age)	2
Loss of 1 trait or evidence of meaningful change in pattern of variation in 2 or more traits	3
Loss of 1 or more traits and evidence of change in pattern of variation in 2 or more traits; or change in pattern of variation of 3 or more traits (e.g., loss of a spawning peak and significant reduction in older age fish)	4
Permanent loss of major pathway (e.g., anadromy for *O. mykiss*, or loss of a juvenile pathway)	5

Scores for the criterion described above were derived for each population.

Appendix III: Trend

Recent abundance and spatial structure trends were assessed as indicators of confidence in viability results. Trend risk scores developed using methods described below were considered when determining current SMU status. In several cases, trend analysis allowed ODFW to utilize abundance indices that were not appropriate for the population viability analysis described above.

Abundance Trend

The abundance of fish within a population can change dramatically from one year to the next. This inherent inter-annual variability can make it difficult to determine whether the difference between the starting and ending abundances over a period of time are attributable to randomness alone, or if there is also an underlying gradual change (i.e., "trend") in abundance. Here, the weight of evidence that there has been a general trend in adult spawner or juvenile abundance during approximately the last two decades is assessed.

The period over which trend is assessed is critical for proper interpretation of the result (Deitloff et al. 2010). For example, trend analysis of a population that is stable over the long-term but cyclic over shorter time periods can produce results that critically depend on the particular time period considered. In the top panel of **Figure A-III: 10**, there is no trend over the 60-year period of record, but there are decadal cycles in abundance. If the record had begun in 2000, then a negative (downward) trend would have been found if data were analyzed in 2010. The opposite result would be found if the record began in 1990 and was analyzed in 2000. The lower panel of **Figure A-III: 10** is the same as the upper panel, except it contains a negative trend over the entire 60-year time period. It is possible to find positive trends within subsections of these data even though the overall trend is negative. The inherent sensitivity of a trend analysis to a particular window of time underscores the need for careful interpretation of the result. This further suggests that trend analysis has limited ability to characterize future abundances.

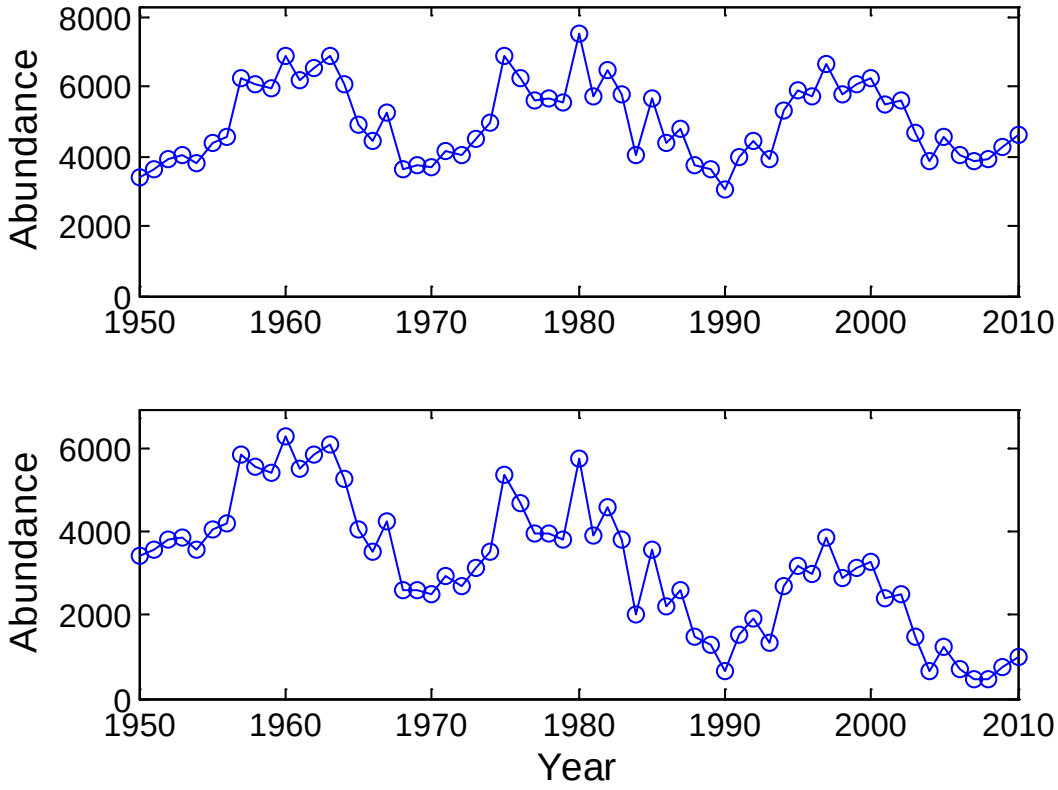


Figure A-III: 10. Hypothetical abundances illustrating that the results of trend analyses are sensitive to the time frame used.

The period for the trend analyses herein was selected to match the period for each population's spawner-recruit analysis, the most recent 20-year period for abundance indices, or the entire time frame available for juvenile abundance indices. Each population's spawner-recruit analysis supplies information that is used in the corresponding PVA. The PVAs do not assume a trend, so the results of the trend analysis are intended to complement the PVA result. For example, if the PVA suggests that a population has a high risk of extinction but the trend analysis reveals that abundance has been increasing, then belief about the population's current status should be intermediate to these two assessments.

The abundance of spawners at time t, S_t, is considered the result of Poisson random variable:

$$S_t \sim Poisson\ (\lambda_t).$$

Unlike the normal distribution, which has a mean and a variance, the Poisson distribution's variance and mean are equal, so it is characterized by a single parameter, λ. Poisson random variables often arise in the context of counts, which must be nonnegative and integer valued. Indeed, the Poisson distribution is

frequently applied to counts of animals. The theory of generalized linear models (Nelder and Wedderburn 1972) indicates that a log-link should be used to model variability in λ. Hence,

$$P(S_t \mid \lambda) = \frac{\lambda^{S_t} e^{-\lambda}}{S_t!}$$

$$\lambda = e^{\alpha + \beta(t - t') + \frac{\sigma^2}{2}}$$

where $P(S_t \mid \lambda)$ is the likelihood of the observation of abundance S_t *given* some value for λ. α is an intercept and β is a slope for the effect of year, *t*. The term t´ is set to the median of the years in order to "center regressors," which improves convergence to stable parameter estimates. σ is the standard deviation of normally distributed error variance, which is divided by 2 because the error variance is exponentiated. A typical analysis would seek values of λ, α, and β that maximizes the product likelihood for all observations of spawner abundance. This is known as a "maximum likelihood" estimate.

Here, the concept of a maximum likelihood estimate is combined with neutral prior beliefs about parameter values in a Bayesian context. This model is fitted using JAGS software. A useful feature of Bayesian modeling with JAGS is the ability to estimate uncertainty in functions of parameters without having to analytically work out computations involving covariances or Jacobians. Thus, trend can be defined as the geometric mean rate of inter-annual change, and all that is necessary to obtain estimates of uncertainty in this new parameter is to simply tell JAGS how the mathematical expectation is computed:

$$\hat{S}_t = e^{\alpha + \beta(t - t') + \frac{\sigma^2}{2}}$$

$$trend = 100\left(\left(\frac{\hat{S}_{t=\max}}{\hat{S}_{t=1}}\right)^{\frac{1}{\max - 1}} - 1\right)$$

The utility of this feature cannot be overstated. Furthermore, after supplying non-informative, uniform priors to this Bayesian analysis, the resulting posterior distribution of trend has the intuitive interpretation of degrees of belief in different ranges of trend. The alternative, non-Bayesian, approach to this problem does not conceive of parameters as random variables, and therefore cannot omit discussion of probabilities of different magnitudes of trend.

Figure A-III: 11 provides a graphical interpretation of "trend" as estimated in the previous paragraph. Incorporating uncertainty in the estimates of trend was explored by Falcy (2016) and repeated here. For a population, the probability of decline (% of posterior distribution to the left of zero) and the probability of losing 50% after 20 years (approximately 4% decline) are computed and plotted into **Figure A-III: 12**. The thinner lines demarcate adjacent risk categories. The top of the thin lines occur at [(0.3, 0.3), (0.5, 0.5), (0.7, 0.7), (0.9, 0.9)] and extend downward at a 60º angle with the heavy line. Note that if the

thin lines were perfectly vertical (making a 90º angle with the x-axis) then risk categories would be entirely independent of the values on the y-axis. By creating a slight angle, the categories are largely determined by the x-axis, but high values on the y-axis can elevate risk to the next higher category. The decision to delineate the risk categories in this manner was made prior to plotting points into the axes, and therefore was not influenced in any way by particular populations' trend estimates.

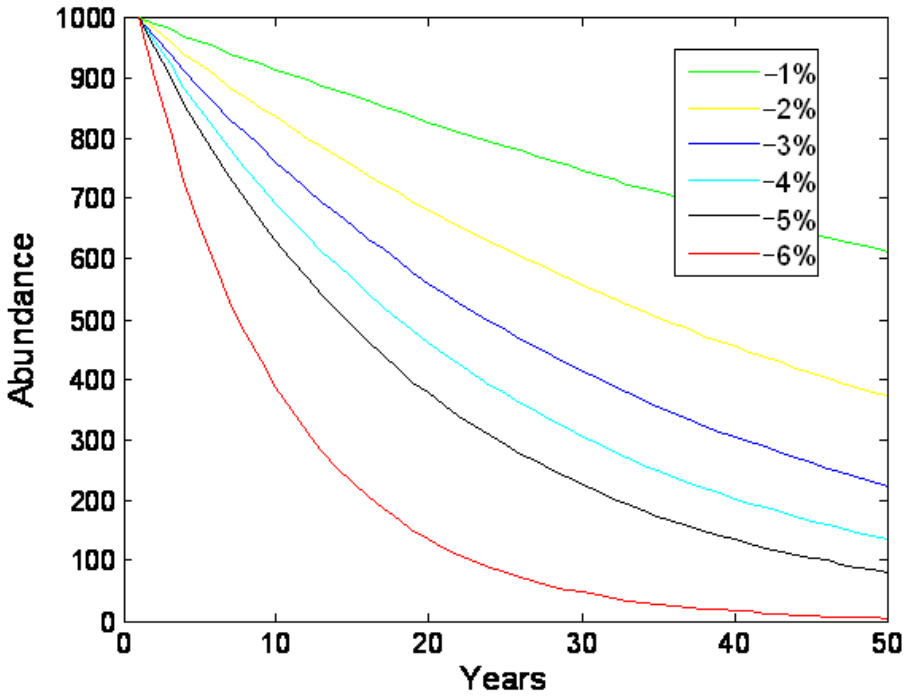


Figure A-III: 11. Trends that are defined as per-year geometric mean rate imply different percent reductions over time from an initial abundance.

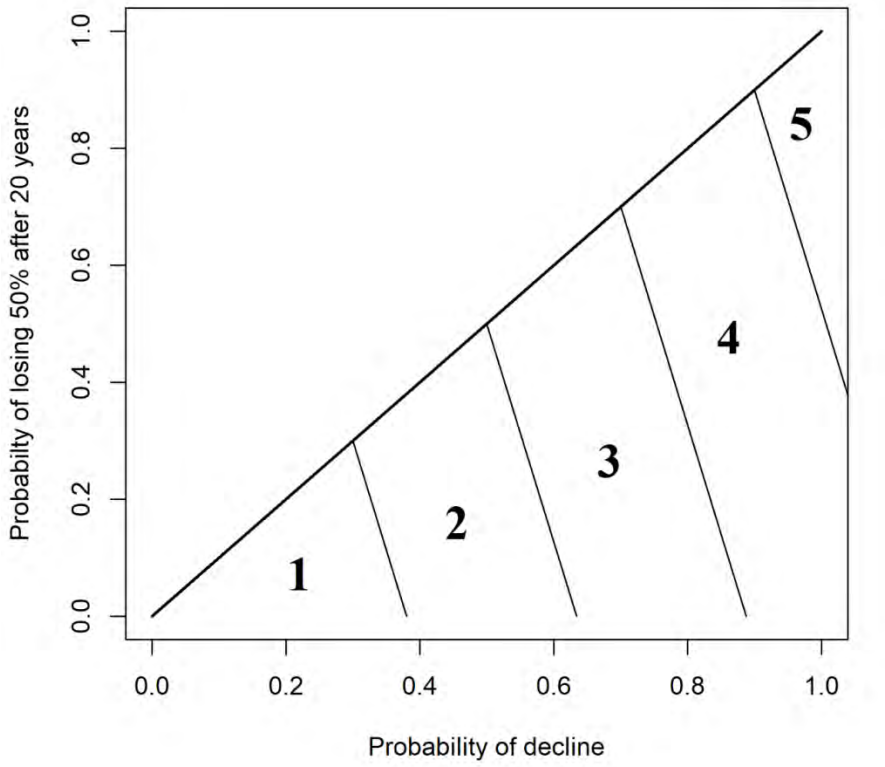


Figure A-III: 12. Discretization of posterior probability of trend into five categories, and the associated risk score. The region above the black line represents impossible values and can be ignored.

Spatial Structure Trend

The spatial distribution of a population can have important consequences for the stability and extinction risk of a population (McElhany at al. 2000). For trend analysis, spatial patterns of juvenile salmonid abundance were examined using Mantel tests. The Mantel statistic is a correlation between dissimilarity matrices. In this case we examined the correlation of the difference in juvenile abundance between sites and the distance between sites (Legendre and Legendre 1998). Results of a Mantel test fall between -1 and 1, with -1 indicating a strong negative correlation and 1 indicating a strong positive correlation, and 0 indicating no correlation. The matrix is subjected to repeated random permutations and the proportion of permutations that lead to a higher correlation coefficient than the observed coefficient is used to assign the significance of the relationship. Strong correlations and low p-values indicate spatial clumping, while weak correlations indicate a more even distribution. Temporal trend was examined by analyzing the trend of these p-values over time.

Mantel tests for dissimilarity were conducted by year and species for three species (coho salmon, steelhead and cutthroat trout) using the Mantel function in the vegan R package (Oksanen et al. 2019). Twenty-one years of observations were available for coho salmon (1998-2018) while 17 years were available for steelhead and cutthroat (2002-2018). In this case we examined the correlation of the difference in abundance between sites and the distance between sites. Due to sample size constraints, the analysis was conducted at the stratum scale. A meaningful distance matrix could not be constructed for

the Coastal Stratum, so the analysis was only applied to the Rogue Stratum. Observations of juvenile density (fish per m^2) collected by snorkeling and electrofishing were obtained by the ODFW Western Oregon Rearing Project/Aquatic Inventory Project (Constable 2018). As might be expected given the aggregated distributions, coho salmon were far more likely to be clustered in any given year than steelhead, with cutthroat trout being intermediate between the two. There were nine years (43%) in which the p-value for the Mantel test for coho salmon was <0.05, and four years (20%) when it was <0.01 (**Table A-III: 12**). The p-value for the Mantel test for cutthroat trout fell below 0.05 in two years (10%). Given that Mantel tests were computed for 21 years we would expect about one false instance of the p-value falling below 0.05 for each species, but steelhead were so evenly distributed that there was no instance when the p-value fell below 0.05. We also tested for trends in the dissimilarity correlations. P-values for the trend were greater than 0.05 for all species (i.e., no trend was detected: coho salmon = 0.94, steelhead = 0.13, cutthroat trout = 0.054). Though the p-value for cutthroat trout approached 0.05, the trend was toward decreasing dissimilarity (more even distribution); the same was true for steelhead. Due to a lack of significant trend, all three species were assigned a score of 1 (low risk) for this metric.

Table A-III: 12. Correlation probabilities from Mantel tests for dissimilarity.

	Coho Salmon	Steelhead	Cutthroat Trout
1998	0.171		
1999	0.611		
2000	0.0302*		
2001	0.0062**		
2002	0.166	0.21	0.359
2003	0.0021**	0.352	0.0118*
2004	0.232	0.16	0.326
2005	0.771	0.862	0.0355*
2006	0.0312*	0.48	0.339
2007	0.304	0.779	0.977
2008	0.457	0.116	0.351
2009	0.0071**	0.242	0.78
2010	0.0018**	0.895	0.487
2011	0.13	0.931	0.777
2012	0.0235*	0.204	0.833
2013	0.156	0.335	0.673
2014	0.502	0.893	0.827
2015	0.015*	0.43	0.255
2016	0.37	0.799	0.295
2017	0.31	0.526	0.564
2018	0.0113*	0.704	0.628

**p-value <0.05; **p-value<0.01*

Appendix III: Results

Table 4 in the RSP provides specific abundance and productivity, spatial structure, and diversity viability assessment results for populations, strata, and SMUs, as well as a summary of indicators in viability result confidence and the overall current status for each SMU.

Abundance and Productivity Results

As noted above, 100-year extinction risk was only evaluated for Upper Rogue winter steelhead and Interior Rogue coho salmon in aggregate due to a lack of spawner-recruit data for other populations. However, juvenile rearing density assessments suggested abundance and productivity were robust and viability risk very low for winter steelhead in the Coastal Stratum and for cutthroat trout in both strata. The juvenile rearing density assessment for Rogue Stratum winter steelhead (risk score of 2 for all populations) was consistent with risk scoring based on the PVA for the Upper Rogue population (100-year extinction risk = 1.3%, risk score = 2). Coho salmon populations in the Interior Rogue were found to have a moderate viability risk based on the Rogue aggregate PVA (100-year extinction risk = 5.6%, risk score = 3) and juvenile density assessment. Elk River coho salmon received the highest abundance and productivity score risk score (4.0) of any population assessed based on juvenile rearing density.

Spatial Structure Results

The assessment of spatial structure found that most populations continue to occupy a very high proportion of their historical distribution, and thus had low risk scores for this metric. Viability risk scores based on probability of occurrence in accessible habitat varied more among species. Probability of occurrence for juvenile steelhead was generally high in all populations (**Table A-III: 8**), with corresponding low (2) or very low (1) risk scores. Risk scores based on probability of occurrence were also low or very low for all cutthroat trout populations. Average probability of occurrence in accessible habitat was much lower for coho salmon, and viability risk scores ranged from moderate (3) to high (4).

Diversity Results

There was little population-level information with which to assess the diversity criterion directly. Documented changes in freshwater and estuarine habitat composition and quality, and loss of access to historical habitat above large dams, are assumed to have led to less variation in at least one life history trait for Upper Rogue winter steelhead and all populations of summer steelhead, coho salmon, and cutthroat trout. There is no indication that life history diversity has been altered or diminished for most winter steelhead populations.

Confidence in Viability Results

Within all SMUs, there were indicators that warrant a cautious approach to implementing management actions based solely on the assessment results. These included varying levels of negative abundance trends for populations and the availability of data for fewer than all four VSP parameters.

Appendix IV – Climate and Ocean Change Assessment

Appendix IV: Climate Metrics

The following section outlines expected changes for climate metrics linked to the health of RSP species in the geographic area covered by the plan, based on currently available science. These metrics informed the Climate Vulnerability Assessment described below.

Air Temperature:

There is significant seasonality in the projected change in air temperatures. The majority of models indicate that summer temperatures will increase the most followed by fall, winter, and spring.

Summer: Average summer air temperature has increased by 4.1°F in Medford since the 1970s[16]. By 2070, it is predicted that summer air temperatures in the planning area will be 5–13°F warmer than the 1971–2000 average, depending on the location/elevation and assuming a high emissions scenario[17] (**Figure A-IV: 1**). Additionally, most locations in Oregon will likely experience a doubling of "hot days", defined as days with daily high temperatures >86 ºF (Mote et al. 2019).

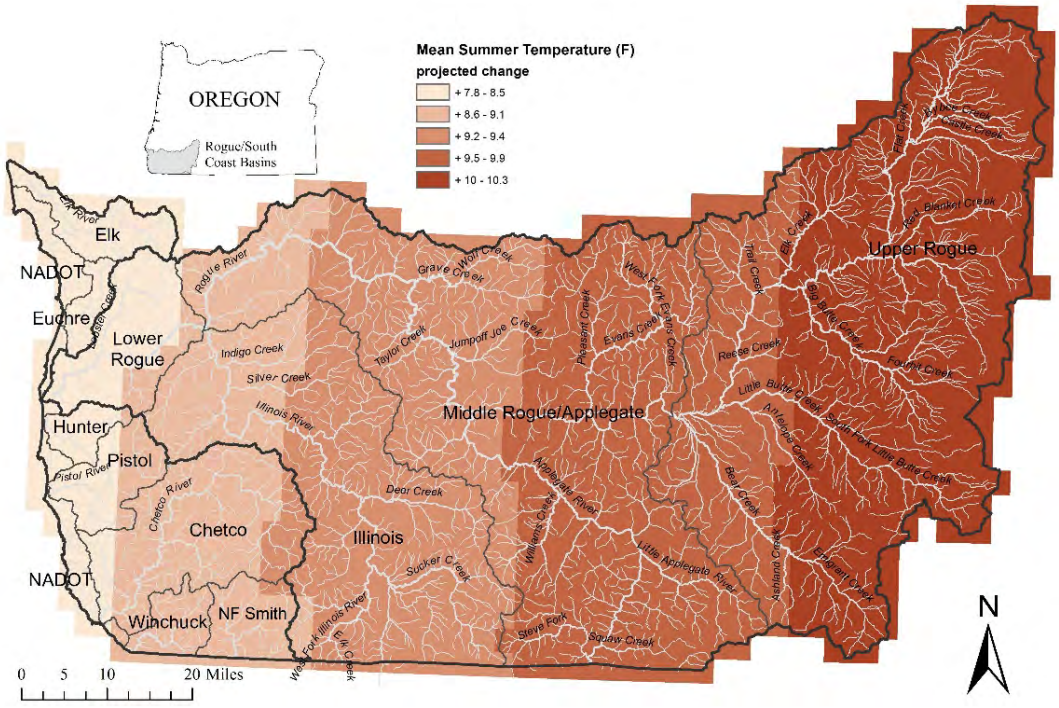


Figure A-IV: 1. Projected change in mean summer air temperature within the planning area (RCP 8.5; 2070–99 vs 1971–2000; ensemble mean of 20 downscaled CMIP5 models)

Winter: Average winter air temperatures have increased 2.1°F in Medford since the 1970's[1], and regionally it is projected that winter temperatures will be 5–7 °F warmer by 2070 (**Figure A-IV: 2**).

[16] Data obtained from NOAA Regional Climate Center Applied Climate Information System (rcc-acis.org)
[17] NW Climate Toolbox, Data: gridMET, High emissions 8.5 2070–2099 vs. historical simulation 1971–2000, mean change, Multi-model mean derived from 20 downscaled CMIP5 models projection is 5-11^{O}F. Halofsky et al. 2020

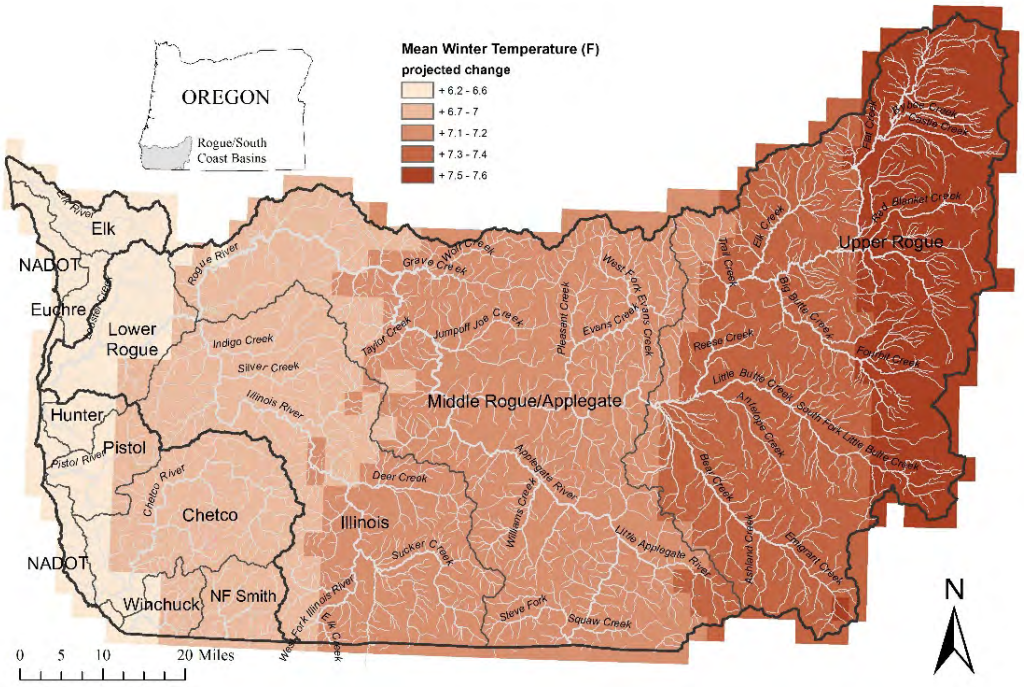


Figure A-IV: 2. Projected change in mean winter air temperature within the planning area (RCP 8.5; 2070–99 vs 1971–2000; ensemble mean of 20 downscaled CMIP5 models)

Precipitation

Rain: There is more uncertainty in model projections for precipitation in this region than for air temperatures. The majority of models predict a slight increase, however several models predict a slight decrease, though generally not significantly less than the 1970–99 baseline. Similar to air temperature, there is significant seasonality to the projected changes in precipitation characterized by an increase in winter and a decrease in the remaining seasons. In the planning area, average spring and fall precipitation is projected to decrease by ~4% in some locations with summer precipitation decreasing by approximately 4–20%[2] (**Figure A-IV: 3**). Although the percent decrease in summer precipitation is relatively large, the absolute change is small as the region currently experiences very little summer precipitation (<5% of total participation) (Halofsky et al. 2020). In addition to changes in precipitation, climate change is expected to result in increased evapotranspiration (27–36% increase across the area in winter, except in a narrow band on the coast[2]), potentially ameliorating any increase in winter precipitation.

Snow: Snowpack has declined by 15–30% since mid-century in the Pacific Northwest (Mote et al. 2018). A continued increase in winter temperatures is projected to result in a continued decline, however, there will be significant differences between the eastern and western portions of the planning area, as detailed by Halofsky et al. (2020). In summary, there will likely be little change in the western, low elevation portion as there is currently very little snow to lose. Conversely, at mid-elevations in the Cascades, the more transient or ephemeral snowpacks will be largely eliminated by the 2080s, and places with moderately persistent snowpacks will become more transient in nature. In the high Cascades,

the average residence time of snow is projected to decrease by 6–8 weeks (Halofsky et al. 2020) and an 11–50% reduction[1] in April 1 Snow Water Equivalents[18] in the region by the 2080s.

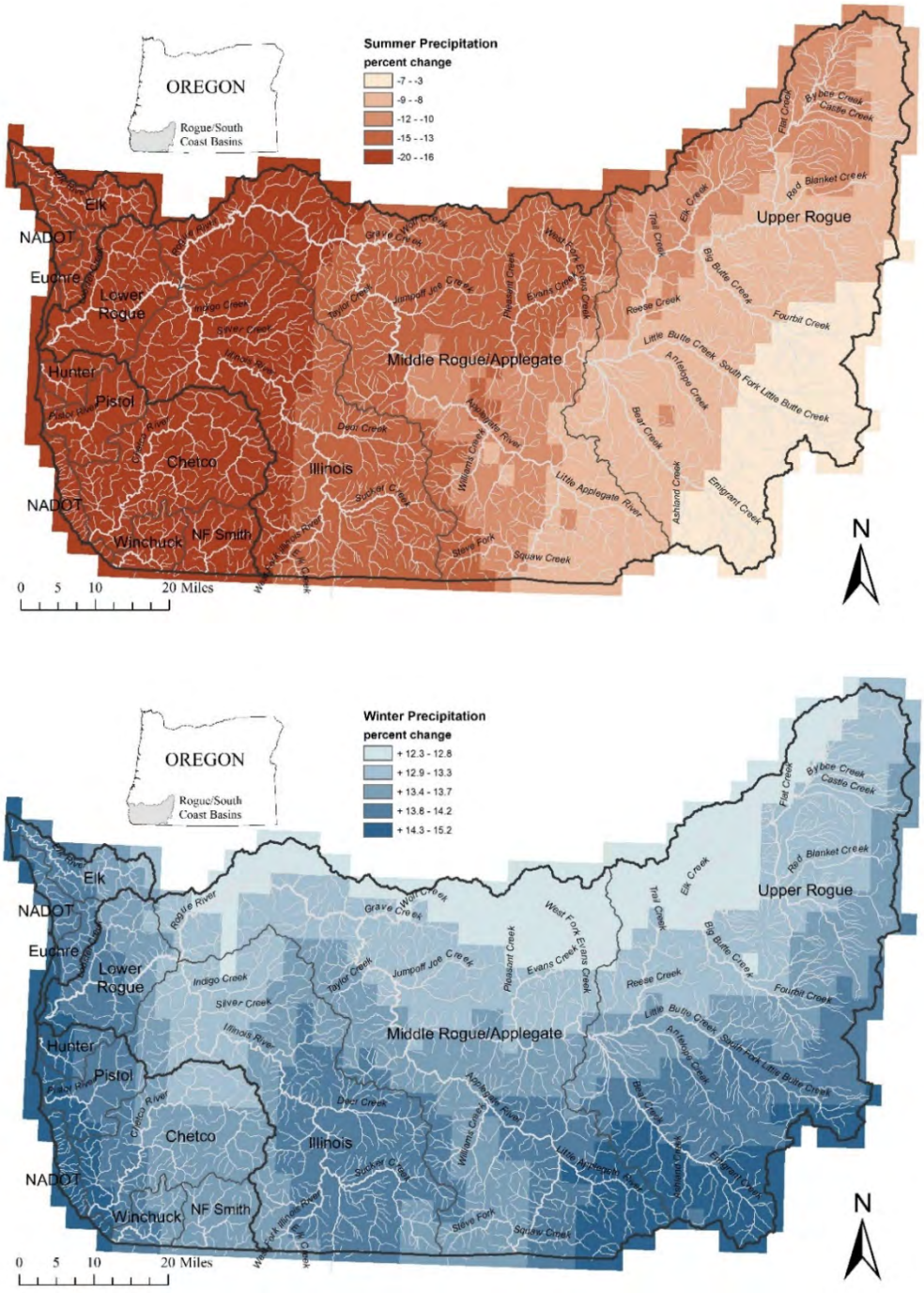


Figure A-IV: 3. Projected percent change in summer (upper) and winter (lower) precipitation within the planning area (RCP 8.5; 2070–99 vs 1971–2000; ensemble mean of 20 downscaled CMIP5 models)

[18] Snow Water Equivalent (SWE) is a measure of the amount of water contained within the snowpack. It can be thought of as the depth of water that would theoretically result if you melted the entire snowpack instantaneously. The Apr 1 SWE metric has traditionally been a useful indicator of the potential water resource during the subsequent summer.

Extreme Storm Events: Major storm events tend to be associated with the occurrence of atmospheric rivers that carry large quantities of warm, wet air from the Pacific Ocean (Warner et al. 2015). Major storm events can result in flooding in coastal or low-elevation mountain ranges and large accumulations of snowpack at higher elevations. At mid elevations, such storms can cause large rain-on-snow events, which elevate the snowline (Crozier et al. 2019). Warner et al. (2015) project a 20% increase in the frequency of atmospheric river events by 2080 relative to the period 1970–99. Similarly, Mote et al. (2019) projected a 10% increase in extreme precipitation events in winter in Western Oregon by mid century (Mote et al. 2019). Stream flow modelling using the Variable Infiltration Capacity model suggests that the headwater areas in the Cascades will experience the biggest increase in the 99th percentile flow magnitude[19] (**Figure A-IV: 4**).

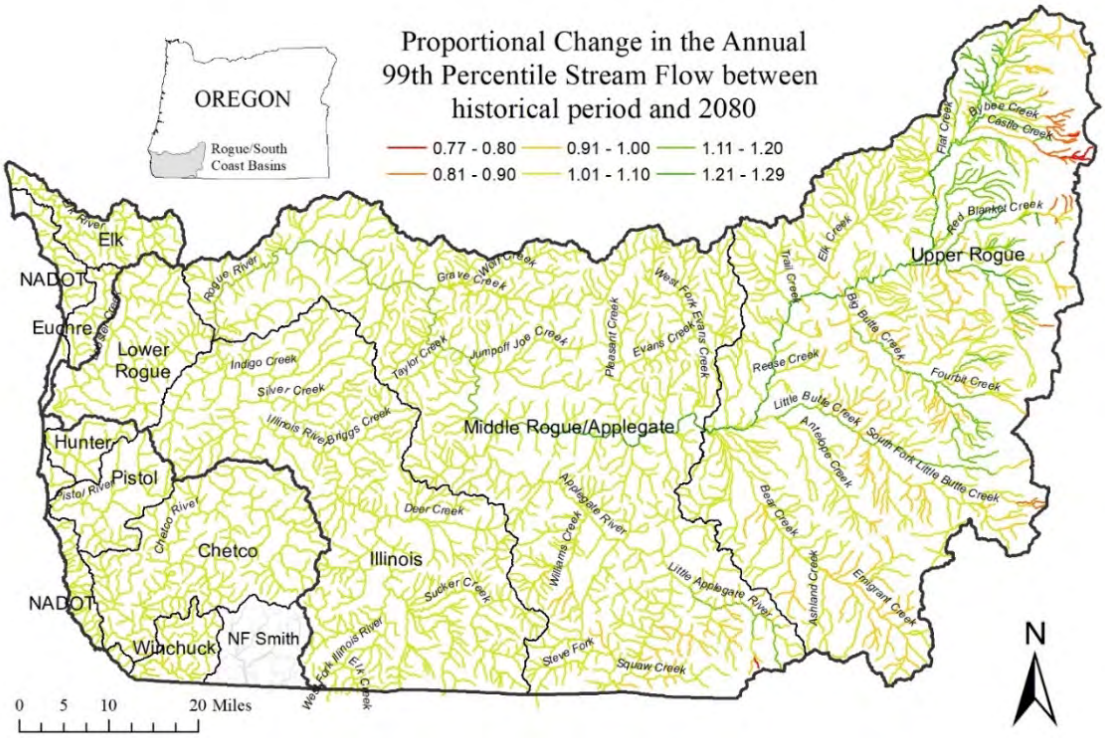


Figure A-IV: 4. Proportional change in the annual 99th percentile of stream flow between historical (1977–2006) and future (RCP 8.5; 2080). Warm colors (<1) indicate areas with fewer high flow events. Cool colors indicate areas with no change (value of 1) or an increase in high flow events (>1).

Drought: In addition to the changes outlined above, the increases in global average air temperature are also expected to result in more drought. In the Pacific Northwest, the spatial extent of future droughts is projected to remain unchanged from the historical base period (1950–2005) in Spring, Fall, and Winter under both RCP 4.5 and 8.5 scenarios (Ahmadalipour et al. 2017). However, the spatial extent of the

[19] To estimate the change in size of high flow events we calculated the 99th percentile of flow across the 30 years of daily flow values from the Variable Infiltration Capacity model historical period data (1977-2006) and for the 30 years of the 2080 climate data (2070-2099).

area experiencing drought is expected to increase significantly under both scenarios in summer. In an analysis of drought potential for the Western states, Ault et al. (2014) concluded that this region has a 40–50% chance of experiencing an 11-year drought, with a 20–50% chance of experiencing a 35-year-plus mega-drought in the coming century. Thus, conditions similar to those experienced in 2015 will be more prevalent.

Summer Stream flow: Summer stream flows have been generally decreasing in the past half century in the Rogue-Siskiyou region (Asarian and Walker 2016). The impact of climate change on summer stream flows will not be uniform across the planning area because of the variable influence of snowpack, rainfall, and geology on summer base flows. Some locations are projected to see significant decreases in summer and fall stream flows by 2080, whereas others will be minimally impacted (**Figure A-IV: 5**). Some aspects of climate change are not incorporated in the modeling; for example, low flows are also likely to be affected by changing vegetation. Increases in fire and insect mortality associated with increasing drought may initially increase water yield by decreasing canopy interception and transpiration (cited in Halofsky et al.2020), but if such disturbances keep forests in earlier seral stages, an increase in the water demand from the vegetation for transpiration may reduce low flows (Perry and Jones 2017).

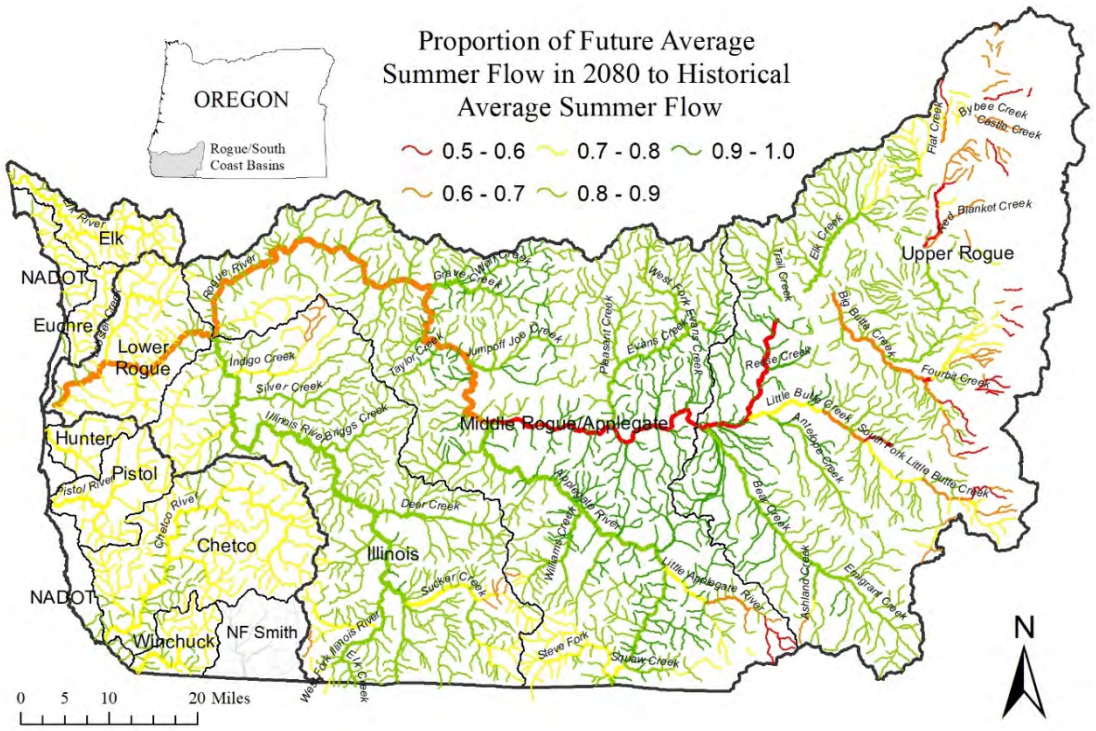


Figure A-IV: 5. Estimated future (2070–2099) mean summer (Jun–Sept) natural flow as a proportion of historical (1977–2006) mean summer natural flow. A value of 1 represents no change, a value of 0.5 represents 50% reduction in flow. Data are were obtained from the VIC model. Flow values should not be used to assess regulated systems. Warmer colors represent areas that will have decreased flow. Areas in dark green colors are expected to change very little.

Streamflow permanence: The type and rate of precipitation and the permeability of the underlying geology influences the hydrological response, including whether streamflow is perennial or ephemeral. A number of streams within the Rogue–South Coast area are historically ephemeral, typically drying or having subsurface only flows during summer (**Figure A-IV: 6**). These streams often provide important seasonal habitat. Climate change is expected to alter the spatial and temporal extent of stream drying both as a result of changes in average conditions (e.g., mean snowpack) but also by increasing the frequency and severity of drought, thereby reducing available habitat. We mapped the probability of stream flow permanence across the period 2004–2016 (**Figure A-IV: 6**) using the PROSPER[20] model then compared values to those in the driest year (2015). The resulting map (**Figure A-IV: 7**) illustrates areas that are wetter or drier during a drought year than an average year. We use 2015 as a proxy for "future average conditions" because regional drought models indicate the Pacific Northwest will experience longer summer droughts across larger areas by 2080. It is expected that years like 2015 will be relatively common after 2050. In general, the middle Rogue and Applegate are most susceptible to increased risk of stream drying whereas the Upper Rogue is relatively buffered from changes as a result of the geology.

Note: PROSPER was developed using observation points from across Oregon, Washington, and Idaho. However, relatively few observations were included from the Rogue/South-Coast area. As a result, the model often underestimates stream drying probabilities in this area. This issue is expected to be addressed in the near future but until then these projections should be used to look at large scale patterns rather than individual reaches.

[20]USGS PROSPER model (https://www.usgs.gov/centers/wy-mt-water/science/probability-streamflow-permanence-prosper?qt-science_center_objects=0#qt-science_center_objects).

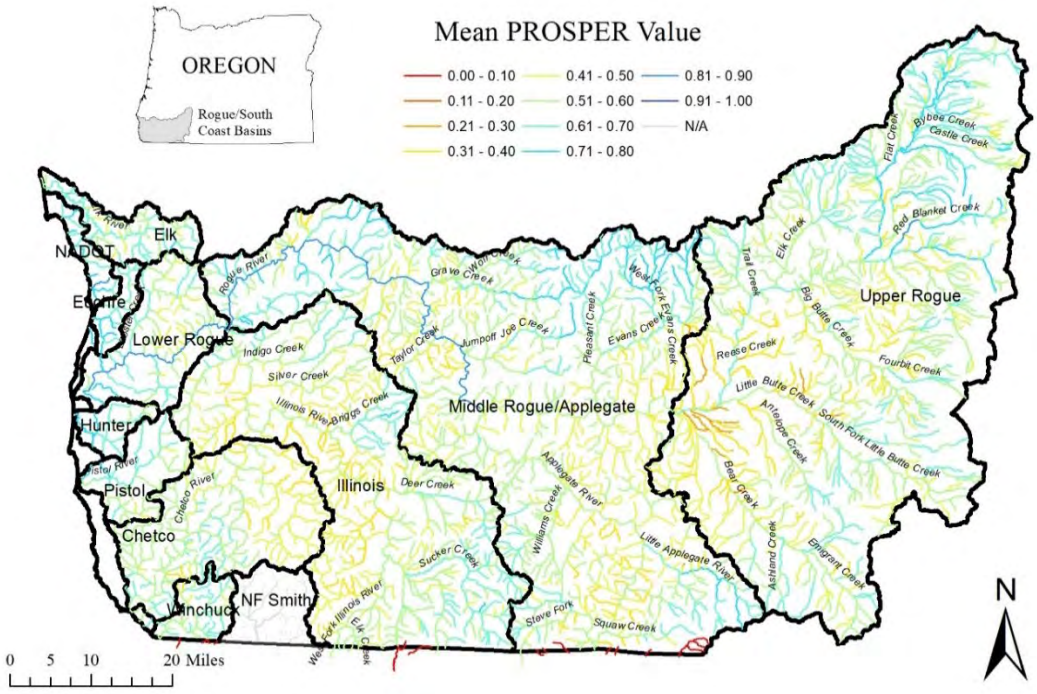


Figure A-IV: 6. Mean stream flow permanence probability (2004–2016). Warm colors indicate areas with significantly higher probability of going dry during summer. Cool colors indicate areas with a higher probability of remaining wet year round.

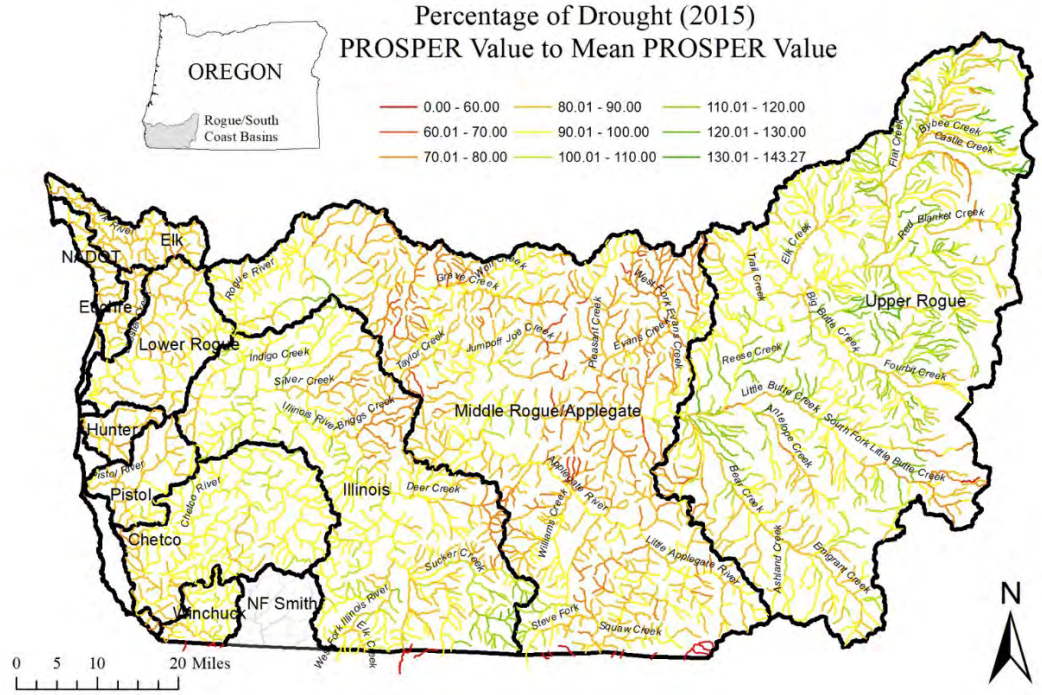


Figure A-IV: 7. Change in stream flow permanence probability during drought years (e.g., 2015) relative to average years. Warm colors indicate areas with significantly more drying during drought years. Cool colors indicate areas with no change or less likelihood of drying during drought years. It is expected that 2015 conditions will more closely represent average conditions by 2050.

Stream Temperature: Stream temperatures will continue to increase in many locations as a result of both the direct (increasing air temperature, decreasing streamflow) and indirect (fire, changes in riparian and upland land cover) impacts of climate change. In the planning area, June stream temperatures have historically been generally cold and cool at higher elevations with localized warming beginning to occur at lower elevations in the Illinois, Middle Rogue and Applegate basins. In small and medium streams, 2080 projections for June indicate there will be a 9% reduction in stream miles experiencing cooler temperatures (<10ºC/50ºF), with future June conditions resembling historical August conditions (**Figure A-IV: 8**; NorWest[21]). For August, 2080 projections indicate a 6% reduction in cooler temperatures and an 11% increase in the extent of streams with temperatures >20°C/68ºF (**Figure A-IV: 9**). Of note in some of the coastal systems, stream temperatures often cool.

NOTE: Percentages indicate the approximate change in stream miles between baseline conditions (2002–2011) and 2080 projections. The NorWest predictions of stream temperature change in the future assume no changes to surrounding land management which can either exacerbate or mitigate the changes expected as a result of climate change.

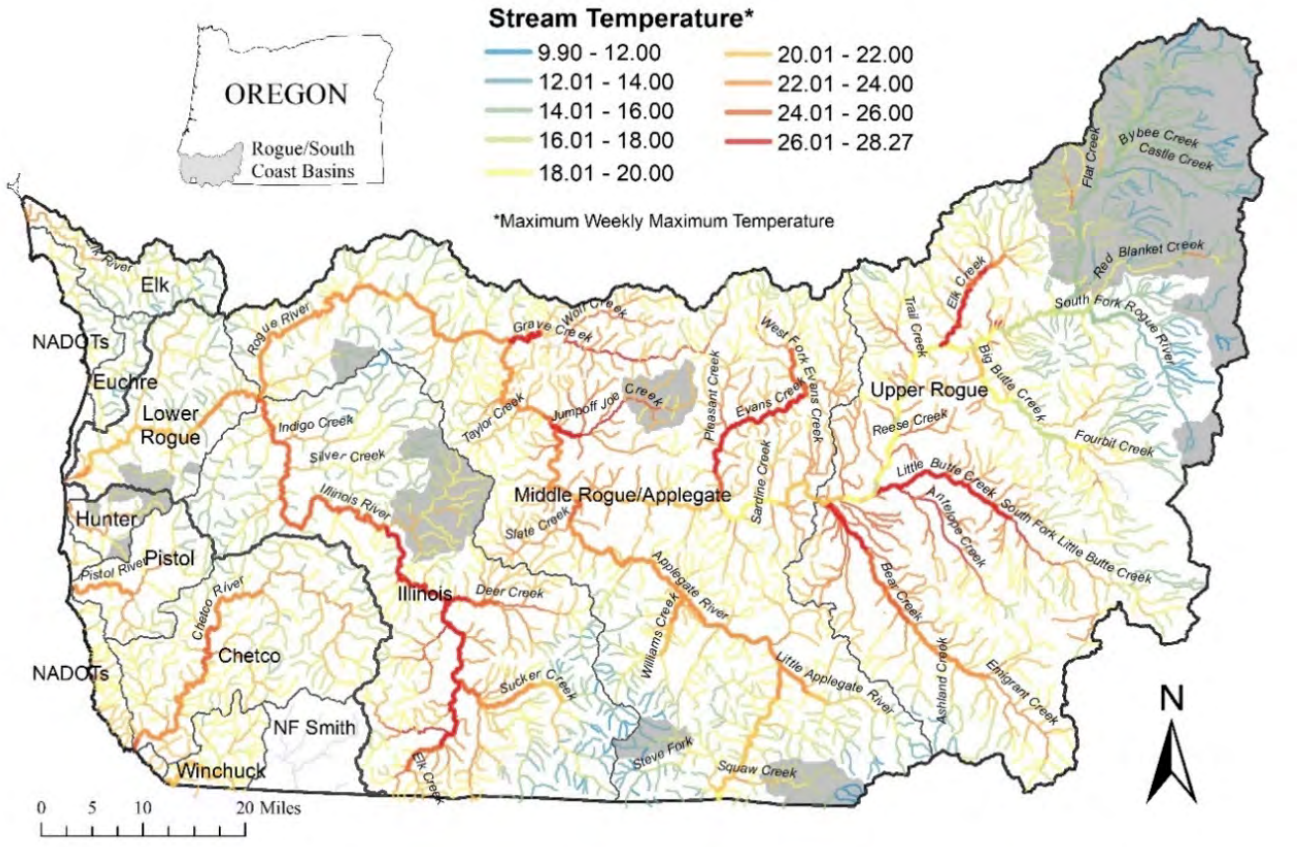


Figure A-IV: 8. Historical (1993–2011) mean maximum weekly maximum temperature (August). Reach specific estimates were obtained from NorWest.

[21] NorWest is a regional temperature model estimating August mean temperature at stream reach scales. See Isaak et al. (2017) for more details.

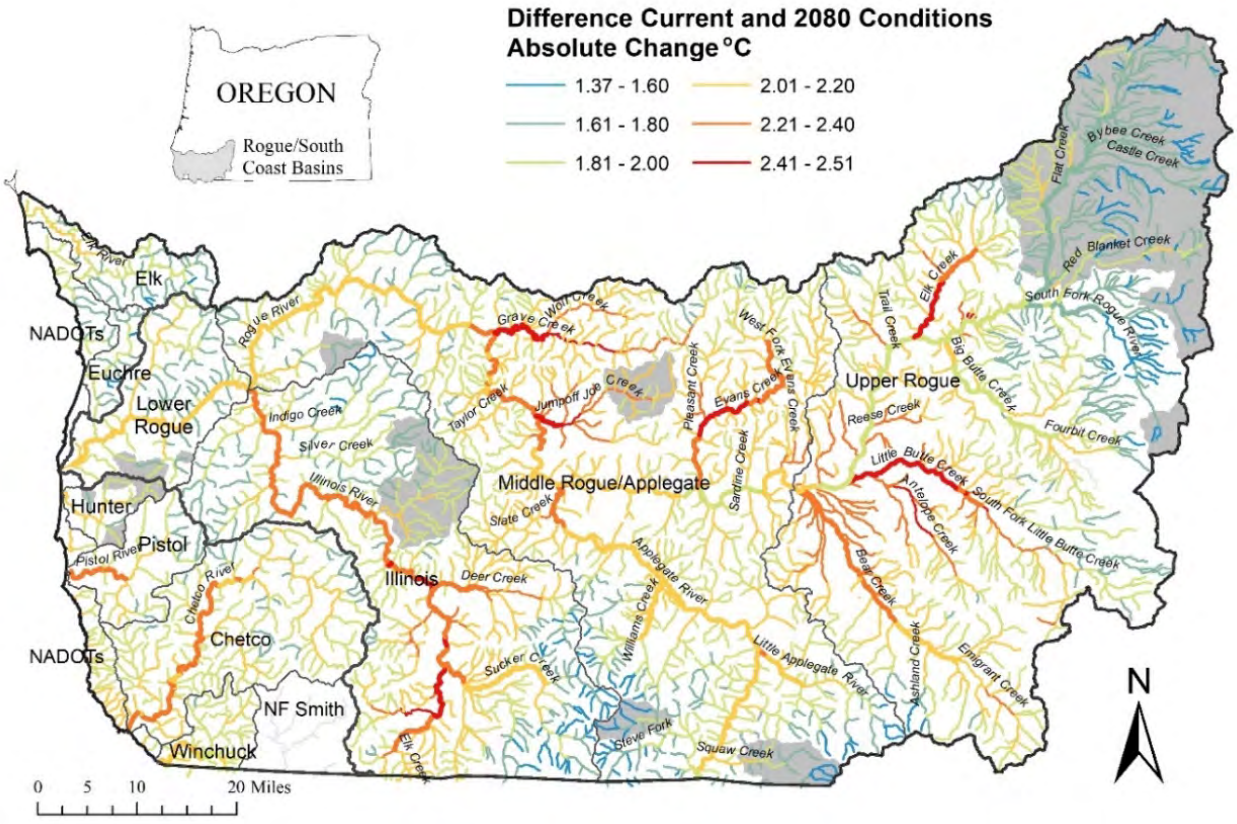


Figure A-IV: 9. Projected change in stream temperature between the historical (1993–2011) and future (2070–2099) time periods under the A1B warming scenario. Reach specific estimates were obtained from NorWest.

Ocean Acidification: The surface pH in offshore areas (>10 miles from shore) within the ocean feeding grounds of plan species is expected to decrease in pH by 0.24–0.32 units by the end of the century[22] (**Figure A-IV: 10**). Areas to the north of Cape Blanco are expected to acidify slightly more than those to the south. Data collected off the Oregon coast indicate that ocean pH is significantly lower within the nearshore area (<10 miles from shore) (pH 7.43) than the global mean (pH 8.1) and it is also expected that this area will be more susceptible to acidification as a result of upwelling and increased productivity over the continental shelf. Species that forage in the near shore area for part or all of their ocean residence will likely experience considerable heterogeneity in pH both temporally and spatially (Chan et al. 2017).

[22] Data downloaded from the Climate Change Web Portal of the NOAA Earth Systems Research Laboratory (https://www.esrl.noaa.gov/psd/ipcc/ocn/). An ensemble of 13 GCMs and earth system models on a 1° × 1° scale were used to calculate projected change in OA within the ocean distribution of plan species.

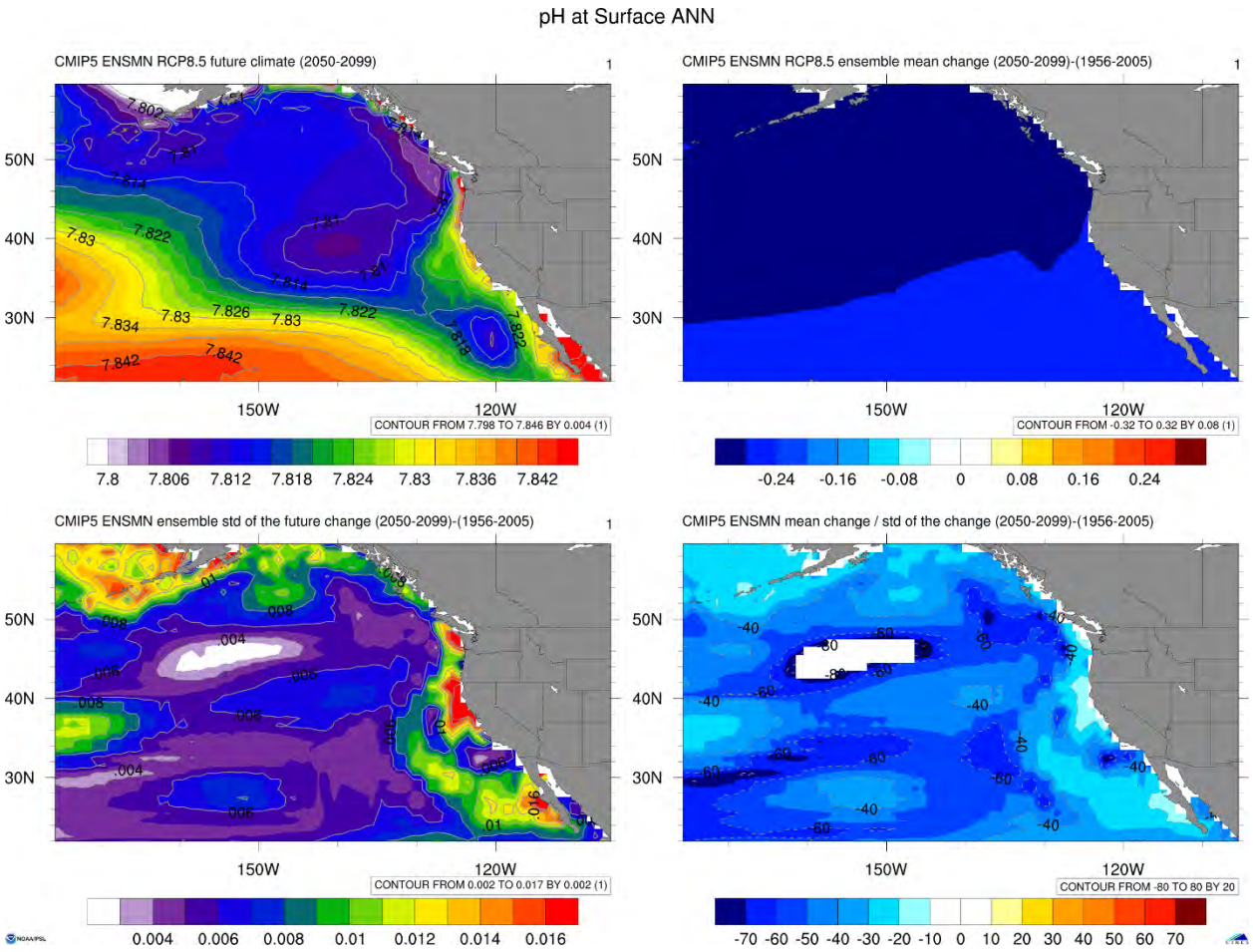


Figure A-IV: 10: Surface pH interpolated on a 1x1 grid for the entire year; First panel: RCP8.5 futur climate for the period (2050-2099); Second panel: difference in the mean climate in the future time period (RCP8.5: 2050-2099) compared to the historical reference period (1956-2005); Third panel: ensemble standard deviation of anomaly (2050-2099)-(1956-2005); Fourth panel: mean change (2050-2099)-(1956-2005) divided by the ensemble spread of the change (2050-2099)-(1956-2005).

Upwelling: Upwelling intensity is correlated with large-scale modes of climate variability such as the El Niño Southern, Pacific Decadal, and North Pacific Gyre Oscillations (ENSO, PDO, and NPGO). The most recent models suggest that in the northern California Current System, upwelling will become more intense in the spring and less intense in the summer as a result of anthropogenic climate change (Rykaczewski et al. 2015). Additionally, changes in upwelling due to climate change will emerge primarily late in the second half of the century (Brady et al. 2017). There remains uncertainty in these predictions because the ensembles include relatively coarse-resolution global models from which it is difficult to resolve local dynamics in the California Current System.

Sea Surface Temperature: The annual average sea surface temperature is projected to increase by 4.3–6.5°F by the end of century under the RCP 8.5 scenario within the North Eastern Pacific (**Figure A-IV: 11**). The largest increases are expected to occur in the northern region of the area. Additionally, marine heatwaves have doubled in frequency since 1982 and are increasing in intensity. They are projected to further increase in frequency, duration, extent and intensity. Their frequency will be 20 times higher at 3.6ºF warming, compared to pre-industrial levels. They would occur 50 times more often if emissions continue to increase strongly (IPCC 2019).

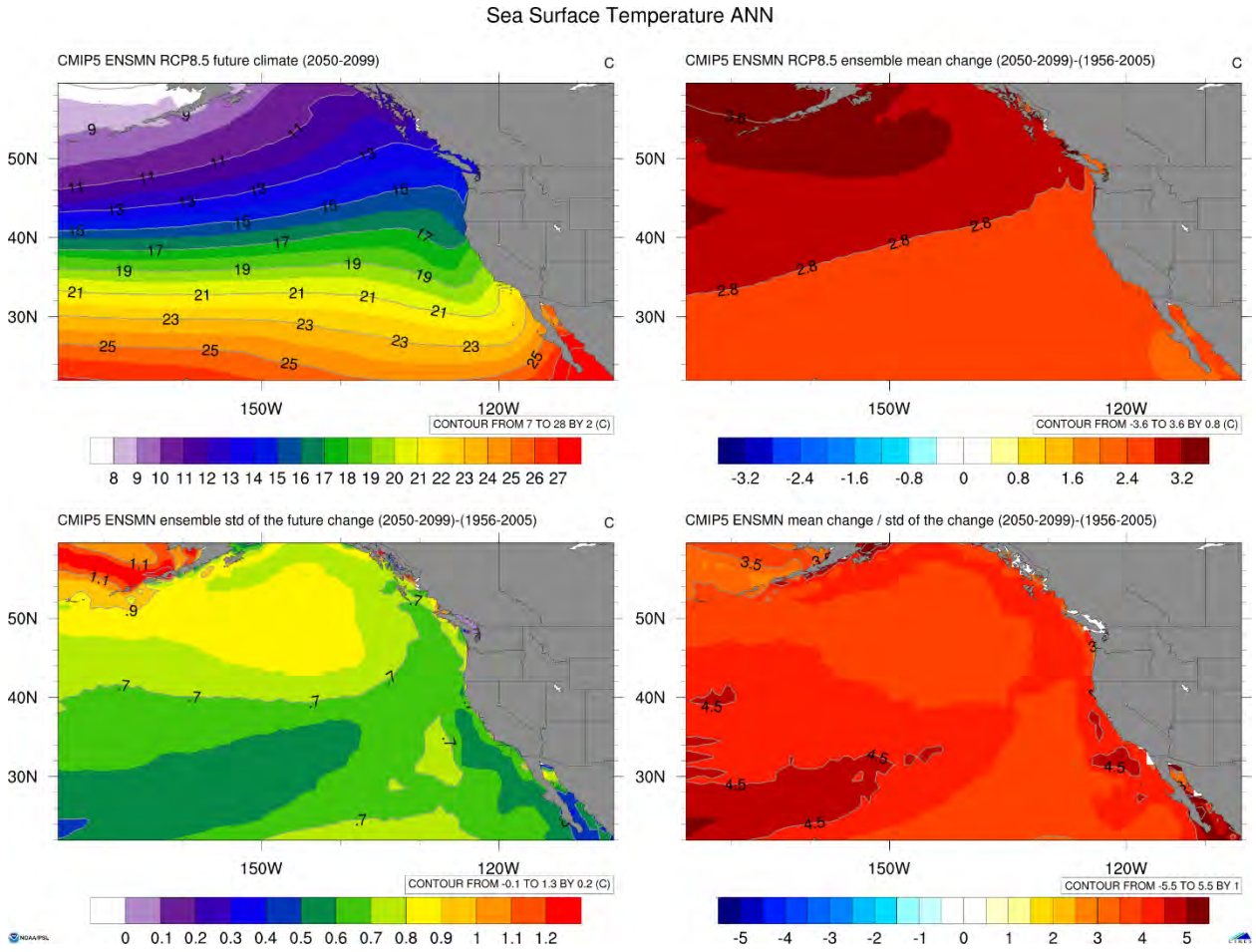


Figure A-IV: 11. Sea Surface Temperature interpolated on a 1x1 grid for the entire year. First Panel: RCP 8.5 future SST for the period 2050–2099; Second Panel: Difference in mean SST between future (RCP 8.5 2050–99) and reference period (1956–2005); Third Panel: ensemble standard deviation for difference in Panel 2; Forth Panel: Mean change between future and reference period divided by the ensemble spread of change.

Appendix IV: Climate Vulnerability Assessment

Methods

Given the expected changes outlined in the previous section, we assessed the risk to long term viability of populations using a framework developed by Crozier et al. (2019) and modified for this region. The assessment evaluated the sensitivity, adaptive capacity, and exposure of plan populations to climate and ocean change using an expert panel approach. Twelve people were invited to join the expert panel, ten of whom participated in the assessment. Participants included staff from the Bureau of Land Management (BLM), Coquille Indian Tribe, NOAA-Fisheries, ODFW, and Trout Unlimited (a full list of participants can be found in the **Acknowledgements**). To complete the assessment, participants were given an information packet with background information and descriptions of bins (low, moderate, high, or very high) for each attribute. Two meetings were held with participants; the first to explain assessment materials and methods, and the second to review and discuss scores. Participants had an opportunity to adjust scores after the second meeting. Not all participants were able to attend both meetings, and so ODFW staff provided additional direction and support to several participants. Each expert independently scored populations based on information contained in the packet as well as their own personal knowledge of RSP populations. Scorers allocated five tallies across four bins (low, moderate, high, or very high) for each sensitivity, adaptive capacity, and exposure attribute.

Climate vulnerability was determined for each population based on sensitivity and exposure scores using methods described in Crozier et al. (2019). Not all panel members had expert knowledge on all populations, so scoring for each population was typically based on responses from five to eight participants. To identify borderline cases, we conducted a bootstrap analysis similar to the one described in Crozier et al. (2019). In our bootstrap analysis, we used 10,000 repetitions to determine the probability of exposure and sensitivity outcomes. Populations were assigned to exposure and sensitivity categories based on the highest probability outcome from the bootstrap analysis. If an outcome had a bootstrap probability of at least 75%, we considered the result for that population to be likely. Otherwise, we considered the population to be borderline between the highest and second highest probability category (Crozier et al. 2019).

Expert panelists scored adaptive capacity, defined as “the potential for behavioral, physiological, or other adaptive response to ameliorate climate stress” (Crozier et al. 2019), for three life history phases (juvenile, marine, and adult freshwater). For each population, a weighted-average score was calculated for each life history stage based on all responses. Lower adaptive capacity at any of these stages could limit population response to climate change, so the minimum score for each population was used to categorize adaptive capacity.

Assessment Results

Figure A-IV: 12 below shows the final vulnerability rank for all independent RSP populations as a product of sensitivity and exposure scores. Adaptive capacity scores and overall categorical ranking for each population are presented in **Table A-IV: 1.**

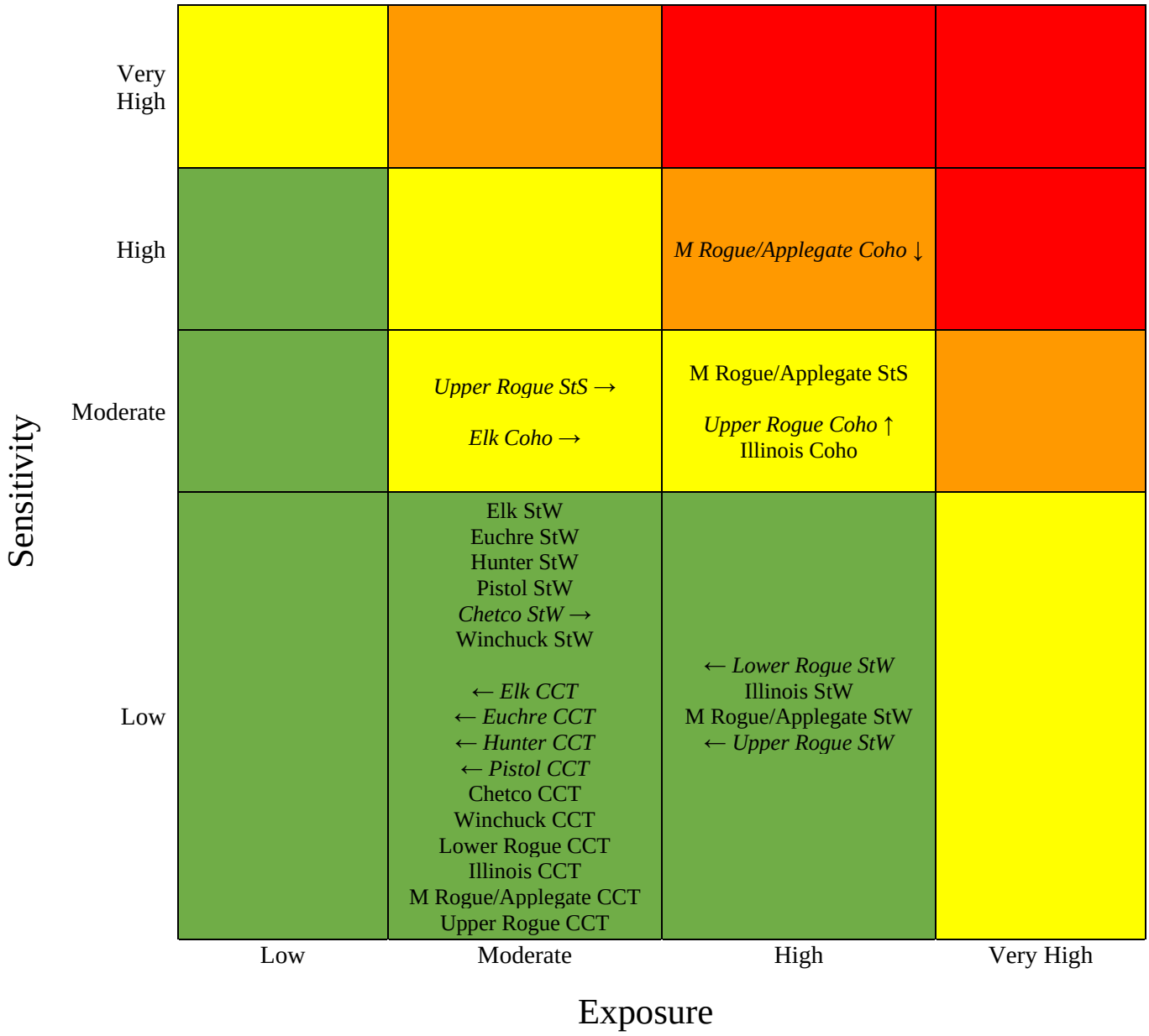


Figure A-IV: 12. Final cumulative vulnerability ranks. Box colors show final vulnerability rank for each population as a product of sensitivity and exposure scores: red indicates very high vulnerability, orange high, yellow moderate, and green low. Uncertainty in final ranks was represented with a bootstrap analysis. Borderline populations are shown in italics, and arrows indicate the direction of uncertainty. All other cumulative vulnerability ranks were considered likely. StW = winter steelhead, StS = summer steelhead, CCT = coastal cutthroat trout.

Table A-IV: 1. Adaptive capacity scores in juvenile, marine, and adult freshwater life history stages (scoring is on a 1-4 scale) and overall ranking for RSP populations. Categorical ranking was based on minimum scores (≤ 1.5 = low; 1.6–2.5 = moderate; 2.6–3.5 = high; > 3.5 = very high)

SMU	Stratum	Population	Adaptive Capacity Scores			Adaptive Capacity
			Juvenile	Marine	Adult FW	
WINTER STEELHEAD	Coastal	Elk	2.4	2.2	2.3	Moderate
		Euchre	2.4	2.2	2.3	Moderate
		Hunter	2.3	2.2	2.3	Moderate
		Pistol	2.3	2.2	2.3	Moderate
		Chetco	2.4	2.2	2.3	Moderate
		Winchuck	2.3	2.2	2.3	Moderate
	Rogue	Lower Rogue	2.3	2.3	2.3	Moderate
		Illinois	2.4	2.4	2.4	Moderate
		M Rogue/Applegate	2.4	2.4	2.4	Moderate
		Upper Rogue	2.4	2.4	2.4	Moderate
SUMMER STEELHEAD	Rogue	M Rogue/Applegate	2.3	2.4	2.2	Moderate
		Upper Rogue	2.2	2.4	2.2	Moderate
COHO SALMON	Coastal	Elk	1.6	1.8	2.0	Moderate
	Interior Rogue	Illinois	1.5	1.5	1.8	Low
		M Rogue/Applegate	1.5	1.5	1.8	Low
		Upper Rogue	1.6	1.5	1.8	Low
CUTTHROAT TROUT	Coastal	Elk	2.6	2.6	2.7	High
		Euchre	2.5	2.6	2.7	Moderate
		Hunter	2.5	2.6	2.7	Moderate
		Pistol	2.6	2.6	2.7	High
		Chetco	2.6	2.6	2.7	High
		Winchuck	2.5	2.6	2.7	Moderate
	Rogue	Lower Rogue	2.6	2.6	2.7	High
		Illinois	2.6	2.6	2.7	High
		M Rogue/Applegate	2.5	2.6	2.6	Moderate
		Upper Rogue	2.6	2.6	2.7	High

Appendix IV: Species Distribution-Abundance Analysis

Methods

ODFW has conducted snorkel surveys in wadeable streams annually to monitor juvenile salmonids in the RSP planning area since 1998 (see **Appendix III – Current Status Methods and Results** for additional details). Counts from these surveys provided an opportunity to use species distribution-abundance modeling to predict potential changes in juvenile rearing abundance and distribution under climate change scenarios. This quantitative approach was intended to complement the expert panel approach described above, but only captures vulnerability at one life stage. Ideally, species-distribution abundance models for all species and populations would have been developed. However, we were not able to identify useful predictive models for coho salmon and cutthroat trout, and so the following methods and results apply specifically to juvenile steelhead. In most population areas, results apply strictly to winter steelhead, the only steelhead run type present. In the Upper Rogue and Middle Rogue/Applegate population areas, juvenile steelhead enumerated in surveys could include summer- and winter-run fish. ODFW's working assumption (see **Appendix III – Current Status Methods and Results**) is that juvenile steelhead encountered in wadeable streams in these populations are primarily winter-run fish.

Species distribution-abundance modeling was based on counts of juvenile (age-1+) steelhead in snorkel surveys, including zero counts when no fish were observed. We excluded all data prior to 2002, as steelhead were not counted with any regularity prior to this date. The final dataset was right-skewed with zeros constituting 11% of the data. A series of candidate zero-inflated negative binomial regression models were fit using *GLMMTMB* function from the *GLMMTMB* library in R studio version 1.0.143. We evaluated the inclusion of a random effect through time, as well as models with and without quadratic versions of both distance from ocean and gradient. We hypothesized that the relationship between steelhead abundance and distance is likely not linear (e.g there may be high abundances close to the ocean and at sites further from the ocean where habitat conditions are suitable). Similarly, we hypothesized that juveniles utilize increasingly steep habitats up to a point when they become too steep and abundances decrease. To avoid collinear predictors, we evaluated particular variables in separate. Given the very different scales and units of the predictor variables, all were standardized using the scale command in R. See **Table A-IV: 2** for a list of variables considered.

We compared the candidate models using AIC (Burnham and Anderson 2002), the model with the lowest ΔAIC value was considered the best, most parsimonious (e.g. minimum predictors, highest explanatory power) model. For this model, we examined the residuals using several functions from the DHARMa package (Hartig 2020). We also evaluated two recommended measures of model fit when working with count data; the rootogram and quantile residuals. Rootograms compare empirical frequencies with fitted frequencies from a probability model and is particularly useful when trying to detect overdispersion. Finally, model fit was evaluated by calculating and comparing predicted versus expected values.

Future Projections

Because future projections of PRISM climate data are not readily available, we used contemporary and future climate data available from the Climate Toolbox (Abatzoglou and Brown 2012). These gridMET data represent statistical downscaled climate data at a 1/24-deg (4 km) resolution. We obtained the historically simulated data for winter precipitation (1971–2000, mean) and the future (2070–2099) projected winter precipitation from 20 climate models run using the RCP 8.5 emission scenario. We calculated the difference between the historical mean and the future mean to obtain a change factor (Prudhomme et al. 2010). We added that change factor to the PRISM winter precipitation data to obtain a scenario neutral, future projection of winter precipitation.

For stream temperature, we used the MWMT temperature data available from NorWeST (Isaak et al. 2017). While these data in their contemporary form are not temporally explicit but an average across 1998–2011, they do provide a future value and do represent in-stream conditions. We did not need to add a change factor to these data as the projection was already available.

Table A-IV: 2. Variables considered in modeling. For seasonal data, spring is represented by Mar – May; winter: Dec – Feb; summer: June – Sept.

Variable	Description
Count	Count of juvenile steelhead
Strata	Geographic boundary distinguishing Coastal from Rogue basins
Distance from ocean	Distance of survey site from ocean
Distance from ocean (poly)	Distance of survey site from ocean; quadratic term
Gradient	Gradient of reach
Gradient (poly)	Gradient of reach; quadratic term
Time	Number representing year snorkel survey was conducted
Spring precipitation, rearing year	From monthly PRISM, sum of spring precipitation for each site in the year surveyed
Winter precipitation, rearing year	From monthly PRISM, sum of winter precipitation for each site in the year surveyed
Maximum weekly maximum temperature	Maximum weekly maximum temperatures, averaged across 1998-2011 (NorWeST, Isaak et al. 2017).
Spring precipitation, spawning year	From monthly PRISM, sum of spring precipitation for each site in the spawning year (1-rear).
Winter precipitation, spawning year	From monthly PRISM, sum of winter precipitation for each site in the spawning year (1-rear).
Summer air temperature, rearing year	From monthly PRISM, mean of summer air temperature for each site in the year surveyed.

Results

We fit 32 models (including the null model) that included predictor variables (freshwater only) that varied through both time and space, and included variations of predictor variable combinations in the conditional (counts) and zero inflation (excess zero counts above expected) sides of the models. Models were fit with a random year effect and allowed the conditional mean to vary with distance from ocean, gradient, stream temperature, and several different measures of spring and winter climate parameters. We included several interactions specifically between climate and static predictor variables. The most parsimonious model, with the lowest AIC, indicated that the conditional mean (juvenile steelhead counts) varied with distance from ocean (poly), gradient (poly), maximum weekly maximum stream temperature (MWMT) and winter precipitation summarized in the season preceding the juvenile sampling. An interaction between total winter precipitation and distance from ocean was also supported. Zero-inflation, or the probability of excess zero counts, was influenced by stream temperature and the relationship between distance from ocean and winter precipitation.

The best-supported model indicated that juvenile steelhead abundance in the planning area has historically been driven by distance from the ocean, gradient, stream temperature, and total winter precipitation preceding the rearing season. Distance from ocean and gradient were both represented as having nonlinear relationships with abundance. A significant interaction between winter precipitation and distance from ocean indicates that the effect of winter precipitation is conditional on distance from ocean or location on the stream network relative to the outlet to the ocean. Additionally, the model shows that abundances decrease with increases in both winter precipitation and summer stream temperatures. The relationship is nuanced; the decrease in abundance given winter precipitation is stronger in the interior Rogue than in the coast. With an increase in winter precipitation, there can be increased access to locations not accessible in some years; however, too much precipitation in the winter can displace juvenile steelhead, decreasing survival and increasing the probability of excess zeros.

The best-supported model was used to estimate current average juvenile steelhead abundance in wadeable streams and future average abundance using climate projections described above. Results are shown in **Figure A-IV: 13**. **Table A-IV: 3** shows the percentage change between current and future estimates for each population**.** Note that percentage change was calculated based on point estimates and does not account for uncertainty associated with current and future estimates.

The model results are an indicator of climate risk based on empirical relationships and a robust data set of juvenile fish observations. However, our models were not able to capture all potential climate-related changes that could affect juvenile abundance and in some cases model results were not consistent with expert opinion in the Climate Vulnerability Assessment. Furthermore, future predictions rely on air temperature and precipitation projections that may not translate directly to rearing conditions across the diverse RSP landscape. The model also does not consider how variability in adult returns influences juvenile abundance due to a lack of escapement data and modeling limitations for non-linear, density-dependent relationships. **Given these limitations, and the uncertainty associated with climate projections, results presented here should be considered a reference point to be considered in context with the climate vulnerability assessment described above.**

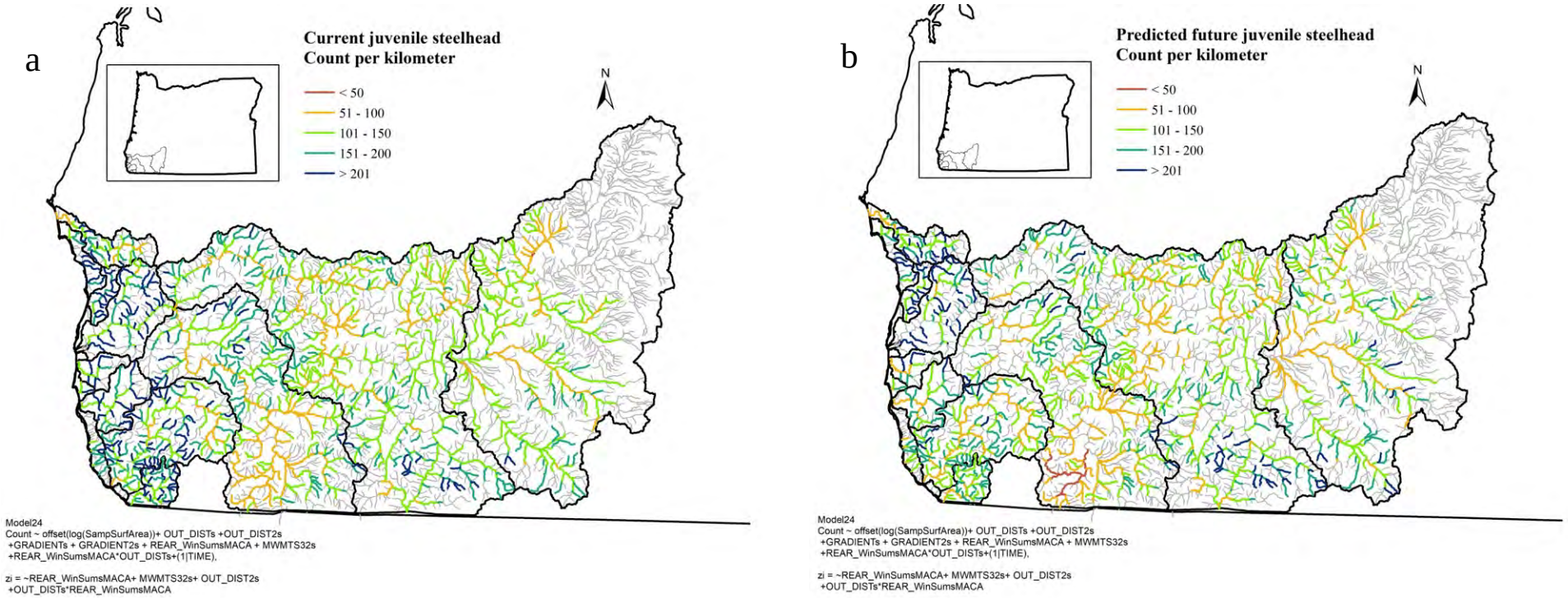


Figure A-IV: 13. Comparison of (a) current juvenile steelhead count per kilometer and (b) predicted future juvenile steelhead count per kilometer based on species distribution-abundance modeling. Juvenile steelhead count is the uncalibrated snorkel survey count in pools.

Table A-IV: 3. Predicted future change in juvenile steelhead abundance based on species distribution-abundance modeling and categorical risk ranking for each population. Categorical ranking was based on percent reduction in abundance between current and future predicted averages (< 10% = low; 10-33% = moderate; 34-66% = high; > 66% = very high). See text for details on climate change predictions and additional considerations when interpreting model results.

SMU	Stratum	Population	Predicted Change in Juvenile Steelhead Abundance (%)	Categorical Risk
WINTER STEELHEAD	Coastal	Elk	+10%	Low
		Euchre	-23%	Moderate
		Hunter	-23%	Moderate
		Pistol	-23%	Moderate
		Chetco	-21%	Moderate
		Winchuck	-23%	Moderate
	Rogue	Lower Rogue	-14%	Moderate
		Illinois	-16%	Moderate
		M Rogue/Applegate	-5%	Low
		Upper Rogue	+3%	Low

Appendix V – Stakeholder Process Report

This report is provided as a separate document at this link.

Appendix VI – Rogue–South Coast Angler Survey

Survey Design and Implementation

In October-November 2019, ODFW implemented an online public opinion survey with questions about angler preferences, experience with fisheries, and potential changes in fishery management in the Rogue–South Coast area. ODFW staff from the Rogue Watershed District, Fish Division Conservation and Recovery Program, and Management Resources Division developed the survey questions and response options. The primary intent of the survey was to gauge opinion among the angling public to inform development of the *Rogue–South Coast Multi-Species Conservation and Management Plan* (RSP), and many questions related to steelhead, coho salmon, and cutthroat trout fishing preferences and/or management. The survey also included questions about spring and fall Chinook salmon fishing to gather a full picture of angler opinion about fisheries in the Rogue–South Coast area.

The survey was implemented through the Allegiance Engage Platform. A link to the survey was distributed via e-mail to 5,000 anglers selected randomly from all annual license holders (Angling, Combined Angling, Sports Pac, etc.) with an e-mail address on file and a home address in Curry, Jackson, Josephine, Coos, Douglas, or Klamath counties. One introductory e-mail and two reminder e-mails were sent during a period of four weeks. A substantial number of e-mails (approximately 500) bounced back due to invalid e-mail addresses. In total, the survey link was active for 4 weeks, after which the survey closed and no further responses were accepted. The survey link was reactivated during the RSP stakeholder process in 2020 to allow stakeholder team members to take the survey. Responses from stakeholder team members were reported during the stakeholder process, and are not included in the results below.

Survey Response

A total of 350 respondents submitted survey results. Nearly one third of respondents indicating that they did not have experience with Rogue–South Coast fisheries and were not interested in completing the survey. Approximately 230 respondents completed the full survey, including 12 guides. Younger anglers responded to the survey at a lower rate than older anglers (**Figure A-VI: 1**). The margin of error for survey results is 6-8%.

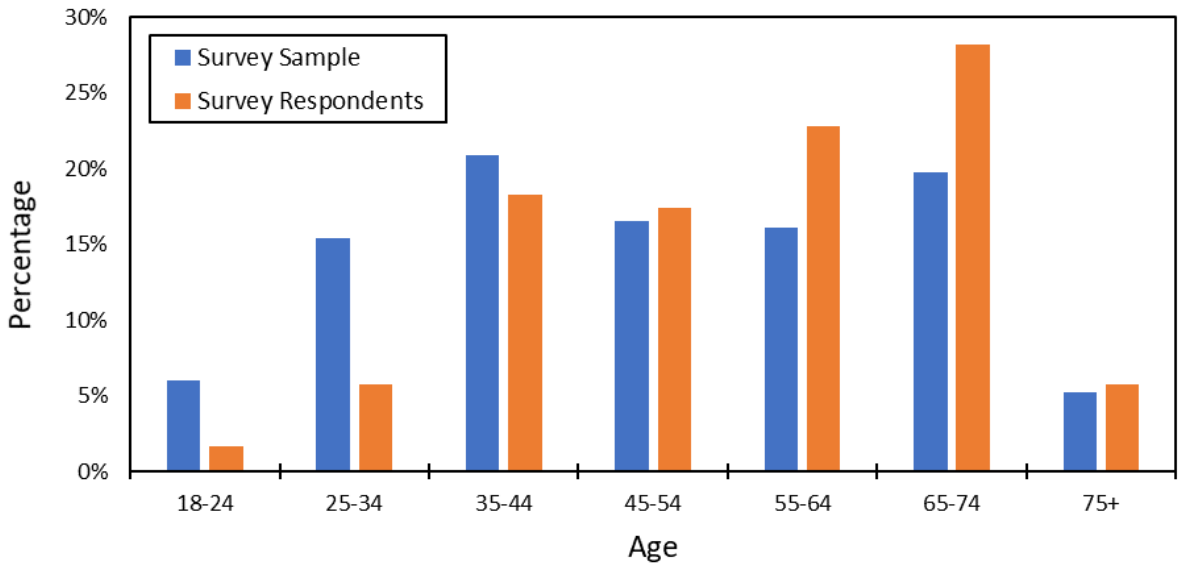


Figure A-VI: 1. Age distribution of anglers in the survey sample (blue bars) and respondents who completed the survey (orange bars).

Survey results

Section 1. Fishing Preferences

	Yes	*No*	Responses
1.1. Are you a professional fishing guide?	5%	95%	**240**
1.2. Do you belong to a fishing group or organization?	7%	93%	**239**

1.3. Do you currently receive information about fishing or angling regulation changes from the following ODFW sources?	*Yes*	*No*	Responses
Recreation Report	57%	43%	**232**
ODFW offices (walk in or call in)	23%	77%	**210**
E-mail / e-newsletter	42%	58%	**217**
Social media (Facebook, Twitter)	28%	72%	**208**
Mailed newsletter	4%	96%	**203**
Community meetings	10%	90%	**205**

1.4. Do you currently receive information about fishing or angling regulation changes from any other sources?	***Yes***	***No***	**Responses**
Angling groups	18%	82%	**210**
Word of mouth	76%	24%	**233**
Non-ODFW Social media (Facebook, Twitter)	27%	73%	**213**
TV news	34%	66%	**211**
Newspaper	37%	63%	**214**
Radio	17%	83%	**206**

1.5. How often do you fish in these locations in the Rogue–South Coast area?	***Never***	***1-2 days per year***	***3-10 days per year***	***>10 days per year***	**Responses**
Lower Rogue River and Bay	37%	30%	17%	16%	**226**
Illinois River	81%	15%	3%	1%	**217**
Middle Rogue River	41%	22%	25%	12%	**224**
Applegate River	64%	23%	8%	4%	**219**
Upper Rogue River	35%	25%	18%	22%	**222**
Elk River	68%	15%	11%	6%	**217**
Chetco River	60%	23%	10%	7%	**220**
Hunter Creek, Euchre Creek, Pistol River, or Winchuck River	78%	12%	6%	4%	**217**

1.6. How often do you fish for these species in the Rogue–South Coast area?	***Never***	***1-2 days per year***	***3-10 days per year***	***>10 days per year***	**Responses**
Winter Steelhead	29%	27%	26%	18%	**227**
Summer Steelhead	38%	27%	22%	13%	**221**
'Half-Pounder' Steelhead	53%	21%	17%	9%	**212**
Spring Chinook	37%	26%	23%	15%	**224**
Fall Chinook	35%	23%	22%	20%	**224**
Coho Salmon	59%	22%	11%	9%	**208**
Resident Cutthroat Trout	64%	18%	11%	7%	**212**
Sea-Run Cutthroat Trout	78%	12%	7%	3%	**206**

1.7. How often do you fish using these methods in the Rogue–South Coast area?	***Never***	***1-2 days per year***	***3-10 days per year***	***>10 days per year***	**Responses**
from a boat (any floating device)	23%	21%	24%	32%	**229**
from the bank (including bridges and docks)	24%	30%	25%	21%	**230**
with a guide	73%	18%	4%	5%	**219**
with bait	22%	20%	30%	29%	**230**
with artificial flies and lures	15%	28%	31%	25%	**228**
with fly fishing gear only	64%	17%	8%	11%	**216**

1.8. How important are the following factors in deciding where you fish and which species you fish for?	***Not Important***	***Slightly Important***	***Neutral***	***Moderately Important***	***Extremely Important***	**Responses**
Distance from home	10%	18%	19%	38%	15%	**233**
Angling regulations at site (gear restrictions, bag limits)	7%	10%	16%	34%	32%	**231**
Facilities at site (parking, boat ramps, bathrooms)	21%	18%	25%	24%	12%	**234**
Opportunity to harvest fish	4%	4%	11%	34%	46%	**235**
Opportunity to catch and release fish	21%	9%	30%	17%	23%	**235**
Limited interaction with other anglers	9%	9%	32%	33%	17%	**235**
Social interaction	39%	8%	38%	13%	3%	**234**

1.9. Which angling practices do you typically use when fishing for steelhead in the Rogue–South Coast area? Select all that apply.						
	Catch-and-release steelhead	**Harvest wild steelhead**	**Harvest hatchery steelhead**	**I did not fish for steelhead**	**Responses**	**%**
1	X	X	X		**22**	**9%**
2	X	X			**1**	**<1%**
3	X		X		**40**	**17%**
4	X				**35**	**15%**
5		X	X		**20**	**8%**
6		X			**6**	**3%**
7			X		**47**	**20%**
8				X	**66**	**28%**
				Total	**237**	

1.10. Which angling practices do you typically use when fishing for cutthroat trout in the Rogue–South Coast area? Select all that apply.					
	Catch-and-release cutthroat trout	**Harvest cutthroat trout**	**I did not fish for cutthroat trout**	**Responses**	**%**
1	X	X		**7**	**3%**
2	X			**65**	**27%**
3		X		**21**	**9%**
4			X	**144**	**61%**
			Total	**237**	

Section 2. Fishing Experience

2.1. How would you generally rate your fishing experience in the following locations?	***Very Poor***	***Poor***	***Fair***	***Good***	***Very Good***	***Did not fish in this location***	**Responses**
Lower Rogue River and Bay	9%	11%	22%	16%	7%	35%	**232**
Illinois River	3%	3%	7%	6%	0%	80%	**227**
Middle Rogue River	3%	11%	22%	17%	6%	40%	**231**
Applegate River	3%	5%	16%	7%	4%	66%	**228**
Upper Rogue River	5%	15%	17%	16%	11%	36%	**228**
Elk River	4%	5%	12%	7%	3%	69%	**230**
Chetco River	6%	6%	16%	7%	3%	63%	**226**
Hunter Creek, Euchre Creek, Pistol River, or Winchuck River	4%	3%	7%	4%	3%	79%	**224**

2.2. How would you generally rate your fishing experience for the following species in the Rogue–South Coast area?	***Very Poor***	***Poor***	***Fair***	***Good***	***Very Good***	***Did not fish for this species***	**Responses**
Winter Steelhead	5%	15%	27%	16%	6%	31%	**231**
Summer Steelhead	3%	9%	30%	10%	4%	43%	**230**
'Half-Pounder' Steelhead	4%	6%	18%	11%	6%	56%	**227**
Spring Chinook	10%	25%	15%	10%	1%	38%	**228**
Fall Chinook	6%	25%	17%	11%	4%	37%	**231**
Coho Salmon	7%	16%	7%	6%	2%	63%	**223**
Resident Cutthroat Trout	4%	6%	15%	9%	2%	64%	**226**
Sea-Run Cutthroat Trout	3%	7%	8%	3%	2%	77%	**221**

Section 3. Fishery Management

Do you agree or disagree with the following statements regarding fishery management?	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	**Responses**
3.1. The opportunity to harvest wild winter steelhead should continue in the Rogue–South Coast area.	7%	8%	21%	32%	32%	**231**
3.2. The size of wild winter steelhead that an angler can retain should be limited to reduce harvest of older and larger steelhead.	14%	17%	34%	24%	12%	**229**
3.3. The winter steelhead season in the Applegate River should be extended to mid-April even if this would increase disturbance of spawning wild steelhead.	16%	25%	44%	11%	5%	**231**
3.4. Seasonal barbless hook regulations should be implemented in Rogue Bay to protect wild coho salmon.	25%	17%	29%	19%	10%	**231**
3.5. Angling opportunity for cutthroat trout should be increased by allowing fishing in some streams that are currently closed to protect juvenile wild steelhead.	10%	20%	41%	22%	7%	**230**
3.6. Angling opportunity for cutthroat trout should be increased through higher bag limits in streams where harvest is currently allowed.	10%	19%	53%	12%	6%	**230**
3.7. The size of wild trout that an angler can retain should be limited to reduce harvest of sea-run cutthroat trout.	9%	19%	52%	11%	9%	**229**
3.8. ODFW anti-snagging gear restriction rules (one single point hook) should be in place in the upper Rogue River when spring Chinook salmon are present.	6%	10%	28%	34%	22%	**229**
3.9. Some pools in the Rogue River where spring Chinook hold during the summer should be seasonally closed to fishing to protect wild spring Chinook salmon (i.e. a specific reach of river).	13%	20%	30%	24%	13%	**225**
3.10. Some locations in the Rogue River that consistently produce complaints about illegal fishing activity should be closed to fishing (for example, Hays Falls/Nugget Falls, or the Hatchery Hole).	16%	19%	28%	21%	16%	**229**

Do you agree or disagree with the following statements regarding fishery management?	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	**Responses**
3.11. Rogue angling regulations should be simplified even if this reduces some fishing opportunities.	11%	24%	33%	18%	14%	**230**
3.12. Outboard motor use should be restricted in the lower Chetco River to reduce steelhead harvest if there is a conservation concern for wild steelhead.	13%	15%	37%	20%	15%	**229**
3.13. The number of professional fishing guides should be limited on the Chetco River or the Elk River.	10%	8%	40%	17%	25%	**230**

3.14. You disagreed with the statement: "The opportunity to harvest wild steelhead should continue in the Rogue–South Coast area." Indicate the reason(s) you disagree. Select all that apply.

	concern about the health of wild steelhead populations	**principle that wild steelhead should never be harvested**	**Other**	**Responses**	**%**
1	X			**16**	**48%**
2	X	X		**7**	**21%**
3	X		X	**3**	**9%**
4	X	X	X	**2**	**6%**
5		X		**2**	**6%**
6		X	X	**2**	**6%**
7			X	**1**	**3%**
			Total	**33**	

3.15. Please provide any specific comments regarding your answers above.

Responses: 29

3.16. In your own words, how can we improve your future fishing experience on the Rogue and other south coast rivers?

Responses: 182

Appendix VII – Management Triggers and Actions

Management Trigger	Purpose	Actions	Metrics/Indicators
General Trigger			
Conservation Status *Table 8*	Trigger management actions to improve a population's status **before** risk becomes too great.	If a status metric falls below the conservation status threshold for two consecutive years (two-year running average), **ODFW will** use adaptive management to modify or renew focus on management actions or strategies implemented as part of the RSP to address limiting factors. *Examples include, but are not limited to:* • Additional fishery enforcement • Additional fishery restrictions (*but also see detail for winter steelhead in Fishery Triggers below*) • Focus habitat protection/restoration effort in key habitat for the target SMU, stratum, or population • Take additional measures to reduce impacts of other species if warranted • Additional research and/or monitoring • Transition hatchery programs (primarily coho salmon) to conservation releases with approval from NOAA	• Adult Abundance (where available) • Juvenile Abundance • Juvenile Occupancy • Half Pounder Abundance **Note:** Additional status metrics may be developed based on proposed monitoring and/or research.
Hatchery Triggers			
Proportion of Hatchery Fish on the Spawning Grounds (pHOS) Limit *Action III.B.1*	Minimize mating between hatchery and wild fish.	If monitoring results indicate the multi-year pHOS average exceeds 10% for any population covered by the plan, **ODFW will** investigate the cause and take actions to reduce pHOS. *Examples include, but are not limited to:* • Alter release strategies (location, timing, etc.) • Encourage angler retention of hatchery fish • Enact additional efforts to capture returning hatchery fish not caught in the fishery • Conduct additional research or monitoring • Adjust hatchery production practices • Adjust the number of smolts released	Population-scale pHOS estimates. **Note:** genetic pHOS monitoring methods may be used in the future.
Hatchery Smolt Release Targets *Table 14*	Provide optimal harvest opportunities and meet mitigation goals while not impeding progress towards desired status targets for wild populations.	• If smolt releases, on average, are above targets, **ODFW will** adjust production consistent with agency policy [OAR 635-007-0545(17)(c)]. • If smolt releases, on average, are below targets, **ODFW will** investigate and attempt to correct factors limiting production.	Average hatchery smolt release number

Management Trigger	Purpose	Actions	Metrics/Indicators
Fishing Triggers			
Wild Winter Steelhead Harvest Rate Limit *Action IV.B.2* *Table 17*	Ensure that harvest does not become a limiting factor for winter steelhead populations.	If the harvest rate exceeds plan limits (10 or 15%), **ODFW will** take actions to reduce harvest in that population or population aggregate, prioritizing actions that maintain fishing opportunity and minimize angling regulation complexity. *Examples include, but are not limited to:* • Adjust angling regulations (locations open to wild steelhead harvest, season length, bag limit, etc.) • Consider other regulation changes in cooperation with the Oregon State Marine Board (e.g., restrictions on motor use).	Harvest rate (wild harvest / return)
Conservation Status *Table 8* *Table 17*	Trigger management actions to improve a population's status **before** risk becomes too great.	If a status metric falls below the conservation status threshold for two consecutive years (two-year running average), **ODFW will** take the following actions: • For winter steelhead, ODFW will either shift to catch and release or close the fishery, depending on location and metric value. • For other plan species, ODFW will evaluate current fishery impact, indicators of ocean productivity (e.g., ENSO/PDO conditions), and the potential biological costs and benefits from additional fishery restrictions before implementing actions to reduce harvest (cutthroat trout) or incidental mortality (coho, summer steelhead).	• Adult Abundance (where available) • Juvenile Abundance • Juvenile Occupancy • Half Pounder Abundance **Note:** Additional status metrics may be developed based on proposed monitoring.
Environmental Conditions *Action IV.A.1*	Make in season regulation changes to protect spawning fish, vulnerable fish or unique life histories when needed because of adverse conditions (low flow, extreme temperatures, etc.).	• When environmental conditions warrant additional protective regulations, **ODFW will** implement in season angling regulation changes that could include adjusting open locations or seasons, gear restrictions, size limits, or any other feasible regulation change. • ODFW is developing a climate adaptive angling regulation framework for in-season management through a separate statewide process.	Could include: • Streamflow • Temperature • Indicators of ocean productivity
Other *Action IV.A.1*	Use all available information, including new monitoring information (e.g., adult surveys) to inform management of fisheries.	• Although not a formal trigger in the plan, **ODFW will** use all available information to manage fisheries and inform the actions above. • The principle of adaptive management will be critical to implementing the correct actions in the correct locations to address the primary need, and also avoid unnecessarily constraining fisheries when viability is not at risk.	

Appendix VIII – References

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