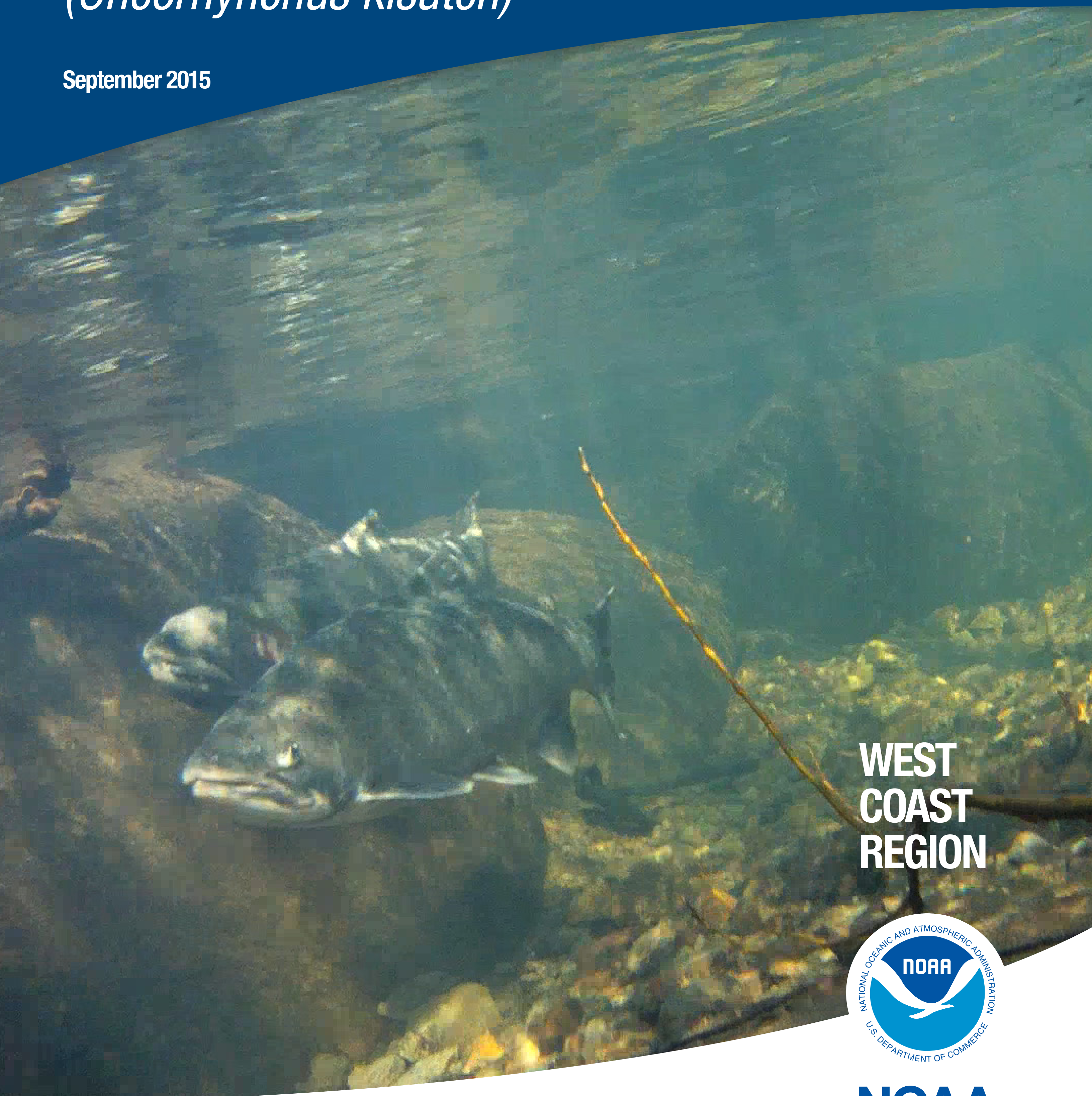
Proposed ESA Recovery Plan for Oregon Coast Coho Salmon *(Oncorhynchus kisutch)*

September 2015



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Acknowledgements

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Acronyms and Abbreviations

AQI	Aquatic Inventories Project
BLM	Bureau of Land Management
BOEM	Bureau of Ocean Energy Management
BMP	Best Management Practice
BRT	Biological Review Team
CCC	Central California Coast Coho
CLAMS	Coastal Landscape Analysis and Modeling Study
CREP	Conservation Reserve Enhancement Program
CWA	Clean Water Act
CWHIP	Coho Winter High Intrinsic Potential Habitat
CZARA	Coastal Zone Act Reauthorization Amendments
DPS	Distinct Population Segments
DSL	Division of State Lands
DSS	Decision Support System
ES	ESU Sustainability
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FMEP	Fishery Management Evaluation Plan
FMP	Forest Management Plan
FRN	Federal Register Notice
HGMP	Hatchery Genetic Management Plan
HIP	High Intrinsic Potential
HLFM	Habitat Limiting Factors Model
HQH	High Quality Habitat
IMST	Independent Multidisciplinary Team
IPCC	Intergovernmental Panel on Climate Change
NIS	Non-native Invasive Species
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration (NOAA Fisheries)
NRCS	National Resources Conservation Service
NWFP	Northwest Forest Plan
NWFSC	Northwest Fisheries Science Center
NWR	Northwest Region (of NOAA Fisheries) (Merged with Southwest Region to form West Coast Region (WCR) on 10/1/13)
OC coho	Oregon Coast Coho Salmon
OCCS	Oregon Coast Coho Salmon
OCCCP	Oregon Coast Coho Conservation Plan
OCMPS	Oregon Coast Multi-Species Plan

OCTRT	Oregon Coast Technical Review Team
ODA	Oregon Department of Agriculture
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODLCD	Oregon Department of Land Conservation and Development
ODOGAMI	Oregon Department of Geology and Mineral Industries
ODOT	Oregon Department of Transportation
ODSL	Oregon Department of State Lands
OFPA	Oregon Forest Practices Act
OGNRO	Oregon Governor's Natural Resources Office
OPI	Oregon Product Index
OWEB	Oregon Watershed Enhancement Board
PCE	Primary Constituent Elements
PCSRF	Pacific Coast Salmon Recovery Funds
PDO	Pacific Decadal Oscillation
PECE	Policy for Evaluating Conservation Efforts
PFMC	Pacific Fisheries Management Council
PHOS	Percent of Hatchery Origin Spawners
PNI	Proportion of Natural Influence
PNOS	Percent of Natural Origin Spawners
PVA	Population Viability Analysis
RMA	Riparian Management Areas
RME	Research, Management and Evaluation
SONCC	Southern Oregon Northern Coast Coho Salmon
STEP	Salmon and Trout Enhancement Program
SWCD	Soil and Water Conservation Districts
SWR	Southwest Region (of NOAA Fisheries)
TMDL	Total Maximum Daily Load
TRT	Technical Recovery Team
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
VSP	Viable Salmonid Populations
WCR	West Coast Region (of NOAA Fisheries)

Glossary

abundance: The number of fish in a population. See also **population**.

adaptive management: Adaptive management in salmon recovery planning is a method of decision making in the face of uncertainty. A plan for monitoring, evaluation, and feedback is incorporated into an overall implementation plan so that the results of actions can become feedback on design and implementation of future actions.

Amendment 13: A key element in the Pacific Fishery Management Council's Pacific Coast Salmon Fishery Management Plan that guides fisheries management for OC coho salmon.

anadromous fish: Species that are hatched in freshwater, migrate to and mature in salt water, and return to freshwater to spawn.

artificial propagation: Hatchery spawning and rearing of salmon, usually to the smolt stage.

AUC: For *area under the curve*. A statistical technique for estimating an annual total number of spawners from periodic spawner counts. See also **spawner**.

barrier: A blockage such as a waterfall, culvert, or rapid that impedes the movement of fish in a stream system.

BLM: For *U.S. Bureau of Land Management*.

broad sense recovery goals: Goals defined in the recovery planning process, in this case by the state of Oregon, that go beyond the requirements for delisting under the ESA, to address, for example, other legislative mandates or social, economic, and ecological values.

BRT: For *biological review team*. The team of scientists who evaluate scientific information for National Marine Fisheries Service status reviews.

catastrophic events: Sudden events that disastrously alter large areas of landscape. These can include floods, landslides, forest fires, and volcanic eruptions.

channel gradient: The slope of a stream reach.

CLAMS: *For Coastal Landscape Analysis and Modeling Study*. A cooperative project between the Oregon State University Department of Forestry and the U.S. Forest Service Pacific Northwest Forest Science Laboratory.

Co-managers: Federal, state, and tribal agencies that cooperatively manage salmon in the Pacific Northwest.

critical habitat: 1) specific areas within the geographical area occupied by the species at the time of listing, on which are found those physical or biological features that are essential to the conservation of the listed species and that may require special management considerations or protection, and 2) specific areas outside the geographical area occupied by the species at the time of listing that are essential for the conservation of a listed species. If a species is listed or critical habitat is designated, ESA section 7(a)(2) requires federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of such a species or to destroy or adversely modify its critical habitat (NMFS 2008).

delisting: Removing a species from the endangered species list.

delisting criteria: Criteria incorporated into ESA recovery plans that define both biological viability (biological criteria) and alleviation of the causes for decline (threats criteria based on the five listing factors in ESA section 4[a] [1]), and that, when met, would result in a determination that a species is no longer threatened or endangered and can be proposed for removal from the Federal list of threatened and endangered species. These criteria are a NMFS determination and may include both technical and policy considerations.

demographic risk: Risks to a small population resulting from population processes such as depensation or chance events in survival or reproductive success.

density effects: Survival of juvenile salmon may be influenced by their density. Survival is usually higher when density is low.

dependent populations: Populations that rely on immigration from surrounding populations to persist. Without these inputs, dependent populations would have a lower likelihood of persisting over 100 years.

depensation: The effect where a decrease in spawning stock leads to reduced survival or production of eggs through either 1) increased predation per egg given constant predator pressure, or 2) the allee effect (a positive relationship between population density and the reproduction and survival of individuals) with reduced likelihood of finding a mate.

direct threats: Human activities or natural events (e.g., road building, floodplain development, fish harvest, hatchery influences, and volcanoes) that immediately degrade recovery goals or objectives (See threats and indirect threats).

diversity: All the genetic and phenotypic (life history, behavioral, and morphological) variation within a population. Variations could include anadromy vs. lifelong residence in freshwater, fecundity, run timing, spawn timing, juvenile behavior, age at smolting, age at maturity, egg size, developmental rate, ocean distribution patterns, male and female spawning behavior, physiology, molecular genetic characteristics, etc.

DNA: For deoxyribonucleic acid. A complex molecule that carries an organism's heritable information. The two types of DNA commonly used to examine genetic variation are mitochondrial DNA (mtDNA), a circular molecule that is maternally inherited, and nuclear DNA, which is organized into a set of chromosomes. See also **electrophoresis.**

DPS: For distinct population segment. A population or group of populations of a vertebrate species that is discrete from other populations and significant to the biological species as a whole. See also ESU.

DSS: For decision support system. A computer application that assists users in using data and models to solve problems. It typically links and analyzes many pieces of data or models at a variety of scales, producing results that aid in decision making rather than replacing human judgment.

ecoregion: An integration of physical and biological factors such as geologic history, climate, and vegetation.

electrophoresis: The movement of charged particles in an electric field. This process has been developed as an analytical tool to detect genetic variation revealed by charge differences on proteins or molecular weight in DNA. See also **DNA**.

endangered species. A species in danger of extinction throughout all or a significant portion of its range. See also **ESA** and **threatened species**.

EPA: For *U.S. Environmental Protection Agency*.

ESA: For *U.S. Endangered Species Act*. Passed by Congress in 1973, its purpose is to provide a means to conserve the ecosystems on which endangered species and threatened species depend. See also **endangered species** and **threatened species**.

escapement: Usually refers to adult fish that escape from fisheries and natural mortality to reach the spawning grounds.

estuarine habitat: Areas available for feeding, rearing, and smolting in tidally influenced lower reaches of rivers. These include marshes, sloughs and other backwater areas, tidal swamps, and tide channels.

ESU: For *evolutionarily significant unit*. An ESU represents a distinct population segment of Pacific salmon under the Endangered Species Act that 1) is substantially reproductively isolated from conspecific populations and 2) represents an important component of the evolutionary legacy of the species. See also **DPS**.

exploitation rate: The proportion of adult fish from a population that die as a result of fisheries.

extinction: The loss of a species or ESU; may also be used for the extirpation of local populations.

factors for decline: These are factors identified that caused a species to decrease in abundance and distribution and become threatened or endangered.

fecundity: The number of offspring produced per female over her lifetime.

fourth-field and fifth-field hydrologic units: In the U.S. Geological Survey, hydrologic units have been divided at different scales. The area of a fourth-field hydrologic unit is 440,000 acres and a fifth-field hydrologic unit is between 40,000 and 250,000 acres.

freshwater habitat: Areas available for spawning, feeding, and rearing in freshwater.

fry: Young salmon that have emerged from the gravel and no longer have a yolk sack.

full seeding: In general, full seeding refers to having enough spawners to fully occupy available juvenile habitat with offspring. As applied in fisheries management for OC coho salmon, it refers to habitat quality sufficient for spawners to replace themselves when marine survival is 3 percent and is based on juvenile rearing capacity.

functionally independent population: A high-persistence population whose dynamics or extinction risk over a 100-year time frame is not substantially altered by exchanges of individuals with other populations (migration). Functionally independent populations are net donor populations that may provide migrants for other types of populations. This category is analogous to the independent populations of McElhany et al. (2000).

gene conservation group: Management area defined by Kostow (1995) to conserve genetic diversity in Oregon Coast coho salmon. See also **monitoring area**.

genetic bootstrap support: A measure of the confidence in a particular branch in a genetic tree. Specifically a large number of trees are created using randomly drawn sets of loci sampled from the data with replacement. The bootstrap value for a node is the proportion of the trees that have all the samples contained on that node.

Goals: We use the term goals to refer to broad, formal statements of the long term condition we seek to achieve (see objectives).

gradient: The slope of a stream segment.

habitat quality: The suitability of physical and biological features of an aquatic system to support salmon in the freshwater and estuarine system.

hatchery: A facility where artificial propagation of fish takes place.

historical abundance: The number of fish produced before the influence of European settlement.

HLFM: For *habitat limiting factors model.*

HTWG: For *Habitat Trends Working Group*. A joint group formed by NWFSC and ODFW and composed of scientists from each agency, with contributions by statisticians from the EPA and Oregon State University.

hydrology: The distribution and flow of water in an aquatic system.

IMST: For *Independent Multidisciplinary Science Team*. A scientific advisory body to the Oregon legislature and governor on watershed, forestry, agriculture, and fisheries science issues.

independent population: A population that historically would have a high likelihood of persisting in isolation from neighboring populations for 100 years.

integrated hatchery: In this case, the Cow Creek hatchery program where wild coho salmon are regularly taken into the hatchery program's broodstock. Typically more than 10 percent of the broodstock annually is of wild fish origin. In some years, 100 percent of the broodstock is wild fish.

Indirect threats: Human activities or natural events that drive, allow, or encourage direct threats – also referred to as 'root causes' of habitat degradation. (See threats and direct threats).

intrinsic potential: A modeled attribute of streams that includes the channel gradient, valley constraint, and mean annual discharge of water. Intrinsic potential in this report refers to a measure of potential coho salmon habitat quality. This index of potential habitat does not indicate current actual habitat quality.

isolation: The degree to which a population is unaffected by migration to and from other populations. As the influence of migration decreases, a population's isolation increases.

jack: A male coho salmon that matures at age-2 and returns from the ocean to spawn a year earlier than normal.

juvenile: A fish that has not matured sexually.

keystone species: A species that plays a pivotal role in establishing and maintaining the structure of an ecological community. The impact of a keystone species on the ecological community is more important than would be expected based on its biomass or relative abundance.

Landsat: For *land remote-sensing satellite.* The satellites supply global land surface images and data.

limiting factors: Factors that limit survival or abundance. They are usually related to habitat quantity or quality at different stages of the life cycle. Harvest and predation may also be limiting factors.

listed species: Species included on the List of Endangered and Threatened Species, authorized under the Endangered Species Act and maintained by the U.S. Fish and Wildlife Service and NMFS.

Listing Factors: From section 4(a)(1) of the ESA, the five listing factors are: A. The present or threatened destruction, modification, or curtailment of the species' habitat or range. B. Over-utilization for commercial, recreational, scientific, or educational purposes. C. Disease or predation D. The inadequacy of existing regulatory mechanisms E. Other natural or human-made factors affecting the species' continued existence

lowland habitat: Low-gradient stream habitat with slow currents, pools, and backwaters used by fish. This habitat is often converted to agricultural or urban use.

marine survival rate: The proportion of smolts entering the ocean that return as adults.

metacercaria: Tiny cysts that contain the intermediate stages of parasites.

metrics: Something that quantifies a characteristic of a situation or process; for example, the number of natural-origin salmon returning to spawn to a specific location is a metric for population abundance.

microsatellite: A class of repetitive DNA used for estimating genetic distances.

migrant: A fish that is born in one population but returns to another population to spawn.

migration: Movement of fish from one population to another.

migration rate: The proportion of spawners that migrate from one population to another. See also **stray rate**.

monitoring area: ODFW's monitoring areas are similar to but not identical to gene conservation groups. Additional information online at http://nrimp.dfw.state.or.us/crl/default.aspx?pn=AIProjOrPlnSalWtrshd.

See also **gene conservation group**.

morphology: The form and structure of an organism, with special emphasis on external features.

naturally produced fish: Fish that were spawned and reared in natural habitats, regardless of parental origin. See also **wild fish**.

NIS: For *nonindigenous species*.

NRR: For *natural return ratio*. The ratio N/T, where N is naturally produced spawners in one generation and T is total (hatchery produced + naturally produced) spawners in the previous generation.

Objectives: We use the term objectives to refer to formal statements of the outcomes (or intermediate results) and desired changes that we have identified as necessary to attain the goals. Objectives specify the desired changes in the factors (direct and indirect threats and opportunities) that we would like to achieve in the short and medium-term "A good objective meets the criteria of being *results oriented, measurable, time limited specific, and practical.*[1]

OCCS: For *Oregon coast coho salmon.*

OCN: For *Oregon coast natural coho salmon*. Often used by ODFW to distinguish from hatchery-raised fish and includes fish from the Southern Oregon/Northern California Coasts Coho Salmon ESU in Oregon.

OCSRI: For *Oregon Coastal Salmon Restoration Initiative*. Now the Oregon Plan for Salmon and Watersheds. A plan established by the State of Oregon in 1997 to restore salmon runs, improve water quality, and achieve healthy watersheds and strong communities throughout the state.

ODF: For *Oregon Department of Forestry.*

ODFW: For *Oregon Department of Fish and Wildlife.*

OFPBDS: For *Oregon Fish Passage Barrier Data Set*.

ONCC TRT: For *Oregon and Northern California Coast Technical Recovery Team*.

Open Standards: Developed by the Conservation Measures Partnership, this is a publicly available approach to project design, management, and monitoring in order to help practitioners improve the practice of conservation, meant to describe the general process necessary for the successful implementation of conservation projects.[2]

http://www.conservationmeasures.org/initiatives/standards-for-project-management

OPI: For *Oregon Production Index*.

OWEB: For *Oregon Watershed Enhancement Board*.

OWRD: For *Oregon Water Resources Department.*

parasite prevalence: The number of hosts infected with one or more individuals of a particular parasite species (or taxonomic group) divided by the number of hosts examined for that parasite species.

parr: The life stage of salmonids that occurs after fry and is generally recognizable by dark vertical bars (parr marks) on the sides of the fish.

PDO: For Pacific Decadal Oscillation. A long-term pattern of Pacific Ocean climate variability, with events lasting 20 to 30 years and oscillating between warm and cool regimes.

[1] Open Standards for the Practice of Conservation
[2] Conservation Measures Partnership: Open Standards for the Practice of Conservation from Version 3.0 (April 2013)

persistent population: One that is able to persist (i.e., not go extinct) over a 100-year period without support from other populations. This includes an ability to survive prolonged periods of adverse environmental conditions, which may be expected to occur at least once in the 100-year time frame.

PFMC: For *Pacific Fishery Management Council*.

phenotype: Any observable characteristic of an organism, such as its external appearance, development, biochemical or physiological properties, or behavior.

piscivorous: (Adj.) Describes fish that eat other fish.

PIT tag: For *passive integrated transponder tag*. An injectable, internal, radio-type tag that allows unique identification of a marked fish passing within a few inches of a monitoring site.

population: A group of fish of the same species that spawns in a particular locality at a particular season and does not interbreed substantially with fish from any other group. See also **abundance**.

population classification: The grouping of populations into functionally independent, potentially independent, and dependent classes.

population dynamics: Changes in the number, age, and sex of individuals in a population over time, and the factors that influence those changes. Five components of populations that are the basis of population dynamics are birth, death, sex ratio, age structure, and dispersal.

population identification: Delineating the boundaries of historical populations.

population structure: This includes measures of age, density, and growth of fish populations.

potentially independent population: High-persistence population whose population dynamics are substantially influenced by periodic immigration from other populations. In the event of the decline or disappearance of migrants from other populations, a potentially independent population could become a functionally independent population.

production: The number of fish produced by a population in a year.

productivity: The rate at which a population is able to produce fish, such as the average number of surviving offspring per parent. Productivity is used as an indicator of a population's ability to sustain itself or its ability to rebound from low numbers. The terms "population growth rate" and "population productivity" are interchangeable when referring to measures of population production over an entire life cycle. Can be expressed as the number of recruits (adults) per spawner or the number of smolts per spawner.

protective efforts: Section 4(b) of the ESA states in part: "The Secretary shall make determinations required by subsection (a)(1) solely on the basis of the best scientific and commercial data available to him after conducting a review of the status of the species and after taking into account those efforts, if any, being made by any State or foreign nation, or any political subdivision of a State or foreign nation, to protect such species, whether by predator control, protection of habitat and food supply, or other conservation practices, within any area under its jurisdiction, or on the high seas." While this requires the USFWS and NMFS "to take into account all conservation efforts being made to protect a species, the Policy for the

Evaluation of Conservation Efforts when making listing decisions (PECE)[3] identifies criteria (the agencies) will use in determining whether formalized conservation efforts that have yet to be implemented or to show effectiveness contribute to making listing a species as threatened or endangered unnecessary. The policy applies to conservation efforts identified in conservation agreements, conservation plans, management plans, or similar documents developed by Federal agencies, State and local governments, Tribal governments, businesses, organizations, and individuals."[4]

recovery: The reestablishment of a threatened or endangered species to a self-sustaining level in its natural ecosystem (i.e., to the point where the protective measures of the ESA are no longer necessary).

recovery domain: The area and species for which a TRT is responsible.

recovery plan: A document identifying actions needed to make populations of naturally produced fish comprising the OCCS ESU sufficiently abundant, productive, and diverse so that the ESU as a whole will be self-sustaining and will provide environmental, cultural, and economic benefits. A recovery plan also includes goals and criteria by which to measure the ESU's achievement of recovery, and an estimate of the time and cost required to carry out the actions needed to achieve the plan's goals.

recovery scenario. Sequence of events expected to lead to recovery of Oregon coast coho salmon.

redd: A nest constructed by female salmonids in streambed gravels where eggs are fertilized and deposited.

run timing: The time of year (usually identified by week) when spawning salmon return to the spawning beds.

salmonid: Fish of the family Salmonidae, including salmon, trout, and char.

significant: Biological significance refers to an effect that has a noteworthy impact on health or survival.

smolt: A life stage of salmon that occurs just before the fish leaves freshwater. Smolting is the physiological process that allows salmon to make the transition from freshwater to salt water.

smolt capacity: The maximum number of smolts a basin can produce. Smolt capacity is related to habitat quantity and quality.

spawner: Adult fish on the spawning grounds. **spawner survey.** Effort to estimate the number of adult fish on spawning grounds. It uses counts of redds and fish carcasses to estimate escapement and identify habitat. Annual surveys can be used to compare the relative magnitude of spawning activity between years.

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[3] http://www.gpo.gov/fdsys/granule/FR-2003-03-28/03-7364
[4] 68FR15100

species: Biological definition: A group of organisms formally recognized by the scientific community as distinct from other groups. Legal definition: refers to joint policy of the USFWS and NMFS that considers a species as defined by the ESA to include biological species, subspecies, and DPSs. In this Plan, 'the species' refers to the Oregon Coast coho salmon ESU.

stakeholders: Agencies, groups, or private citizens with an interest in recovery planning, or those who will be affected by recovery planning and actions.

stratum: A group of salmonid populations that is geographically and genetically cohesive. The stratum is a level of organization between demographically independent populations and the ESU or DPS.

stray rate: As used in this document, stray rate refers to the number of spawning adults that return to a stream other than their natal stream within a basin. See also **migration rate**.

sustainability: An attribute of a population that persists over a long period of time and is able to maintain its genetic legacy and long-term adaptive potential for the foreseeable future.

sustainable population (or **ESU**): One that, in addition to being persistent, is also able to maintain its genetic legacy and long-term adaptive potential for the foreseeable future. "Sustainable" implies stability of habitat availability and other conditions necessary for the full expression of the population's (or ESU's) life history diversity into the foreseeable future. As used in this plan, sustainable and sustainability are the same, or nearly the same, as viable and viability. For clarity, after we introduce both terms, we use the term sustainable in place of viable, except where it used in a quote or other specific application of the TRT or BRT such as viable salmonid population.

Technical Recovery Team (TRT): Teams convened by NMFS to develop technical products related to recovery planning. Planning forums unique to specific states, tribes, or regions may use TRT and other technical products to identify recovery actions.

threats: Human activities or natural events (e.g., road building, floodplain development, fish harvest, hatchery influences, volcanoes) that cause or contribute to limiting factors. Threats may exist in the present or be likely to occur in the future.

threatened species: A species not presently in danger of extinction, but likely to become so in the foreseeable future. See also **endangered species** and **ESA**.

TRT: For *technical recovery team*. The TRT establishes biologically based ESA recovery goals for listed salmonids within a given recovery domain. Members serve as science advisors to the recovery planning phase.

USFS: For *U.S. Forest Service*.

valley constraint: The valley width available for a stream or river to move between valley slopes.

Viable, viability: The likelihood that a population will sustain itself over a 100-year time frame. As used in this plan, viable and viability are the same, or nearly the same, as sustainable and sustainability.

Viability criteria: A prescription of a population conservation program that will lead to the ESU having a negligible risk of extinction over a 100-year time frame.

VSP: For *viable salmonid population*. An independent population of any Pacific salmonid (genus *Oncorhynchus*) that has a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a long time frame (**McElhany** et al. 2000).

Warm water fish: Spiny-rayed fish such as sculpins, minnows, darters, bass, walleye, crappie, and bluegill that generally tolerate or thrive in warm water.

Wild fish: Fish whose ancestors have always lived in natural habitats, that is, those with no hatchery heritage. See also **naturally produced fish**.

Oregon Coast Coho Salmon Recovery Plan Summary

Introduction

This recovery plan serves as a roadmap for the protection and recovery of Oregon Coast coho salmon (*Oncorhynchus kisutch*). NOAA's National Marine Fisheries Service (NMFS) first listed Oregon Coast coho salmon as a threatened species under the Endangered Species Act (ESA) in 1998. NMFS relisted the species in 2008, and reaffirmed the listing status in 2011 (see Section 1 for a chronology and explanation, including the results of federal court decisions). NMFS will retain this listing status until the ESA goal is met ─ improving the status of the species and the habitat upon which it depends to the point where protection under the ESA is no longer required.

Oregon Coast coho salmon spawn and rear in Oregon rivers and lakes along the coast of the Pacific Ocean. The species' range includes the ocean and the Oregon Coast from the Necanicum River near Seaside on the north to the Sixes River near Port Orford on the south (Figure ES-1).

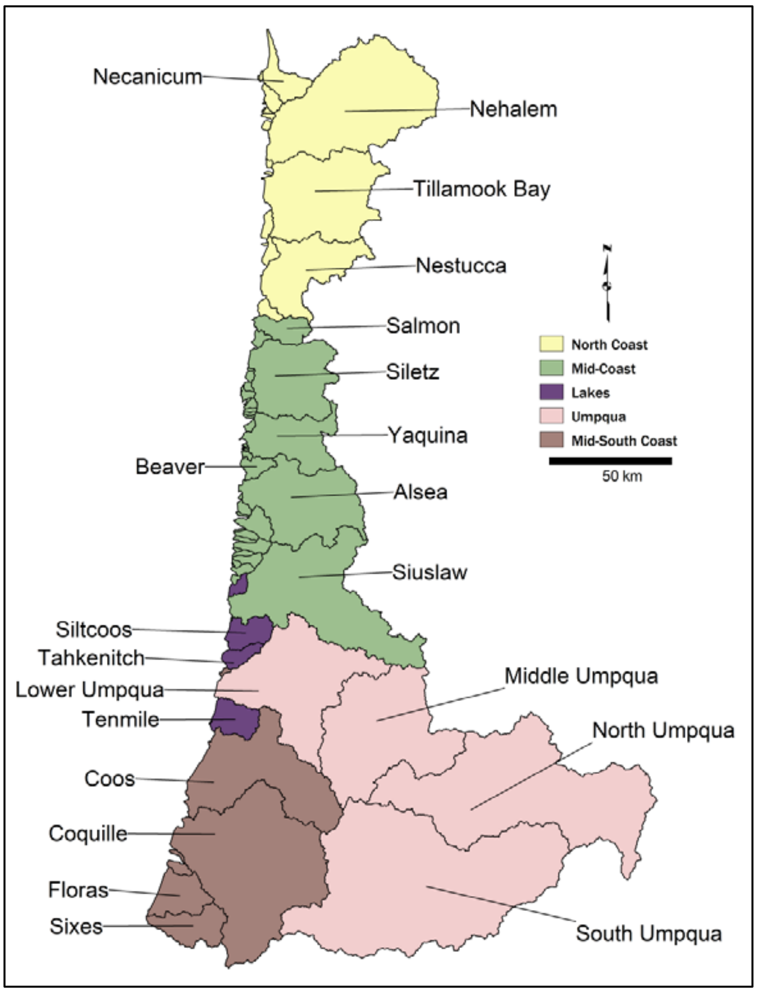

Figure ES-1. Map of Oregon Coast Coho Salmon ESU showing populations and strata (larger population groupings).

This recovery plan aims to establish self-sustaining, naturally spawning Oregon Coast coho salmon populations that are sufficiently abundant, productive, and diverse to persist in the long term, defined as the next 100 years. The species needs to be resilient enough to survive catastrophic changes in the environment, including events such climate change and decreases in ocean productivity. Overall, the recovery direction for Oregon Coast coho salmon has a single overriding focus: restoring degraded habitat and the ecosystem processes that affect the habitat. Most recommended actions target the protection and restoration of freshwater and estuarine habitats, especially habitats that support juvenile rearing coho salmon.

History and Perspective

During the 1800s and early 1900s, strong runs of coho salmon returned each year to rivers and lakes along the Oregon coast. The spawning run is estimated to have been in the range of one to two million during periods of favorable ocean conditions. The run began to decline in the mid-1900s and dropped to record lows ─ around 20,000 adults ─ in the late 1990s, leading to its listing under the ESA. (See Figure ES–2.) We attribute the species' drastic decline to multiple factors, including high harvest rates, high levels of production of hatchery coho salmon, significantly degraded habitat, and periods of poor ocean conditions.

Improvements made by multiple parties over the last twenty years have contributed to reversing the species' decline. With variable ocean conditions, recent coho salmon returns have fluctuated from a modern-era record of 350,000 down to approximately 100,000 (Figure ES-2) While the current status of Oregon Coast coho salmon is better than in the past, it remains unclear whether recent levels of abundance can be sustained. Adding to concern, recent projections indicate that we may be entering a new period of poor ocean conditions, which could result in reduced ocean survival rates and decreased ESU sustainability. This suggests that more actions are needed to ensure the species is sustainable and no longer needs ESA protection.

Why a recovery plan?

Oregon Coast coho salmon, which spawn and rear in rivers, streams and lakes along the coast of the Pacific Ocean, remain at risk of extinction. The once strong salmon run began to decline in the mid-1900s and dropped to record lows in the 1990s. This sharp decline persuaded NMFS to list the species as Threatened under the federal Endangered Species Act, and triggered many changes to stem the decline and bring the run back to a healthy level.

Many more coho salmon now return to Oregon's coastal stream systems than at the time of ESA listing but the run is still vulnerable, with the number of returning adults sometimes fluctuating greatly between years. The primary remaining bottleneck is lower than needed survival and productivity as the fish grow from eggs to smolts. More work is needed to take the species the remaining distance to reach a naturally self-sustaining level and ensure its long- term survival.

What is needed to reach recovery?

The recovery strategy aims to establish sustainable naturally spawning coho salmon populations that are sufficiently abundant, productive, and diverse and are likely to persist in the long term, defined as the next 100 years. The strategy's primary focus is to protect and restore the freshwater and estuarine rearing habitats upon which egg-to-smolt survival depends.

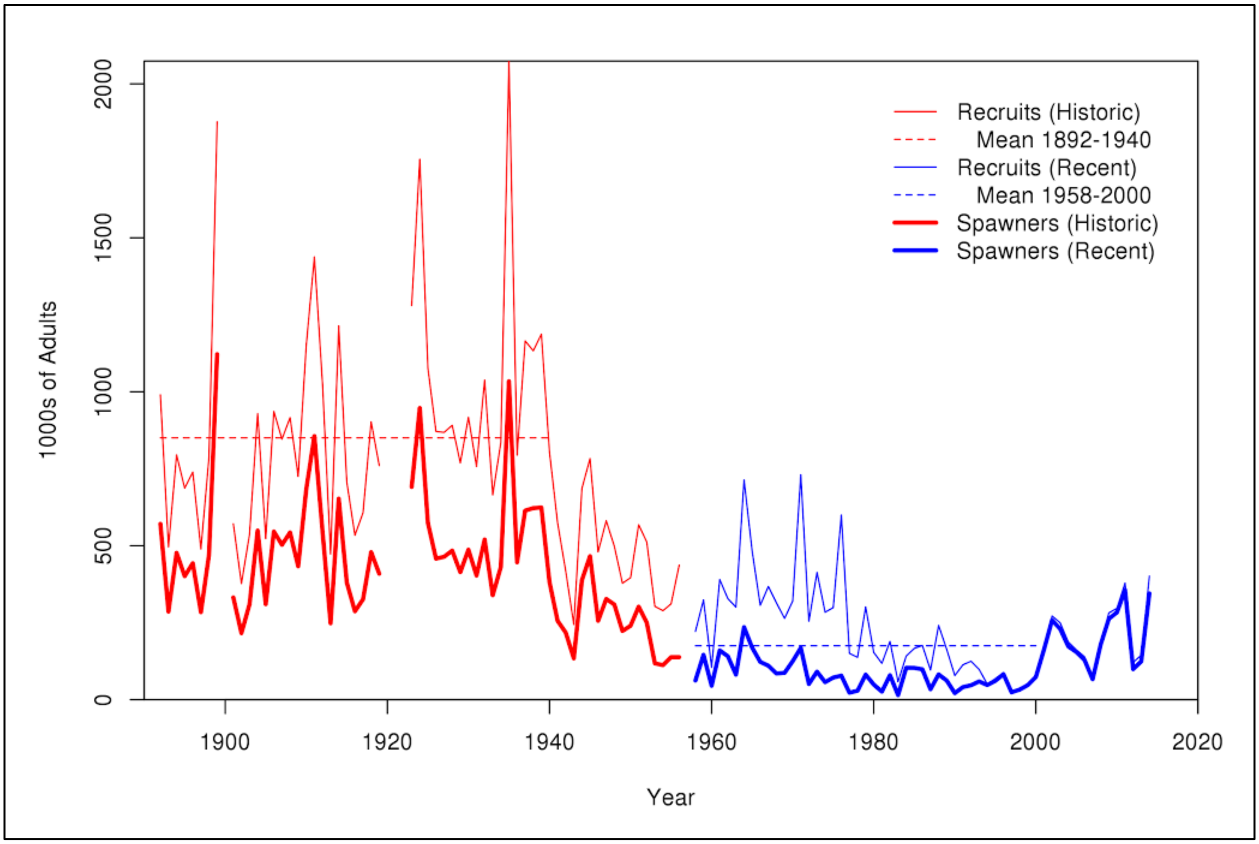

Figure ES-2. Historical Oregon Coast coho salmon abundance (1892-1958) compared to recent (1958-2014) estimates of spawner abundance and pre-harvest recruits. Horizontal lines are the geometric mean recruits for 1892–1940 and 1960–2009. Analysis based on data from Cleaver 1951, Mullen 1981a, and Mullen 1981b; recent data from Wainwright et al. 2008, ODFW 2009a, and Wainwright 2015.

About This Recovery Plan

This Recovery Plan (or Plan) provides information required to satisfy section 4(f) of the ESA. It describes: (1) recovery goals and objectives (measurable criteria which, when met, will result in a determination that the species be removed from the threatened and endangered species list); (2) site-specific management actions necessary to achieve the Plan's goals; and (3) estimates of the time required and cost to carry out the actions. It also describes factors and threats leading to the species ESA listing, as well as those that currently affect the species' sustainability. It includes recommendations for monitoring and evaluation and adaptive management to fine-tune the course towards recovery. NMFS intends to use the Plan to organize and coordinate recovery of the species working with local, state, tribal, and federal partners.

Building on Current Efforts

The Plan builds upon and complements ongoing conservation, restoration and research efforts for Oregon Coast coho salmon. NMFS developed the Plan through a collaborative effort that rides on a related planning process involving state and federal agencies, tribal and local governments, other regional stakeholder teams, representatives of industry and environmental groups, and individual landowners and the public. Through this approach, we aim to effectively address ESA goals while respecting local interests and needs based on social, economic, and ecological values. In particular, this federal recovery plan relies to a great extent on the direction defined in the state's Oregon Coast Coho Conservation Plan (OCCCP or conservation plan). Our goals and the state's goals for Oregon Coast coho salmon are different but compatible. While this federal recovery plan focuses on getting to delisting, the state's conservation plan goals are broader and go beyond the ESA requirements. Consequently, our recovery plan incorporates many of the state conservation plan's strategies and actions, but it also includes additional measures. In particular, we recommend that the state enhance protective regulatory mechanisms that will help ensure that Oregon Coast coho salmon can meet ESA delisting criteria on activities such as agricultural, floodplain, and forest practices and others that affect water quality (see Section 6, Recovery Strategies and Actions).

NMFS will rely, to a great extent, on voluntary efforts by local citizens, landowners, and regional agencies and jurisdictions to implement actions identified in this Plan. Recovery plans are advisory, not regulatory, documents. NMFS intends to use the Plan to support the Oregon Coast Coho Conservation Plan as well as to inform federal, state and local agencies and interested stakeholders about what will be needed to recover Oregon Coast coho salmon to the point where they can be self-sustaining for the long term and can be removed from the list of threatened and endangered species.

Oregon Coast Coho Salmon and Habitat

Oregon Coast coho salmon are an evolutionarily significant unit (ESU) of coho salmon, a wide-ranging species of Pacific salmon. Coho salmon spawn in rivers and rear in streams and estuaries around the Pacific Rim from Monterey Bay in California north to Point Hope, Alaska; through the Aleutian Islands; and from the Anadyr River in Russia south to Korea and northern Hokkaido, Japan.

> **What is an evolutionarily significant unit (ESU)?**
>
> An ESU is a group of Pacific salmon that is (1) substantially reproductively isolated from other groups of the same species and (2) represents an important component of the evolutionary legacy of the species. ESUs are defined based on geographic range as well as genetic, behavioral, and other traits.
> All Pacific salmon belong to the family Salmonidae and the genus Oncorhynchus. Coho Salmon belong to the species (*Oncorhynchus kisutch).*

The Oregon Coast coho salmon ESU includes the Pacific Ocean and the freshwater and estuarine habitat (rivers, streams and lakes) along the Oregon Coast from the Necanicum River near Seaside on the north to the Sixes River near Port Orford on the south. These rivers, streams, estuaries, and lakes lie within the Coast Range ecoregion, which displays low mountains covered by highly productive, rain-drenched coniferous forests. Rivers in this ESU flow from the mountains of the Coast Range, with the exception of the Umpqua River, which extends east through the Coast Range to drain the Cascade Mountains. Most of the rivers transition to estuaries before reaching the Pacific Ocean.

The anadromous life cycle for coho salmon begins in their home stream, normally a small tributary with moderate to low gradient stream reaches. After emerging from the gravel, the small fish seek cool, slow moving stream reaches with quiet areas such as backwater pools, beaver ponds, and side channels. They generally spend one summer and one winter in these freshwater areas before migrating as juveniles through the estuaries to the ocean. Low gradient stream reaches with complex stream habitat are particularly important for winter survival of juvenile coho salmon because they provide shelter when flows are high, water temperatures are low, and food availability is limited. They are also important for summer survival, when high water temperatures can threaten the fitness and survival of juvenile salmon. Since coho salmon spend up to half of their lives in freshwater, the condition of the winter and summer juvenile rearing habitat is a key factor in their survival.

Most juvenile coho salmon migrate to the ocean as smolts in the spring, typically from late April until early June, although migration strategies are important as a feature of life history diversity. Coho salmon smolts may be present in estuaries for a period of weeks to perhaps a month during their migration to the ocean. During their stay in the estuaries they seek low-salinity gradients to grow and slowly acclimate to saltwater. They reside in shallow areas and side channels, as well as deeper channels and plumes of freshwater extending offshore at varying times of the year. Most adult coho salmon return to natal tributaries from September to November as 3-year-old fish, after spending two summers in the ocean (Figure ES-3). The early ocean life stage is believed to be a critical time for the fish since significant marine mortality can occur during the first two weeks to months of ocean life.

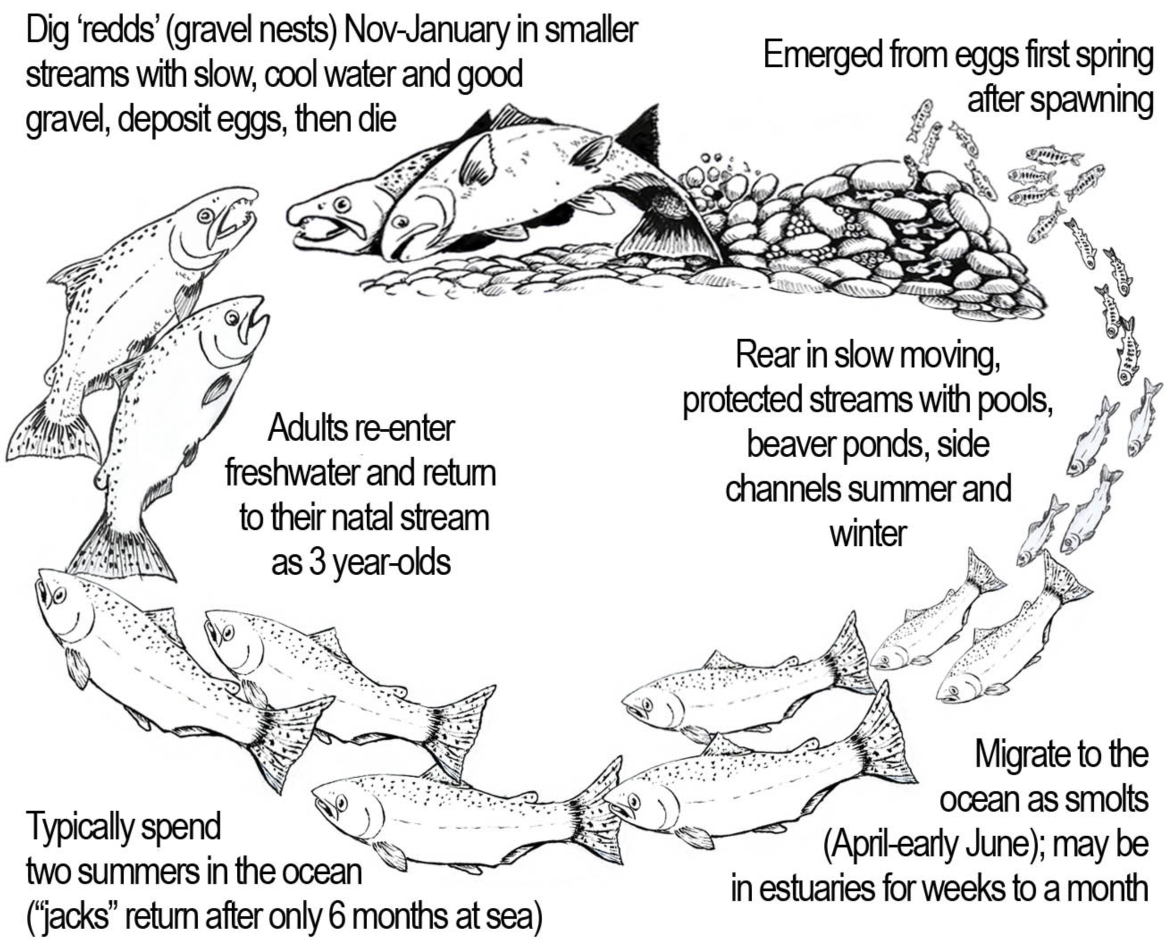

Figure ES-3. Oregon Coast coho salmon life cycle.

Listing Factors and Threats Analysis

What are limiting factors and threats?

Limiting factors are the biological and physical conditions that limit a species' viability (e.g. high water temperature).

Threats are the human activities or natural processes that cause the limiting factors. The term "threats" carries a negative connotation; however, they are often legitimate and necessary human activities that at times may have unintended negative consequences on fish populations. These activities can be managed to minimize or eliminate the negative impacts.

Factors Leading to ESA Listing

Many human activities contributed to the ESA listing of Oregon Coast coho salmon as a threatened species. NMFS determined in 1998: "For coho salmon populations in Oregon, the present depressed condition is the result of several longstanding, human-induced factors (e.g., habitat degradation, water diversions, harvest, and artificial propagation) that serve to exacerbate the adverse effects of natural environmental variability from such factors as drought, floods, and poor ocean conditions." A status review in 2003 by NMFS' biological review team found that risks posed by hatchery fish and fisheries had been greatly remedied, but questioned whether the ESU's deteriorated freshwater habitat was capable of supporting levels of coho productivity needed to sustain the species during periods of poor ocean conditions.

Factors Affecting ESU Status Today

Several threats that contributed to the species' ESA listing, especially hatchery and harvest practices, have been addressed and now present little harm to the coho salmon populations. Other threats continue to threaten sustainability of the Oregon Coast coho salmon ESU (see Figure ES-4). We summarized the threats in Table ES-1 based on the listing factors described in the ESA section 4(a)(1):

A. The present or threatened destruction, modification, or curtailment of the species' habitat or range
B. Over-utilization for commercial, recreational, scientific, or educational purposes
C. Disease or predation
D. The inadequacy of existing regulatory mechanisms
E. Other natural or human-made factors affecting the species' continued existence

Today, Oregon Coast coho salmon are primarily affected by threats posed in two of these five categories: degraded habitat and the inadequacy of existing regulatory mechanisms (related to habitat). A 2012 review by NMFS' biological review team, found that the combination of past and ongoing forest management practices, along with lowland agricultural and urban development, has resulted in a situation where the areas of highest potential habitat capacity for coho salmon are now severely degraded. The review team determined that the long-term decline in Oregon Coast coho salmon productivity reflected deteriorating conditions in freshwater habitat, and that the remaining quality of the habitat may not be high enough to sustain species productivity during cycles of poor ocean conditions. This situation leaves the ESU vulnerable to near-term and long-term declines in ocean productivity, as well as to climate effects in freshwater.

Loss of stream habitat complexity to support overwinter rearing of juvenile coho salmon is especially a concern. A 2005 state of Oregon assessment identified reduced stream complexity as the primary or secondary limiting factor for all independent Oregon Coast coho salmon populations. This instream habitat is critical to produce high enough juvenile survival to sustain productivity, particularly during periods of poor ocean conditions. Habitat conditions that create sufficient complexity for juvenile rearing and overwintering include large wood, pools, connections to side channels and off-channel alcoves, beaver ponds, lakes, and connections to wetlands and backwater areas. The benefits to coho salmon from these habitat conditions are maintained through connection to the surrounding landscape. Beaver provide considerable help in providing this connection and in maintaining proper watershed functioning in Oregon coast streams.

Degraded water quality, including high water temperatures, increased fine sediment levels, and pollutants reduce coho salmon production in some population areas. The state's 2005 assessment identified water quality as the primary or secondary limiting factors for 13 of the 21 coho salmon populations in the ESU.

Impaired fish passage due to culverts, stream crossings, tide gates and other barriers also remains a concern in some streams and estuary areas, although many past barriers have been removed or redesigned to improve fish access. In addition, the coho salmon populations in lake areas and some lower stream reaches are further affected by predation from introduced warm water fishes, such as smallmouth and largemouth bass. Concerns posed by summer water temperature and predation rates may become more important in the future due to climate change, and there is increasing concern about predation from birds and marine mammals.

Table ES-1. Primary ESU-level threats and limiting factors for Oregon Coast coho salmon.

Listing Factor	Threat	Primary Limiting factors	Current level of Concern
LF A- *Destruction, modification or curtailment of habitat or range*	Historical, current and future land use activities that affect watershed functions that support coho habitat	Loss of stream complexity	High
		Degraded water quality	High
		Blocked/hindered passage	High
LF B- *Overutilization*	Overharvest of OC coho salmon in ocean and freshwater tributaries	Reduced abundance and productivity due to harvest mortality	Low
LF C- *Disease or predation*	Disease and increase in parasites	Reduced productivity due to increased infection	Low
	Predation from birds, marine mammals and warm water fishes	Reduces coho abundance and productivity	Medium
LF D- *Inadequacy of existing regulatory mechanisms*	Ineffective regulatory mechanisms	Lack of adequate habitat protection	High
LF E- *Other factors*	Hatchery operations and releases	Competition, predation and reduced diversity	Low
	Changes in ocean conditions	Reduced fitness and survival, thereby abundance and productivity	High
	Climate change	Further habitat degradation and thereby productivity	Medium- High

Recovery Goals and Delisting Criteria

The recovery plan provides recovery goals and criteria that NMFS expects to use in future status reviews of the Oregon Coast coho salmon ESU. The primary goal for the species is recovery to a self-sustaining condition. In the simplest terms, we will remove Oregon Coast coho salmon from ESA listing when we determine that:

- The species is sufficiently recovered from a biological perspective, and
- Factors that led to listing have been reduced or eliminated to the point where federal protection under the ESA is no longer needed.

NMFS aims to achieve this goal while recognizing broader needs ─ other social, cultural and economic values ─ regarding the Oregon Coast as well as the listed species. Section 4 describes the recovery goal and criteria.

ESA Recovery Goal: Our primary goal is that the ecosystems upon which Oregon Coast coho salmon depend are conserved such that the ESU is sustainable and persistent and no longer needs federal protection under the ESA.

Delisting Criteria: NMFS applies two kinds of ESA recovery, or delisting, criteria to determine if the recovery goal for the ESU has been achieved. The first, biological recovery criteria, examines the biological health (viability - sustainability and persistence) of the species (§4.2). The second, threats criteria, relate to the five listing factors in ESA section 4(a)(1) and describes the human activities (threats) that contributed to the decline in the status of the species. Together, the biological recovery criteria and threats criteria, described in Section 4, make up the "objective, measurable criteria" [delisting criteria] required under section 4(f)(1)(B)(ii) for the delisting decision (See Figure ES-4).

The two types of criteria allow NMFS to make a delisting decision based on the best available science concerning the current status of the species and its prospects for long-term survival.

1. Biological viability criteria define population or demographic parameters. The NMFS Technical Memorandum *Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units* (McElhany et al. 2000) provides guidance for defining biological viability criteria. Consistent with this guidance, the Oregon and Northern California Coasts technical recovery team (TRT) defined viable salmonid population (VSP) parameters in terms of four measures: population abundance, population growth rate (productivity), population spatial structure, and diversity. These four measures (discussed in Section 4.2) form the basis for our evaluations of the individual salmon populations that comprise the species under the ESA.

   The technical recovery team's biological viability criteria focus on coho salmon status at the population level, and then "roll up" the combined status of the populations to determine the status of the ESU. The team's approach gathers the populations into five "strata", groups of populations with similar traits, and then combines the status of the five strata to determine the status of the ESU. The technical recovery team developed two principle elements within the biological criteria:

- Most of the independent populations had to be sustainable in each stratum.
- All five strata had to be sustainable for the whole ESU to be sustainable.

The team also considered risks that operate at a broader ESU-level scale. These risks relate to how populations interact with each other to preserve diversity, how multiple populations might be vulnerable to catastrophic events, and how ecosystem processes alter habitat features.

2. Listing Factors/ Threats criteria. At the time of a status review for the Oregon Coast coho salmon ESU, NMFS will examine whether the five listing factors previously described have been sufficiently abated to warrant delisting.

   Section 4.3.2 describes goals and criteria for assessing each of the five listing factors. Addressing these criteria will help to ensure that underlying causes of decline have been addressed and mitigated before the Oregon Coast coho salmon ESU is considered for delisting, and that adequate regulatory mechanisms are in place that ensure continued persistence of a viable species beyond ESA recovery and delisting.

NMFS will use the delisting criteria in making a listing determination based in the biological status of the Oregon Coast coho salmon ESU and the five listing factors. Section 4.4 introduces a framework for assessing the biological status and listing factors. It also shows how the framework could be applied to take all these into consideration in a future listing determination, tailoring the ESA requirements to Oregon Coast coho salmon.

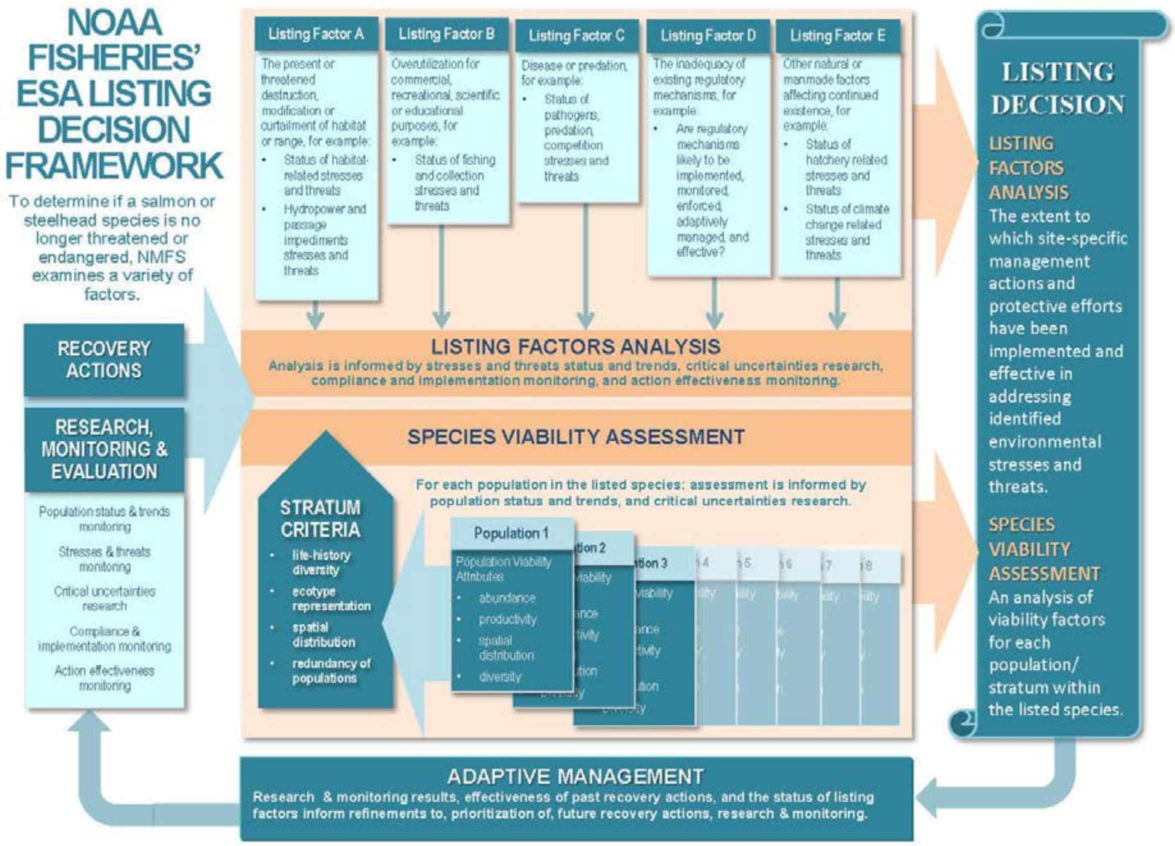

Figure ES-4. Framework components of an ESA-listing determination.

Current ESU Status

Since ESA listing, significant progress has been made toward ensuring that the Oregon Coast coho salmon ESU is sustainable and persistent and no longer needs federal protection under the ESA. In the most recent biological status review (published in 2012), members of our science team determined that they had a low to moderate certainty that the ESU was sustainable (viable) but "concluded that, when future conditions are taken into account, the (Oregon Coast coho) ESU as a whole is at moderate risk of extinction." The team was primarily concerned that the overall productivity of the ESU has remained low, and described the ESU's vulnerability to near-term and long-term climate effects and periods of poor ocean conditions. Based on the science team's review and NMFS' analysis of the five listing factors, NMFS determined that the species should remain threatened under the ESA due to uncertainties about the current quality of freshwater habitats, and that climate change could lead to a long-term downward trend in freshwater and marine coho salmon habitat compared to current conditions. Since the science team's review, Oregon Coast coho salmon abundance has increased, and then fluctuated. Consequently, uncertainty remains about the adequacy of the habitat and habitat protections in light of expected future downturns in ocean survival and climate change. Uncertainty also exists concerning predation effects on Oregon Coast coho salmon from non-native fish species, such as smallmouth and largemouth bass, as well as birds and marine mammals.

Recovery Strategies and Actions

Our recovery strategy for Oregon Coast coho salmon is designed to meet the ESA recovery goal and criteria for delisting. It aims to establish self-sustaining, naturally spawning populations that are sufficiently abundant, productive, and diverse so they no longer need ESA protection. As the species continues to recover over time, NMFS supports the attainment of broader goals that go beyond achieving species recovery under the ESA and provide multiple ecological, cultural, social and economic benefits.

Overall, our recovery direction for Oregon Coast coho salmon centers on restoring degraded habitats and the ecosystem processes and functions that affect those habitats. The primary focus is to protect and restore freshwater and estuarine rearing habitats upon which egg-to-smolt survival depends. Increasing habitat quality and capacity for over-wintering and summer rearing juvenile coho salmon is critical. Related state and federal scientific reports and findings identify reduced stream complexity and degraded water quality (increased temperature) as the primary factors that continue to threaten ESU viability. We include habitat strategies and actions for each of the five strata in Section 6. For the Lakes Stratum populations (Siltcoos, Tahkenitch, and Tenmile Lakes), predation by warm water fish also restricts recovery. At the same time, we will participate in decisions to maintain harvest rates and hatchery practices at levels that continue to support recovery.

Developing Scientifically Sound, Coordinated Approaches to Recovery

Our strategy is to develop and apply well-formulated, scientifically sound approaches to address the primary limiting factors for Oregon Coast coho salmon. It recognizes that habitat restoration efforts should begin with restoring natural watershed or ecosystem processes and addressing indirect threats instead of focusing at the project-level scale. Thus, efforts to increase stream complexity, improve water quality, and address predation and other limiting factors will include steps to protect and restore the ecosystem processes that influence habitat health and stability. Critical to this effort, NMFS aims to strengthen partnerships with local organizations, including watershed councils and soil and water conservation districts, local and state governmental agencies, and others to provide collaboration toward recovery and conservation of Oregon Coast coho salmon populations. NMFS will rely on a combination of regulatory programs plus effective long-term participation in non-regulatory, voluntary conservation work to achieve ESU viability.

Further, our strategy recognizes the importance of linking actions at the population and watershed levels to those at the ESU level. At the ESU level, we will create a common framework to provide a strategic approach to recovery that coordinates efforts to improve key watershed processes and habitats so they effectively support recovery goals for individual coho salmon populations and ESU. This consistency also supports adaptive management by improving our ability to assess the effectiveness of salmon recovery efforts, to identify uncertainties, and to update priorities and actions. At the watershed or population level, we aim to collaborate on the development of a step-by-step approach to define site-specific strategies and actions that will integrate the best available science.

We intend this Plan to serve as a ‘roadmap’ that describes alternate routes (strategies and actions) to get to recovery because there is no one ‘right’ way to get success. NMFS recognizes two fundamental ingredients in any successful effort to protect habitat and recover protected efforts – 1) applying the best available science and 2) obtaining sufficient local support to implement strategic plans. A universal challenge associated with stream and river restoration is effectively integrating the two, and we approach the recovery effort for Oregon Coast coho salmon with a goal of achieving that integration. Where local plans incorporate both, we support them; where they need strengthening, we will work with ODFW and other agencies to help improve the plans.

Management Actions

Because of the many similarities between the habitats of the populations, we provide a list of site-specific habitat management actions that are generally applicable to the ESU, followed by strata-level actions. Many of the actions aim to restore and maintain ecological processes in the watersheds that create healthy habitat conditions. This list (shown, in part, in the following text box and in more detail in Section 6) is intended to serve as a 'menu' of the types of site-specific management actions that will contribute to the recovery of Oregon Coast coho salmon. The actions will be further refined, sequenced and scheduled during future development of the Recovery Implementation Schedule. In addition, we will continue to participate in processes to ensure that fisheries and hatcheries are managed to achieve and maintain a sustainable Oregon Coast coho salmon ESU.

- Regulatory actions. On the regulatory front, it is important to strengthen laws and/or regulations related to some habitat altering actions and/ or boost enforcement of existing regulatory mechanisms to provide habitat conditions that can support a sustainable ESU. Thus, an important element in our Plan is to identify regulatory changes that could, if implemented, address indirect threats ─ the roots causes of ecosystem impairment.

  At the same time, we will support the reforms already implemented for Oregon Coast coho salmon harvest and hatchery management and work with ODFW, the Pacific Fishery Management Council, and others to update these reforms as needed to achieve and maintain ESU viability.

- Voluntary actions. In the long run, protection and restoration of salmon habitat will only be accomplished if the people who call the area home make that a priority. We will continue to encourage and support conservation work by private landowners, local conservation groups (soil and water conservation districts, watershed councils, forestland owners, Salmon and Trout Enhancement Program (STEP) volunteers, etc.) and others to improve ecological processes and habitats, particularly in areas with the greatest potential to create and/or support high quality coho salmon rearing habitat.

- Research, monitoring, and evaluation actions. We recognize the remaining unknowns regarding our understanding of the specific factors that affect the fish now, or might influence their recovery in the future. As a result, the Plan includes actions to gain critical information about the factors that affect the fish, or may affect the fish in the future given global climate change. Continuing effective research, monitoring, and evaluation is critical to our success. Information gained through these efforts will be used to assess and, where necessary, correct recovery strategies and actions.

Potential Management Actions for Recovery of Oregon Coast Coho Salmon

Listing Factor A: Habitat Actions (includes actions for Listing Factor D)
Habitat actions at the ESU Scale

- A1.1 Revise regulatory mechanisms in order to provide increased protection for Oregon Coast coho salmon habitat.
- A1.2 Develop and update guidance for Oregon Coast coho salmon conservation and recovery.
- A1.3 Provide secure financial support to implement actions needed at achieve recovery.

Potential site-specific management actions at the stratum and population scales

- A2.1 Develop and approve scientifically credible, thorough Strategic Action Plans (SAPs) using a common framework developed for this Plan[1], for each independent population. Implement the best available science, including, when available, life cycle models.
- A2.2 Implement the SAP in each independent population to protect and restore ecosystem functions and coho habitat, evaluating each of the threat categories and implementing local activities consistent with the recovery strategies in this section.
- A2.3 Develop and implement SAPs, as resources allow, for dependent populations to prevent degradation of population status.
- A2.4 Plan and provide public outreach, including education and promoting volunteer efforts.

Habitat research, monitoring, and evaluation actions

- A3.1 Continue to provide research, monitoring, and evaluation to track ecosystem processes and habitat conditions to inform the adaptive management of recovery implementation.
- A3.2 Continue to monitor habitat conditions and trends at the strata level and if possible expand the monitoring to include non-wadable streams, wetlands, and estuaries and population-level trends.
- A3.3 Develop a means to track the gain and loss of key habitat features to estimate net changes in coho salmon habitat at the watershed scale.
- A3.4 Enhance the temperature monitoring system on the coast to better track warm -water and cold-water refugia.
- A3.5 Implement monitoring to track progress toward achieving recovery goals.
- A3.6 Conduct climate change risk analysis for habitats in all population areas.

Listing Factor B: Harvest Actions (includes actions for Listing Factor D)

- B1.1 Maintain abundance-based harvest management, adaptively managing to ensure harvest levels are not too high if marine survival is projected to be very low.
- B1.2 Review and amend as appropriate the definition and use of ‘full seeding’ in harvest management.

Listing Factor C: Predation and Disease Actions (includes actions for Listing Factor D)

- C1.1 Monitor for predation (especially in the Lakes populations), disease, aquatic invasive species, and competition and develop actions as needed.
- C1.2. Develop actions to control warm water fish predation on salmonids in the Lakes populations and lower Umpqua River.

Listing Factor E: Other Issues – Hatchery Management and Climate Change (includes actions for Listing Factor D)
Hatchery Management

- E1.1 Continue the release of hatchery fish to control mixing of hatchery-origin fish with wild fish on spawning grounds.
- E1.2 Continue the release of hatchery fish to reduce competition and predation with wild fish in tributaries and estuaries.

Climate Change

- E2.1 Monitor for increasing water temperatures (climate change) and ‘flashiness’ of streams.
- E2.2 Use information from climate change risk analysis to identify at risk populations and habitat areas and to help prioritize actions.

Time and Cost Estimates

There are unique challenges related to estimating time and cost for salmon recovery, given the complex relationship of the fish to the environment and to human activities. The recovery plan contains a list of actions to recover the populations; however, it recognizes that there are many uncertainties involved in predicting the course of recovery and in estimating total costs. Such uncertainties include the rate at which new actions are implemented, biological and ecological responses to recovery actions, scientific uncertainty regarding unforeseen changes in climate or ocean conditions, as well as long-term and future funding.

The time needed to recover Oregon Coast coho salmon under the ESA depends on near-term conditions (marine and freshwater), the actions that are implemented, and how effective the actions are in addressing remaining limiting factors and threats. For instance, if the biological status were good and Oregon were to revise key regulatory mechanisms ─ including floodplain management, agricultural and forest practices, and water quality rules ─ it is possible that we could delist Oregon Coast coho salmon in relatively few years, depending on the specifics of the new mechanisms and the speed and effectiveness of implementation. On the other hand, without significant changes in regulatory mechanisms, relying for the most part on the funding and implementation of voluntary actions, and depending on marine conditions, it could take ten years or more to recover and delist the species.

NMFS believes that, due to the many uncertainties, it is most appropriate to focus costs on the first five years of implementation, with the understanding that before the end of each five-year implementation period, specific actions and costs will be estimated for subsequent years. We base our costs on those provided in the Oregon Coast Coho Conservation Plan and the implementation of the Oregon Plan for Salmon and Watersheds, and assume continued expenditures at approximately the same level as in the last 17 years. Based on these assumptions, we estimate the cost of recovery for the next five years to be approximately $55 million and at approximately $110 million to achieve recovery, depending greatly on the ability to target habitat restoration activities to areas where the greatest gains can be made in improving winter and summer rearing habitats. The cost will also depend on success in improving laws and regulations to protect coho salmon habitat, and then enforcing them. These numbers do not include potential direct and opportunity costs to private sector businesses, depending on the actions and regulatory mechanisms implemented, nor do they include financial benefits that we expect to result from successful recovery of the Oregon Coast coho salmon ESU. Section 7 discusses our time and cost estimates.

Implementation

Ultimately, recovery of Oregon Coast coho salmon depends on the commitment and dedicated actions of the many groups and individuals who share responsibility for the species' future. Recovery plan implementation involves many entities and stakeholders, and the needs for coordination are complex and occur at multiple levels. Implementation and coordination needs exist at the regional, state, ESU, population and watershed levels and involve government and non- governmental entities.

Implementation of recovery actions has been improving Oregon Coast coho salmon sustainability since ESA listing. This recovery plan seeks to build upon the successful efforts by these different forums. It also provides a full life-cycle context for assessing the collective and relative effectiveness of ongoing actions, evaluating uncertainties, and identifying the most effective actions for the species and delisting.

We will continue to partner with the state of Oregon to integrate implementation of this recovery plan with similar efforts to implement the state Oregon Coast Coho Conservation Plan, including development of site-specific management actions.

Adaptive Management, Research, Monitoring, and Evaluation

Adaptive management plays a critical role in recovery planning (See Figure ES-5). The long-term success of recovery efforts will depend on the strategic use of research, monitoring, and evaluation to provide useful information to decision makers within an adaptive management framework. Research, monitoring, and evaluation programs associated with recovery plans need to gather the information that will be most useful in tracking and evaluating implementation and action effectiveness and assessing the status of listed species relative to recovery goals. Planners and managers then need to use the information collected to guide and refine recovery strategies and actions. Adaptive management provides the mechanism to facilitate these adjustments.

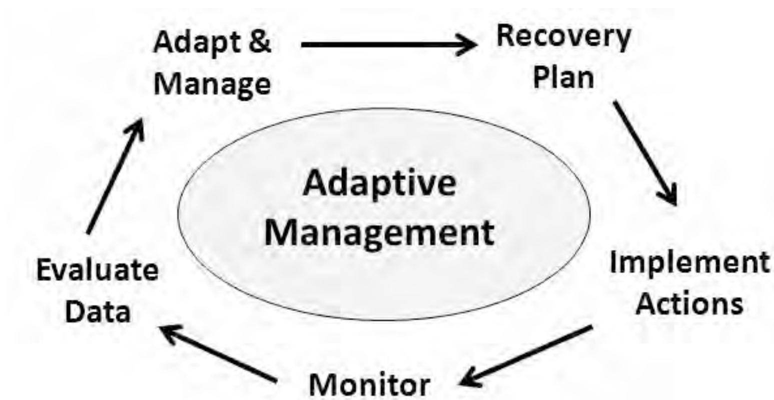

Figure ES-5. The Adaptive Management Cycle.

Successful adaptive management requires that monitoring and evaluation plans be incorporated into overall implementation plans for recovery actions. These plans should link monitoring and evaluation results explicitly to feedback on the design and implementation of actions (Figure ES-5). In adaptive management, recovery strategies are treated like working hypotheses that can be acted upon, tested, and revised. The research, monitoring, and evaluation plans will frame activities to answer remaining key questions, including the following: (1) is the status of the ESU improving? (2) Is the freshwater habitat good enough to support coho salmon productivity during expected future periods of poor ocean survival? (3) Is the habitat at the ESU, strata and population levels getting better? (4) Are the regulatory mechanisms pertaining to land use and water quality ‘adequate’ to meet ESA requirements?

For Oregon Coast coho salmon, NMFS intends to support implementation of the adaptive management, research, monitoring, and evaluation programs in the Oregon Coast Coho Conservation Plan. We will also develop a life-cycle model to identify and assess potential factors that could limit sustainability of Oregon Coast coho salmon, including effects under current climate change projection scenarios.

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1. Background

This is an Endangered Species Act (ESA) recovery plan (or Plan) for Oregon Coast coho salmon (OC coho salmon), an Evolutionarily Significant Unit (ESU) of coho salmon (*Oncorhynchus kisutch*). The National Marine Fisheries Service (NMFS), a branch of the National Oceanic and Atmospheric Administration (NOAA), first listed Oregon Coast coho salmon as a threatened species under the ESA on August 10, 1998 (NMFS 1998, 63 FR 42587). It retained this threatened listing for the species on June 20, 2011 following several Federal court cases, biological reviews and listing determinations (NMFS 2011, 76 FR 35755).

1.1 Purpose of Recovery Plan

NMFS' goal is to improve the viability of the Oregon Coast coho salmon ESU to the point that the species is self-sustaining in the wild and no longer requires protection under the Endangered Species Act.

This recovery plan provides guidance for the recovery of the species. NMFS developed the Plan pursuant to section 4(f) of the Endangered Species Act. The ESA requires NMFS to develop recovery plans for species listed as endangered or threatened under the ESA. Under the ESA, recovery plans identify actions needed to resolve the threats to the species and ensure self-sustaining populations in the wild.

Recovery plans serve as advisory documents and provide a roadmap for species recovery based on the best information. They lay out where we need to go and how best to get there, and they can help prioritize limited resources. Although recovery plans are guidance documents rather than regulatory documents, the ESA envisions recovery plans as the central organizing tool for guiding each species' recovery process.

As directed by ESA section 4(f)(1)(B), the recovery plan includes: 1) a description of site-specific management actions that may be necessary to achieve the Plan's goal for the conservation and survival of the species; 2) objective, measurable criteria, which, when met, would result in a determination that the species be removed from the threatened and endangered species list; and 3) estimates of the time required and the cost to carry out those measures needed to achieve the Plan's goal and to achieve intermediate steps toward that goal.

1.2 Overview

Historically, rivers that drain into the ocean and lakes along the Oregon coast supported strong runs of coho salmon. The Oregon Department of Fish and Wildlife (ODFW) estimated that pre-development coho salmon runs to the Oregon Coast coho salmon ESU may have been in the range of one to two million fish during periods of favorable ocean conditions (ODFW 2007). The runs began to decline in the mid-1900s, primarily due to overharvest by fisheries, a period of poor ocean conditions, and watershed habitat degradation as timber harvest and agricultural activities expanded in the area. By the 1970s through the 1990s, the run dropped to all-time low returns of around 20,000 coho salmon spawners (Weitkamp et al. 1995). The sharp decline in Oregon Coast coho salmon led to the first petitioning of the ESU for listing in 1993 (NMFS 1993). This petitioning triggered a series of actions to stop the species decline and restore its viability. These actions to restore the fish populations continue today.

The listed ESU for Oregon Coast coho salmon covers much of the Oregon coast along the Pacific Ocean (Figure 1-1). It includes all the freshwater habitat (rivers, streams and lakes) from the Necanicum River near Seaside to the Sixes River near Port Orford on the south. Several large river systems in this area support Oregon Coast coho salmon, including the Nehalem, Nestucca, Salmon, Siletz, Tillamook Bay, Yaquina, Alsea, Siuslaw, Coos, Coquille, and Umpqua systems (Figure 1-1). The ESA-listed ESU also includes artificially produced coho salmon from the Cow Creek (South Umpqua) hatchery program.

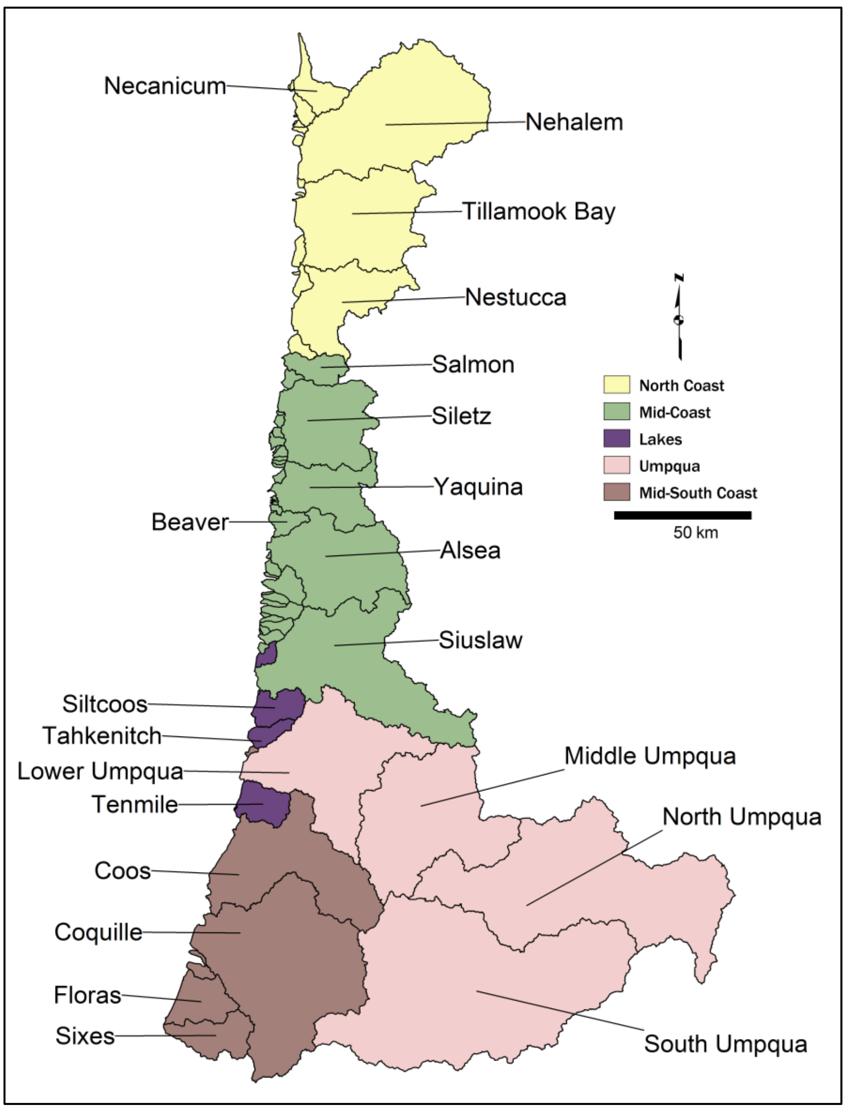

Figure 1-1. Map of the Oregon Coast Coho Salmon ESU showing biogeographic strata and independent populations

1.3 Context of Plan Development

This recovery plan contains the work and contributions of federal, state, and local agencies and other stakeholders with interests in Oregon Coast coho salmon and their habitats. Through the collaborative process of developing this Plan, we aimed to effectively address ESA goals while respecting local interests and needs based on social, economic, and ecological values. Consequently we developed this ESU-level recovery plan in the context of other processes that relate to the Oregon Coast coho salmon ESU and the habitat upon which they depend. These related processes involved ODFW and other state agencies, regional stakeholder teams within Oregon, other federal agencies, tribal and local governments, representatives of industry and environmental groups, and the public. Our resulting ESU-level recovery plan synthesizes related information from these processes, including:

1. The Oregon Coast Domain Workgroup of the Oregon/Northern California Technical Recovery Team (OCTRT)
2. The Oregon Coast Coho Biological Review Team (BRT)
3. The Oregon Coast Coho Conservation Plan (OCCCP) and iterative process employed by the State of Oregon and NMFS to develop that plan (see discussion below)
4. The Oregon Coast Multi-Species Plan (OCMSP) (currently being developed)
5. Local habitat restoration efforts
6. Other sources

The Plan recognizes the long history of listing determinations for Oregon Coast coho salmon under the ESA. The status of the ESU has been reviewed repeatedly since the early 1990s. Oregon Coast coho salmon were first petitioned for listing in 1993. NMFS listed the species as threatened under the ESA in 1998. Considerable litigation has surrounded the listing status of the species since then, and the species' listing has changed between "not warranted for listing" and "threatened" several times. NMFS called on its biological review team to review the status of the species in 2009 and, based on this review, retained the species' listed status in 2011. A more recent status review completed in 2015 found that while some aspects of the species' status have improved, the listing remains warranted. The chronology in Text Box 1-1 provides an overview of this history.

Text Box 1-1. Chronological History of Oregon Coast Coho Salmon ESA-Listing Determination

July 2013	NMFS files notice to prepare recovery plan to Oregon Coast Coho salmon.
June 2012	NMFS issues ESA status review for Oregon Coast coho salmon.
June 2011	NMFS retains ESA threatened status of Oregon Coast coho salmon.
May 2010	NMFS proposes to retain ESA threatened status of Oregon Coast coho salmon.
April 2009	NMFS initiates ESA status review of Oregon Coast coho salmon.
February 2008	In accordance with court opinion, NMFS lists Oregon Coast coho salmon as threatened under ESA.
October 2007	U.S. District Court in Oregon invalidates January 2006 decision not to list Oregon Coast coho salmon.
March 2007	ODFW issues its Oregon Coast Coho Conservation Plan (OCCCP).
June 2006	Trout Unlimited et al. challenges NMFS' decision not to list.
January 2006	NMFS concludes that Oregon Coast coho salmon are "not likely to become endangered" in foreseeable future and decides against listing them under ESA; agency withdraws ESA listing proposal.
June 2005	NMFS releases final ESA hatchery listing policy and announces six-month extension on listing determination for Oregon Coast coho salmon.
May 2005	Oregon releases final report of its Coastal Coho Assessment, concluding Oregon Coast coho salmon are viable and likely to persist into foreseeable future
February 2005	NMFS requests public review and comment on Oregon's draft Coho Project Report.
June 2004	NMFS formally proposes to list Oregon Coast coho salmon as "threatened" under ESA and issues draft hatchery policy.
October 2003	Oregon begins Coastal Coho Project to evaluate effectiveness of Oregon Plan at recovering Oregon Coastal coho salmon; state and NMFS work jointly on project.
November 2002	NMFS convenes Oregon Coast coho salmon technical recovery team, charged with establishing biologically based delisting criteria and recovery goals, and serving as science advisors to recovery planning.
July 2002	NMFS responds to ESA petition to redefine Oregon Coast coho salmon population.
February 2002	NMFS initiates ESA status review of West Coast salmon, including Oregon Coast coho salmon.
November 2001	NMFS begins developing new hatchery policy to address issues raised in U.S. District Court decision and says it will apply new policy to all West Coast ESA-listed salmon and steelhead.
September 2001	Alsea Decision, U.S. District Court in Oregon finds that ESA does not allow NMFS to split a salmon ESU into two components -- hatchery and wild -- and then list only one of those components; functional effect of ruling is to delist Oregon Coast coho salmon.
August 1998	NMFS lists Oregon Coast coho salmon as threatened under ESA.
June 1998	U.S. District Court for Oregon rules that "not warranted" determination for Oregon Coast coho salmon is arbitrary and capricious, saying ESA does not let NMFS consider biological effects of future or voluntary conservation measures
May 1997	NMFS determines Oregon coast coho salmon is "not warranted" for listing under the ESA based in part on Oregon's conservation measures contained in the plan.
March 1997	Oregon completes its Salmon Initiative Plan and submits it to NMFS.
October 1995	Oregon embarks on its Coastal Salmon Restoration Initiative to conserve and restore coastal salmon and steelhead.
July 1995	NMFS proposes to list Oregon Coast coho salmon as threatened under ESA.
October 1993	NMFS receives petition from Pacific Rivers Council and 22 others requesting the agency list Oregon Coast coho salmon under ESA.

Relationship to Oregon Coast Coho Conservation Plan

Early in 2004, NMFS embarked with the State of Oregon in a collaborative process to develop a plan to conserve coastal coho salmon populations on the Oregon Coast. This process, which led to the development of the Oregon Coast Coho Conservation Plan (OCCCP or conservation plan), involved significant participation by diverse public and interest group representatives (stakeholder team), state agency representatives (core team), and scientists with coastal coho salmon expertise (technical recovery team).

NMFS considers the state's conservation plan a precursor to, and foundation for, this proposed recovery plan, recognizing that the ESA goals are different but compatible. While many of the elements of the state's conservation plan are consistent with this recovery plan, the conservation plan's goals are broader and go beyond the ESA requirements for delisting. Nevertheless, the two plans have much in common, including the following goals: 1) long-term persistence of sustainable populations of naturally produced Oregon Coast coho salmon; 2) distribution of healthy coho salmon populations across their native range; 3) providing social and cultural benefits of meaningful harvest opportunities that are sustainable over the long term; and 4) pursuing salmon conservation and recovery using an open and cooperative process that respects local customs and benefits local communities and economies. We believe that achieving viability of natural-origin OC coho salmon populations and recovery under the ESA is an important milestone on the way to achieving the broader goals of the state conservation plan. Upon delisting, NMFS will work with co-managers and local stakeholders, using our non-ESA authorities, to pursue the conservation plan's broader recovery goals while continuing to maintain robust natural populations.

Importantly, this Federal recovery plan for the Oregon Coast coho salmon ESU calls for measures in addition to those in the Oregon Coast Coho Conservation Plan. As the above chronology shows, when ODFW published the conservation plan in March, 2007, Oregon Coast coho salmon were not listed as a threatened species under the ESA. Shortly thereafter, the U.S. District Court invalidated NMFS' decision not to list Oregon Coast coho salmon (for the second time). Consequently, in 2008 NMFS listed Oregon Coast coho salmon as threatened under ESA, and in 2011 we retained that listing status. This Federal recovery plan for Oregon Coast coho salmon, as we explain in subsequent Sections, includes strategies and actions that incorporate much of the state's conservation plan, but it also includes additional measures. In particular, we recommend the state enhance protective regulatory mechanisms that will help ensure that Oregon Coast coho salmon can meet ESA delisting criteria on activities such as forest and agricultural practices and others that affect water quality (see Section 6).

Relationship to Other Recovery Planning Efforts

The Oregon Coast coho salmon ESU is one of 19 salmonid species in the Pacific Northwest that are listed as threatened or endangered under the ESA. One other of these listed evolutionarily significant units (ESUs) of salmon occurs on the Oregon Coast, the Southern Oregon Northern California coho salmon (SONCC) ESU. This Plan covers Oregon Coast coho salmon, while a separate plan covers the Southern Oregon Northern California coho salmon (NMFS 2014).

For the purpose of recovery planning for the listed salmon and steelhead species, the NMFS designated five geographically based “recovery domains”: the Interior Columbia, Willamette-Lower Columbia, Puget Sound, Oregon Coast, and Southern Oregon/Northern California Coast domains (see Figure 1-2). We delineated these domains by considering ESU or DPS boundaries, ecosystem boundaries, and local planning units. The range for the Oregon Coast coho salmon ESU is in the Oregon Coast domain.

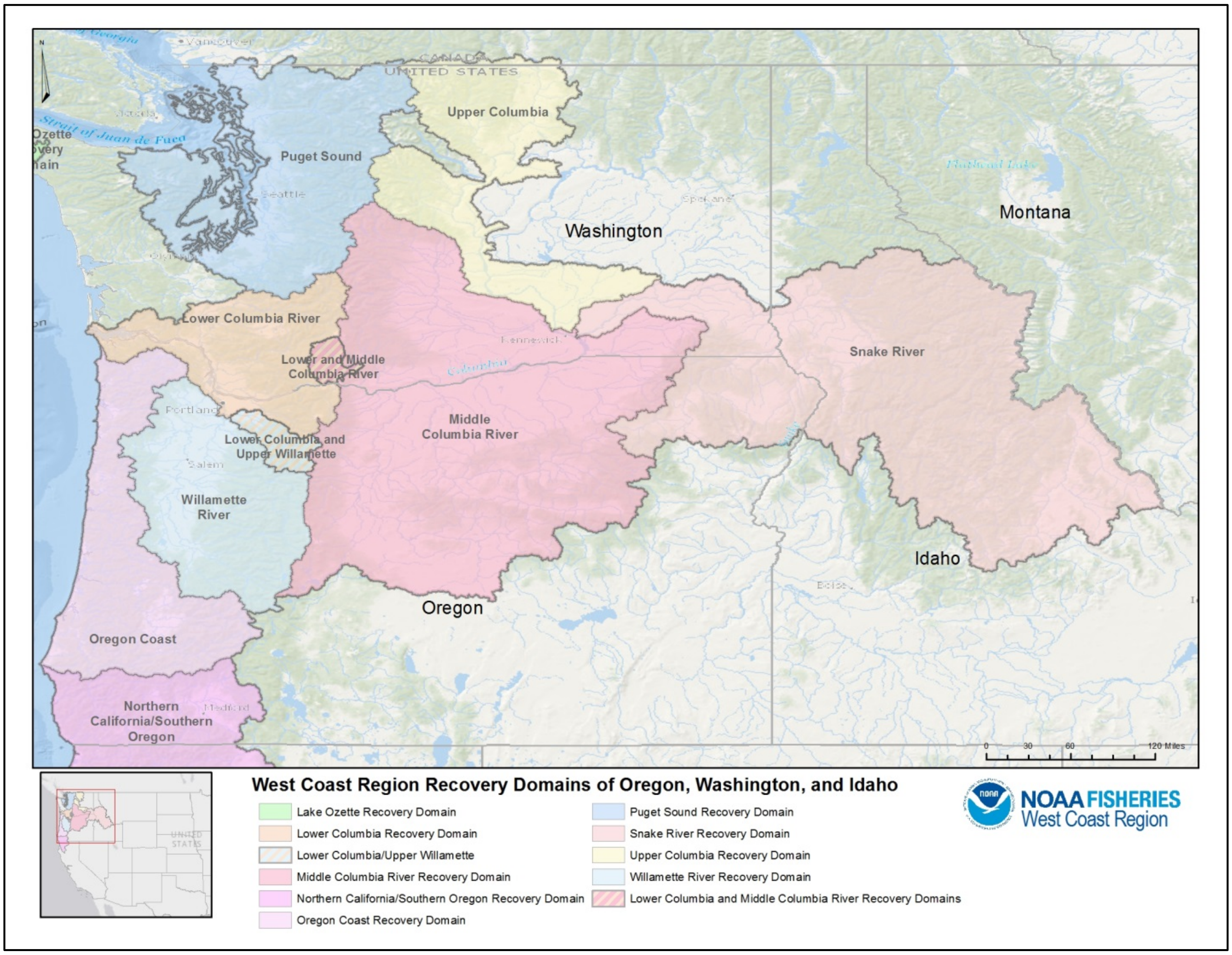

Figure 1-2. NMFS West Coast Region Recovery Domains.

For each domain, NMFS appointed a team of scientists who have geographic and species expertise to provide a solid scientific foundation for recovery plans. The charge of each TRT was to define the historical population structure of each ESU or DPS, to recommend biological viability criteria for each ESU or DPS and its component populations, to provide scientific support to local and regional recovery planning efforts, and to provide scientific evaluations of proposed recovery plans. NMFS formed the Oregon Coast Technical Recovery Team (OCTRT) in the fall of 2001 and included representatives from our Northwest Fisheries Science Center, the ODFW, the U.S. Forest Service (USFS), the Oregon Watershed Enhancement Board (OWEB) and a private consultant.

Each TRT used the same biological principles to develop its recommended ESU and population viability criteria; we will use these criteria in combination with criteria based on mitigation of the factors for decline to determine whether a species has recovered sufficiently to be downlisted or delisted. The biological principles that underlie the viability criteria are described in the NMFS technical memorandum "Viable Salmonid Populations (VSP) and the Recovery of Evolutionarily Significant Units" (McElhany et al. 2000). A viable ESU or DPS is naturally self-sustaining over the long term (100 years). McElhany et al. describe VSP in terms of four parameters: abundance, population productivity or growth rate, population spatial structure, and life history and genetic diversity.

Each TRT based its recommendations on the VSP framework and considerations related to, data availability, the unique biological characteristics of the ESU or DPS and the habitats in the domain, and the TRT members' collective experience and expertise. Although NMFS encouraged the TRTs to develop regionally specific approaches for evaluating viability and identifying factors limiting recovery, each TRT was working from a common scientific foundation to ensure that the recovery plans are scientifically sound, and based on consistent biological principles.

We used TRT recommendations in developing goals for the recovery plans. As the agency with ESA jurisdiction for salmon and steelhead, NMFS makes final determinations of ESA delisting criteria (see Section 4 for Oregon Coast coho salmon delisting criteria).

1.4 How We Intend to Use the Plan

NMFS intends to use this Plan to support the Oregon Coast Coho Conservation Plan as well as to inform federal, state and local agencies and interested stakeholders about what will be needed to recover Oregon Coast coho salmon to the point where they are self-sustaining in the wild and can be removed from the list of threatened and endangered species. Although recovery plans are advisory, not regulatory, they are important tools that help to do the following:

- Provide context for regulatory decisions
- Guide decision making by federal, state, tribal, and local jurisdictions
- Provide criteria for status reporting and delisting decisions
- Organize, prioritize, and sequence recovery actions
- Organize research, monitoring, and evaluation efforts
- Provide a framework for the use of adaptive management

NMFS encourages federal agencies and non-federal jurisdictions to use recovery plans as they make decisions and allocate their resources including:

- Actions carried out to meet federal ESA section 7(a)(1) obligations
- Actions that are subject to ESA sections 4d, 7(a)(2), or 10
- Hatchery and Genetic Management Plans and permit requests

- Harvest plans and permits
- Selection and prioritization of subbasin planning actions
- Development of research, monitoring, and evaluation programs
- Revision of land use and resource management plans
- Other natural resource decisions at the federal, state, tribal, and local levels

We will emphasize recovery plan information in ESA section 7(a)(2) consultations, section 10 permit development, and application of the section 4(d) rule by considering:

- The importance of affected populations to listed species viability
- The importance of the action area to affected populations and species viability
- The relation of the action to recovery strategies and management actions
- The relation of the action to the research, monitoring, and evaluation plan for the affected species

We expect that agencies and others will use this recovery plan as a reference and a source of context, expectations, and goals. We will encourage federal agencies to describe in their biological assessments how their proposed actions will affect specific populations and limiting factors identified in the recovery plans, and to describe any mitigating measures and voluntary recovery activities in the action area.

1.5 Tribal Trust Responsibilities

The coho salmon that were once abundant on the Oregon Coast were crucial to Native Americans throughout the region. Pacific Northwest Indian tribes today (in particular, the Coos, Coquille, Cow Creek, Grand Ronde, Lower Umpqua, Siletz, and Siuslaw) retain strong spiritual and cultural ties to salmon and steelhead, based on thousands of years of use for tribal religious/cultural ceremonies, subsistence, and commerce.

While many Northwest Indian tribes have treaties reserving their right to fish in usual and accustomed fishing places, none of the tribes on the Oregon Coast have treaty reserved rights. They do have, however, a trust relationship with the federal government and an interest in salmon and steelhead management, including harvest for subsistence and ceremonial purposes in areas covered by this Plan, in compliance with agreements with the state of Oregon.

Restoring and sustaining a sufficient abundance of salmon and steelhead for harvest is an important requirement in fulfilling tribal fishing aspirations. We are committed to meeting federal treaty and trust obligations to the tribes. These obligations are described in a July 21, 1998, letter from Terry D. Garcia, Assistant Secretary for Oceans and Atmosphere, U.S. Department of Commerce, to Mr. Ted Strong, Executive Director of the Columbia River Inter-Tribal Fish Commission. This letter states that recovery "must achieve two goals: (1) the recovery and delisting of salmonids listed under the provisions of the ESA, and (2) the restoration of salmonid populations over time, to a level to provide a sustainable harvest sufficient to allow for the meaningful exercise of tribal fishing rights.” Thus it is appropriate for recovery plans to take these conditions into account and plan for a recovery strategy that includes Indian harvest during and after recovery.

The NMFS Regional Administrator, in testimony before the U.S. Senate Indian Affairs Committee (Lohn 2003), emphasized the importance of this co-manager relationship: “We have repeatedly stressed to the region’s leaders, tribal and non-tribal, the importance of our co-management and trust relationship to the tribes. NMFS enjoys a positive working relationship with our Pacific Northwest tribal partners. We view the relationship as crucial to the region’s future success in recovery of listed salmon.”

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2. Description of Species and Habitat

This section provides a brief summary of the geographic setting and the features that describe Oregon Coast coho salmon and the species' freshwater and marine habitats.

2.1 Geographical Setting

Pacific salmon are a wide-ranging species of Pacific salmon, spawning in rivers and rearing in streams and estuaries around the Pacific Rim from Monterey Bay in California north to Point Hope, Alaska; through the Aleutian Islands; and from the Anadyr River in Russia south to Korea and northern Hokkaido, Japan.

The geographic setting for the Oregon Coast coho salmon ESU includes the Pacific Ocean and the freshwater habitat (rivers, streams and lakes) along the Oregon Coast from the Necanicum River near Seaside on the north to the Sixes River near Port Orford on the south. This area is included in the Coast Range ecoregion designated by the Environmental Protection Agency (EPA). As described by the EPA, the Coast Range ecoregion displays low mountains covered by highly productive, rain-drenched coniferous forests. Sitka spruce forests originally dominated the fog-shrouded coast, while a mosaic of western red cedar, western hemlock, and seral Douglas-fir blanketed inland areas. The Oregon Coast includes considerable physical diversity, ranging from extensive sand dunes to rocky outcrops. With the exception of the Umpqua River, which extends through the Coast Range to drain the Cascade Mountains, rivers in this ESU have their headwaters in the mountains of the Coast Range.

Land uses vary from forestry and agriculture to urban and rural residential development. Much of the upper portions of the region's watersheds are forested and managed for timber production. The population of the coastal zone is about 225,000 Oregonians ─ about 6.5 percent of the state's total population ─ in about 7,800 square miles of land area. Due largely to topographical constraints and a very limited network of arterial roadways, a large majority of coastal residents live very near the coastline or along narrow coastal river valleys.[5]

2.2 Description of Oregon Coast Coho Salmon

All Pacific salmon belong to the family *Salmonidae*, the genus *Oncorhynchus*. Coho salmon belong to the species *Oncorhynchus kisutch*. This section summarizes characteristics specific to Oregon Coast coho salmon. Numerous reports and other documents provide extensive general information on coho salmon, including the final Recovery Plan for Central California Coast Coho Salmon, which contains an excellent history of salmon (Section 2).[6] The Recovery Plan for Lower Columbia River species[7] provides information about salmon and steelhead populations just north of the Oregon Coast coho salmon ESU and the Recovery Plan for Southern Oregon

[5] http://www.oregon.gov/LCD/OCMP/pages/cstzone_intro.aspx#Population_and_Demographics
[6] http://swr.nmfs.noaa.gov/recovery/ccc_coho/
[7] NMFS 2013.

Northern California Coho, completed in 2014, discusses coho populations to the south of this ESU[8].

2.2.1 Historical and Current Abundance

During pre-development times (circa 1850) coho salmon were far more abundant than Chinook salmon in the majority of Oregon coastal watersheds. Runs of coho salmon to these coastal rivers and streams were likely only approached, or exceeded, by runs of chum salmon in rivers along the northern portion of the Oregon coast. The Oregon Coast Coho Conservation Plan estimated that pre-development coho salmon runs to the Coast coho salmon ESU (1800s and early 1900s) may have been in the range of one to two million fish or more during periods of favorable ocean conditions. Runs of this size would create concentrations of several hundred spawners per mile across the ESU. Such densities of coho salmon spawners are within the range of spawner densities that have been observed for this species in many undisturbed watersheds throughout the Pacific Northwest.

Oregon Coast coho salmon were the most numerous species harvested in commercial and recreational fisheries off the Oregon coast during the 1950s and through the 1970s. Harvest rates of Oregon Coast coho salmon ranged from 60 percent to 90 percent from the 1960s into the 1980s (Stout et al. 2012). Modest harvest reductions were achieved in the late 1980s, but rates remained high until the species' dwindling return numbers led to further tightening of harvest regulations in the early 1990s.

NMFS' biological review team (BRT) that evaluated the status of the ESU discussed historic abundance, stating in part:

> In the 1994 status review, Weitkamp et al. (1995, p. 113) considered historical estimates of abundance for this ESU and concluded that "these numbers suggest current abundance … may be less than 5 percent of that in the early part of the century." …
>
> While these historical abundance estimates are very rough …they suggest that there has been a substantial decrease in ESU-wide abundance during the twentieth century. In fact, the decline was a concern to state biologists as early as the late 1940s (Cleaver 1951). Cleaver did not discuss causes of the decline other than to note that it was not caused by changes in harvest rates. However, Lichatowich (1989) related the overall decline to habitat loss, reporting a decline in production potential from about 1.4 million recruits ca 1900 to only 770,000 in the 1980s, likely resulting from habitat alterations related to timber harvest and agriculture, which both expanded on the coast between 1910 and 1950. (See Figures 2-1 and 2-2)

[8] NMFS 2014

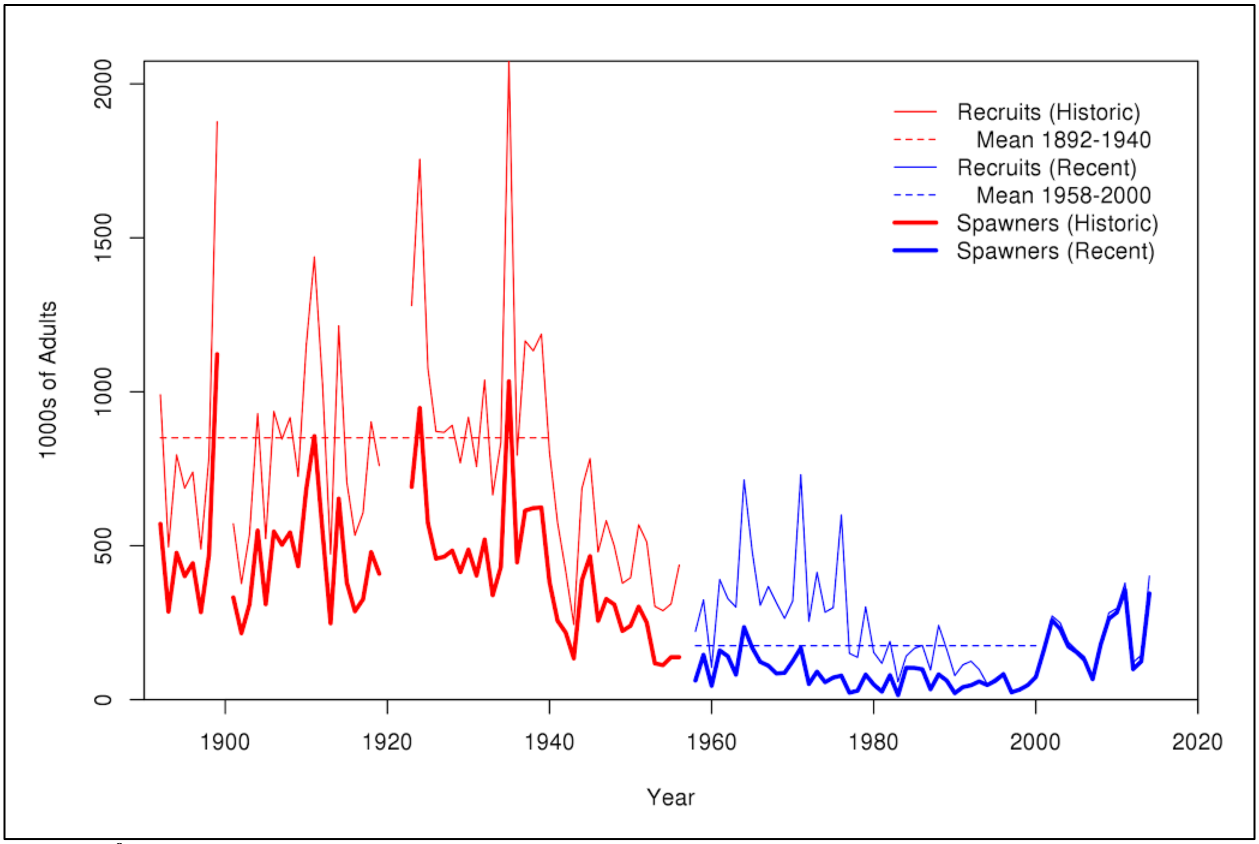


Figure 2-1[9]**.** Comparison of historical (1892–1956) and recent (1958–2014) estimates of spawner abundance and pre-harvest recruits. Horizontal lines are the geometric mean recruits for 1892–1940 and 1960–2009. Analysis based on data from Cleaver 1951, Mullen 1981a, and Mullen 1981b; recent data from Wainwright et al. 2008 and ODFW 2009a.

According to the BRT report[10], all-time low returns, in the 1970s and 1990s, were around 20,000 coho salmon spawners, which could be as low as one percent of some of the pre-development run sizes. Since the mid-1990s, Oregon Coast coho spawner escapement levels have varied greatly but peak abundance in several years (2011 and 2014) has been higher than at any other period since the 1950s (ODFW 2015).

[9] Figure 6 in the BRT Report
[10] Table 3

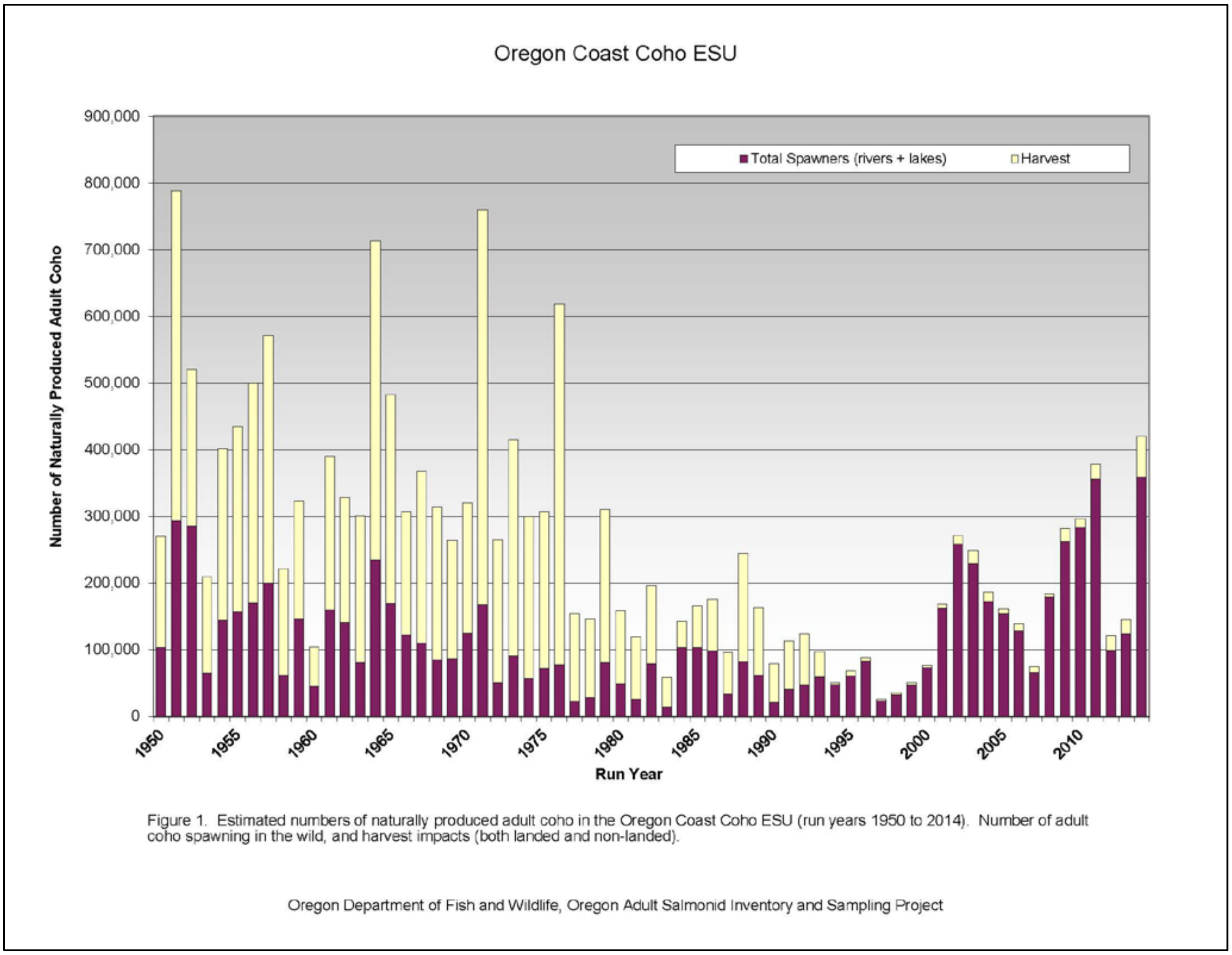


Figure 2-2. Estimated number of naturally produced adult Oregon Coast coho salmon (1950 to 2014). Number of adult coho that spawned and those that were caught in fisheries.

2.2.2 Life History

When compared to Chinook salmon and steelhead, coho salmon exhibit a relatively less complex life history. The vast majority of coho salmon migrate as juveniles through estuaries to the ocean after spending one winter in freshwater and then spend two summers in the ocean before returning to spawn as 3-year old adults in the autumn and winter.

Freshwater Life History

The anadromous life cycle of coho salmon begins in their home stream where they emerge from eggs as ‘alevins’ (a larval life stage dependent on food stored in a yolk sac). These very small fish require cool, slow moving freshwater streams with quiet areas such as backwater pools, beaver ponds, and side channels (Reeves et al. 1989) to survive and grow through summer and winter seasons. In particular, low gradient stream reaches on lower elevation land are important for winter survival of juvenile coho salmon (Stout et al. 2010). Current production of coho salmon smolts in the Oregon Coast coho salmon ESU is particularly limited by the availability of complex stream habitat that provides the shelter for over-wintering juveniles during periods when flows are high, water temperatures are low, and food availability is limited (ODFW 2007). Since coho salmon spend up to half of their lives in freshwater, the condition of the winter and summer juvenile rearing habitat is a key factor in their survival.

Oregon Coast coho salmon follow a yearling-type life history strategy, with most juvenile coho salmon migrating to the ocean as smolts in the spring, typically from as late March into June. Coho salmon smolts may be present in estuaries for a period of weeks to perhaps a month during their migration to the ocean (Table 2-1). Adult coho salmon return to natal tributaries from September to November. They normally spawn in relatively small tributaries with moderate to low gradient stream reaches close to where they were hatched. This life history subjects them to variability in climate patterns affecting rainfall and temperature, estuarine habitats, catastrophic events like floods and fire, and land modifications and uses adjacent to streams (Hall et al. 2012).

Table 2-1. Primary Life History of Coho Salmon by Month.

September – November	Adults re-enter freshwater
November – January	Coho spawn in ‘redds’ (gravel nests) then die
Winter	Eggs incubate in redds for 1.5 to 4 months
First spring after spawning	Eggs hatch as alevins then emerge from gravel as ‘fry’
Summer	Summer rearing (cool temperatures, slow water, shelter required)
Winter	Winter rearing (slow water, shelter required)
Second spring after spawning	Juveniles “smolt” and migrate to the estuary and ocean about 18 months after being deposited in gravel
About 18 months	Coho salmon typically spend two growing seasons in the ocean before returning to their natal stream to spawn as 3 year-olds. Some precocious males, called ‘‘jacks,’’ return to spawn after only 6 months at sea.

Ocean Life History

After rearing in these protective freshwater areas, juvenile coho salmon migrate downstream, into the estuary were they continue to grow and acclimate to salt water. In the ocean, salmon reach maturity before they return to their home streams. This life cycle subjects them to considerable variability in ocean currents and productivity (Hall et al. 2012).

Oregon Coast coho salmon tend to make relatively short ocean migrations. Coho from this ESU are present in the ocean from northern California to southern British Columbia, and even fish from a given population can be widely dispersed in the coastal ocean[11] but the bulk of the ocean harvest of coho salmon from this ESU are found off the Oregon coast. This ESU is strongly influenced by ocean conditions off the Oregon Coast, especially by the timing and intensity of

[11] Weitkamp and Neely 2002

upwelling (a condition characterized by near- shore ocean currents providing cool, nutrient-rich water that stimulates production of food that supports coho salmon and other fish species).

From central British Columbia south, the vast majority of coho salmon adults return to spawn as 3–year-olds, having spent approximately 18 months in freshwater and 18 months in salt water (Gilbert 1912, Pritchard 1940, Sandercock 1991). The primary exceptions to this pattern are ‘‘jacks,’’ sexually mature males that return to freshwater to spawn after only 5 to 7 months in the ocean. West Coast coho salmon juveniles typically leave freshwater in the spring (April to June) and re-enter freshwater from September to November when sexually mature. They spawn from November to December and occasionally into January (Sandercock 1991). The BRT report (Stout et al. 2012) and the OCCCP (ODFW 2007) provide more detailed descriptions of the important role that marine survival plays in the abundance and productivity of Oregon Coast coho salmon. The BRT report observed that given current habitat conditions, Oregon Coast coho salmon are thought to require an overall marine survival rate of 0.03 to achieve a spawner: recruit ratio of 1:1 in high quality habitat (Nickelson and Lawson 1998).

2.2.3 Population Structure of Oregon Coast Coho Salmon

The Oregon/Northern California Coast Technical Recovery Team identified 56 historical populations that function collectively to form the Oregon Coast coho salmon ESU (Table 2-2). The team categorized these populations as independent and dependent. Functionally independent populations were historically self-sustaining and likely had relatively little demographic influence from neighboring populations; potentially independent populations were historically self-sustaining but also likely were demographically influenced by neighboring functionally independent populations (Lawson et al. 2007). In comparison, dependent populations rely on immigration from surrounding populations to persist. The team classified 21 of the populations as independent because they occur in basins with sufficient historical habitat to have persisted through several hundred years of normal variations in marine and freshwater conditions (Table 2-2). Two reports describe these populations and the process used to identify them: Identification of Historical Populations of Coho Salmon in the Oregon Coast Evolutionarily Significant Unit (Lawson et al. 2007) and Biological Recovery Criteria for the Oregon Coast Coho Salmon Evolutionarily Significant Unit (Wainwright et al. 2008).

Table 2-2. Classification of Oregon Coast Coho Salmon ESU historical populations. Modified from Lawson et al. (2007) and listed north to south within biogeographic strata.[12] I = Independent Population, D = Dependent Population.

Stratum	Population	Type	Stratum	Population	Type
North Coast	Necanicum	I	Mid-Coast	Salmon	I
	Ecolab	D		Devils Lake	D
	Arch Cape	D		Siletz	I
	Short Sands	D		Schoolhouse	D
	Nehalem	I		Fogarty	D
	Spring	D		Depoe Bay	D
	Watseco	D		Rocky	D
	Tillamook Bay*	I		Spencer	D
	Netarts	D		Wade	D
	Rover	D		Coal	D
	Sand	D		Moolack	D
	Nestucca	I		Big (near Yaquina)	D
	Neskowin	D		Yaquina	I
Lakes	Sutton (Mercer Lake)	D		Theil	D
	Siltcoos	I		Beaver	I
	Tahkenitch	I		Alsea	I
	Tenmile	I		Big (near Alsea)	D
Umpqua	Lower Umpqua	I		Vinnie	D
	Middle Umpqua	I		Yachats	D
	North Umpqua	I		Cummins	D
	South Umpqua	I		Bob	D
Mid-South Coast	Threemile	D		Tenmile	D
	Coos	I		Rock	D
	Coquille	I		Big (near Siuslaw)	D
	Johnson	D		China	D
	Twomile	D		Cape	D
	Floras/New	I		Berry	D
	Sixes	I		Siuslaw	I

*Includes coho salmon inhabiting all basins that drain directly into Tillamook Bay (Trask, Wilson, Tillamook, Miami, Kilchis, and other minor tributaries).

The Oregon Coast coho salmon ESU's long-term sustainability relies on the larger independent and potentially independent populations (Lawson et al. 2007). Dependent populations occupy smaller watersheds and rely on straying from neighboring independent populations to remain sustainable. The populations were grouped together to form five biogeographic strata -- North Coast, Mid-Coast, Lakes, Umpqua, and Mid-South Coast. Populations are the basic elements of the ESU, and population strata represent clusters of populations that share ecological or geographic and genetic similarities. Collectively, the five strata form the ESU as a whole (Figure 2-3).

[12] TRT Table 1

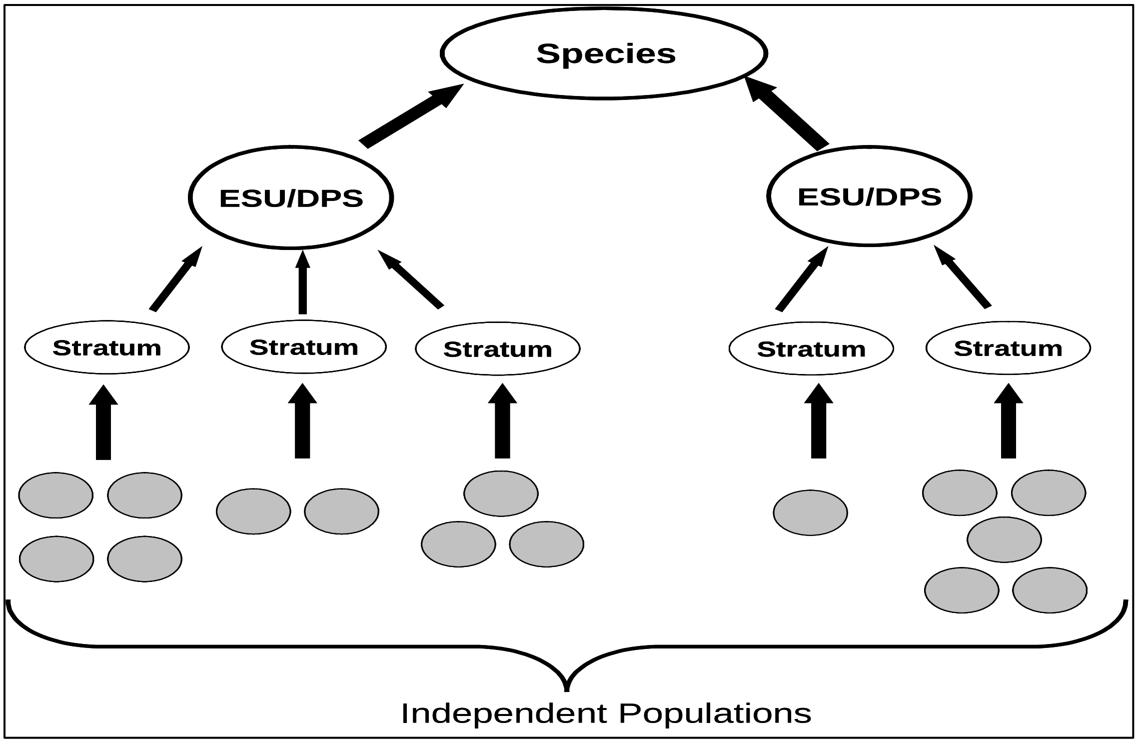


Figure 2-3. Hierarchical population structure within ESA-listed ESUs, as identified by the TRT.

2.2.4 Hatchery Release of Coho Salmon in the ESU

In order to augment commercial and recreational harvest of Oregon Coast coho salmon, ODFW and private parties developed numerous hatchery programs, which reached a peak production of approximately 35 million fish in 1981[13]. In the early 1990s, ODFW released hatchery coho salmon in 17 independent populations, with 16 different brood stocks throughout the ESU.

Hatchery managers reduced or eliminated coho salmon hatchery programs on the Oregon coast starting in the 1990s due to concerns over the negative impact that they were having on naturally spawning coho salmon and for budgetary reasons.[14] By 2009, the number of coho salmon hatchery fish released had fallen to approximately 260,000 smolts (Figure 2-2), (ODFW 2005a; ODFW 2009a, 2009b) and hatchery coho salmon were released in only three of the ESU populations (Nehalem, Trask, and South Umpqua) with three brood stocks still in propagation (ODFW 2009b). Figure –2-4 shows the location and size of current hatchery programs.

[13] 73 FR 7828

[14] Hatchery managers reduced or eliminated coho salmon hatchery programs on the Oregon coast starting in the 1990s, thereby greatly reducing concerns over the negative impact that they were having on naturally spawning coho salmon and for budgetary reasons.

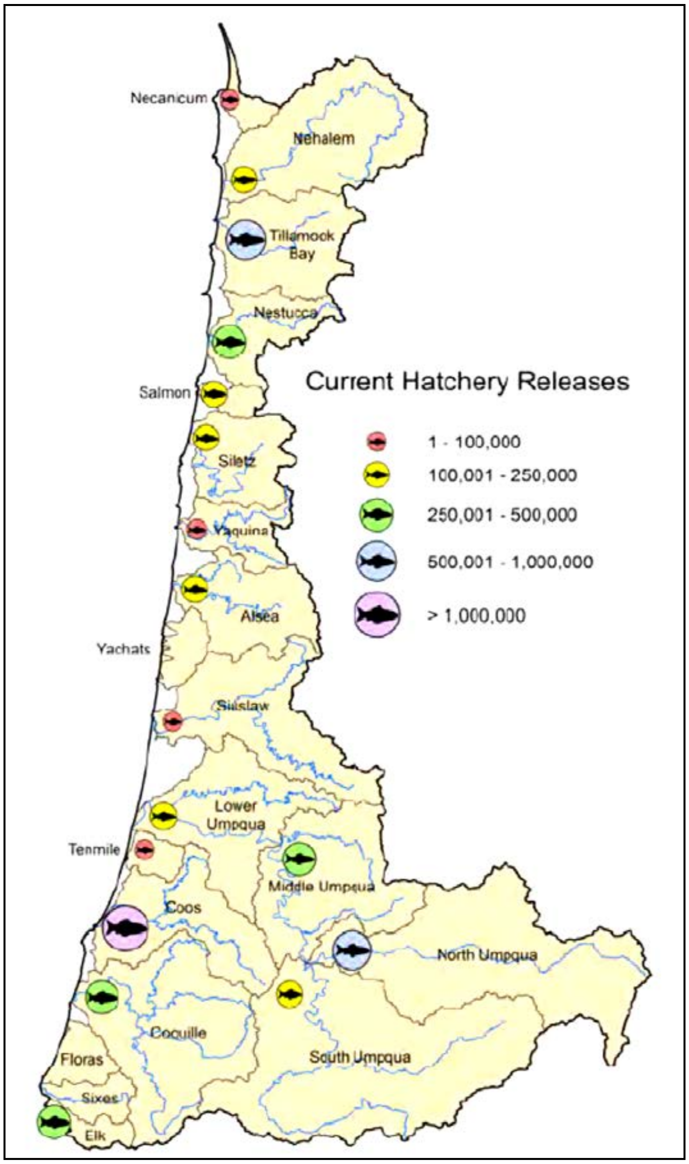


Figure 2-4. Location of current hatchery fish releases (total numbers of Chinook and coho salmon, and steelhead released) from the Elk River to Necanicum River by ODFW. Figure taken from ODFW (2014).

Artificial Propagation — Membership in the ESU

As part of its evaluation, the BRT considered membership of fish from hatchery programs within the ESU, applying NMFS' Policy on the Consideration of Hatchery-Origin Fish in ESA Listing Determinations (NMFS 2005, 70 FR 37204). The BRT determined that only one, Cow Creek (South Umpqua), of three hatchery programs that produce coho salmon within the boundaries of this ESU should be considered part of the ESU. The North Fork Nehalem and Trask (Tillamook) hatchery programs are not included in the ESU.

- The Cow Creek stock (South Umpqua population) is managed as an integrated program and is included as part of the ESU because the original brood stock was founded from the local natural-origin population and natural- origin coho salmon have been incorporated into the brood stock on a regular basis. The Cow Creek stock is probably no more than moderately diverged from the local natural-origin coho salmon population in the South Umpqua River because of these brood stock practices and is therefore considered a part of this ESU.

- The North Fork Nehalem coho stocks are managed as an isolated harvest program. Natural-origin fish have not been intentionally incorporated into the brood stock since 1986, and only adipose fin clipped brood stock have been taken since the late 1990s. Because of this, the stock is considered to have substantial divergence from the native natural population and is not included in the Oregon Coast coho salmon ESU.
- The Trask (Tillamook population) coho salmon stock is also managed as an isolated harvest program. Natural-origin fish have not been incorporated into the brood stock since 1996 when all returns were mass marked. Therefore, this stock is considered to have substantial divergence from the native natural population and, based on our Policy on the Consideration of Hatchery-Origin Fish in ESA Listing Determinations, is not included in the Oregon Coast coho salmon ESU.

2.2.5 Critical Habitat Designation

Section 4(a)(3) of the ESA requires the federal government to designate "critical habitat" for any species it lists under the ESA. The Act defines critical habitat as areas that contain physical or biological features that are essential for the conservation of the species, and that may require special management or protection and requires that critical habitat designations be based on the best scientific information available, in an open public process, within specific timeframes. On February 11, 2008, we designated critical habitat for the Oregon Coast coho salmon ESU (NMFS 2008, 73 FR 7816), and this critical habitat designation remains in effect.

A critical habitat designation does not set up a preserve or refuge, and critical habitat requirements do not apply to citizens engaged in activities on private land that do not involve a federal agency. The designation applies only when federal funding, permits, or projects are involved. Under section 7 of the ESA, all federal agencies must ensure that any actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species, or destroy or adversely modify its designated critical habitat. Before we designate critical habitat, we consider its economic impacts, impacts on national security, and other relevant impacts. The Secretary of Commerce may exclude an area from critical habitat if the benefits of exclusion outweigh the benefits of designation, unless excluding the area will result in the extinction of the species concerned.

The physical and biological elements, also called "primary constituent elements," or PCEs, that support one or more life stages and that we consider essential to the conservation of the species are described in detail in the final rule designating critical habitat for 12 West Coast salmon and steelhead ESUs/DPSs (NMFS 2005, 70FR52630). Habitat essential for the conservation of Oregon Coast coho salmon consists of four components: (1) spawning and juvenile rearing areas: (2) juvenile migration corridors; (3) areas for growth and development to adulthood; and (4) adult migration corridors.

Essential features of spawning and rearing areas are described in Table 2-3 below. The adult migration corridors are the same areas, and the essential features are the same with the exception of adequate food (adults do not eat on their return migration to natal streams).

Table 2-3 is a summary of the physical and biological features that we consider essential for coho salmon.

Table 2-3. Types of sites and essential physical and biological features designated as PCEs for anadromous salmonids, and the life stage each PCE supports (Bambrick et al. 2004).

Site	Essential Physical and Biological Features	ESU/DPS Life Stage
Freshwater spawning	Water quality, water quantity, and substrate	Spawning, incubation, and larval development
Freshwater rearing	Water quantity and floodplain connectivity	Juvenile growth and mobility
	Water quality and forage	Juvenile development
	Natural cover[a]	Juvenile mobility and survival
Freshwater migration	Free of artificial obstructions, water quality and quantity, and natural cover[b]	Juvenile and adult mobility and survival
Estuarine areas	Free of obstruction, water quality and quantity, and salinity	Juvenile and adult physiological transitions between salt and freshwater
	Natural cover,[a] forage,[b] and water quantity	Growth and maturation
Nearshore marine areas	Free of obstruction, water quality and quantity, natural cover,[a] and forage[b]	Growth and maturation, survival
Offshore marine areas	Water quality and forage[b]	Growth and maturation

[a] Natural cover includes shade, large wood, log jams, beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

[b] Forage includes aquatic invertebrate and fish species that support growth and maturation.

We recognize that salmon habitat is dynamic and that present understanding of areas important for conservation will likely change as recovery planning sheds light on areas that can and should be protected and restored, such as areas upstream of barriers where fish could be reestablished in historical habitat.

2.2.6 Other Species that could benefit from this Plan

A major component of this Plan is the protection and restoration of the habitat that is critical for Oregon Coast coho salmon recovery. Other species are likely to benefit from improved natural ecosystem function as well, including eulachon, green sturgeon, spring and summer Chinook salmon, chum salmon, winter and summer steelhead, and cutthroat trout. In this respect, we intend this Plan, while focused on a single-ESA-listed species, to be supportive of and consistent with the broader goals of ecosystem protection and restoration on the Oregon Coast.

3. Threats Assessment and Listing Factors

In Section 2 we described the decline in the abundance of Oregon Coast coho salmon, from between one and two million historically, to as low as 20,000 from the 1970s into the 1990s. In this Section, we describe the fundamental causes of this decline and what has changed since ESA listing. The causes of decline are not unique to Oregon Coast coho salmon, but are consistent with other species of salmon and steelhead as well as the findings described in section 2 of the ESA, where Congress declared that:

1. various species of fish, wildlife, and plants in the United States have been rendered extinct as a consequence of economic growth and development untempered by adequate concern and conservation; and
2. other species of fish, wildlife, and plants have been so depleted in numbers that they are in danger of or threatened with extinction.

3.1 Background: Threats and Limiting Factors

Designing effective recovery strategies and actions requires an understanding of limiting factors and threats that led to the species' decline and continue to hinder viability. For the purposes of recovery planning, we define the terms threats and limiting factors as follows:

Threats

Threats are human activities or natural events, such as floodplain development or drought, that cause (direct threats) or contribute to (indirect threats) limiting factors. Threats may exist in the present or be likely to occur in the future. While the term "threats" carries a negative connotation, it does not mean that activities identified as threats are inherently undesirable. They are often legitimate human activities that may have unintended negative consequences on fish populations—and that can be managed in a manner that minimizes or eliminates the negative impacts. As discussed previously, many improvements have been made to reduce the threats to Oregon Coast coho salmon since they were listed.

> Primary Limiting Factors
>
> For recovery of Oregon Coast coho salmon, our primary focus is on degraded habitat, particularly rearing habitat. State and federal scientific reports and findings identify reduced stream complexity and degraded water quality (especially increased water temperature) as the primary limiting factors for this species.

The term 'threats' is often used as synonymous with the listing factors detailed in the ESA section 4(a)(1). Consequently we have categorized the threats to Oregon Coast coho salmon based on section 4(a)(1) of the ESA:

A. The present or threatened destruction, modification, or curtailment of the species' habitat or range
B. Over-utilization for commercial, recreational, scientific, or educational purposes
C. Disease or predation

D. The inadequacy of existing regulatory mechanisms
E. Other natural or human-made factors affecting the species' continued existence

Limiting Factors

Limiting factors are biological, physical, or chemical conditions and associated ecological processes and interactions that limit a species' viability. Key limiting factors are those with the greatest impacts on a population's ability to reach the desired status.

A single limiting factor may be caused by one or more threats. Likewise, a single threat may cause or contribute to more than one limiting factor and may affect more than one life stage. In addition, the impact of past threats may continue to contribute to current limiting factors through legacy effects. For example, current high water temperature could be the result of earlier practices that reduced stream complexity and shade by removing trees and other vegetation from the streambank. Designing effective recovery strategies and actions requires an understanding of the range and impact of limiting factors and threats affecting the species, across its entire life cycle.

3.2 Factors that Led to Listing of Oregon Coast Coho Salmon

Many human activities contributed to the original ESA listing of OC coho salmon as a threatened species. In 1998, NMFS determined: "For coho salmon populations in Oregon, the present depressed condition is the result of several longstanding, human-induced factors (e.g., habitat degradation, water diversions, harvest, and artificial propagation) that serve to exacerbate the adverse effects of natural environmental variability from such factors as drought, floods, and poor ocean conditions (NMFS 1998)."[15] A subsequent status review in 2003 by NMFS' BRT found that risks posed by hatchery fish and fisheries had been greatly remedied, but questioned whether the ESU's deteriorated freshwater habitat was capable of supporting levels of coho productivity needed to sustain the species during periods of poor ocean conditions (Good et al. 2005).

Table 3-1 lists the human-made and natural factors that contributed to ESA listing, and to the reaffirmation of the listing. It also identifies human activities that contributed to listing the OC coho salmon as threatened. The table is organized by the Listing Factors in the ESA section 4(a).

[15] (63 FR 42587).

Table 3-1. Summary of how human-made and natural factors (underlying causes) contributed to listing of Oregon coast coho salmon.

Human Activities and Natural Factors	Summary of how activities and factors contributed to listing Oregon Coast coho salmon (limiting factors)
A. The present or threatened destruction, modification, or curtailment of the species' habitat or range (Section 3.2.1)	
Cumulative effects of all human activities that threaten coastal coho salmon viability	BRT (2010) findings: Little evidence of an overall improving trend in freshwater habitat conditions since mid-1990s, and evidence of negative trends in some strata. Ongoing uncertainty about the future management of habitat, particularly forested habitat on state, federal, and private lands. Persistence of numerous primary threats to OC coho salmon, including legacy effects from past forest management, and agricultural activities and urban development in high intrinsic potential habitat, global climate change, etc. (NMFS 2011, 76 FR 35755).
Protecting property and infrastructure by confining rivers and streams with levees, bulkheads, rip-rap and other armaments, dams, tide gates, culverts, etc.	Reduced habitat complexity is the key limiting factor for OC coho salmon (# of habitat units per length of stream, # pools , amount of wood etc. that control channel features). Complexity contributes to slow moving water and sheltered conditions necessary for juvenile rearing. Any construction, including roads, dams, tide gates etc. can block OC coho salmon access to habitat. Coho suffer reduced life history diversity due to altered ecosystem.
Estuary and wetland development and floodplain development that impairs stream habitat	Altered ecosystem function resulted in reduced rearing habitat
Withdrawing water	Reduced water availability (esp. Mid-South Coast Stratum); reduced connectivity of streams; increased temperature, reduced growth and survival
Building and maintaining roads that impair stream habitat	Negative correlation between road density and coho salmon productivity.
Forest management activities that impair stream habitat	Historical and ongoing timber harvest and road building have reduced stream shade, increased fine sediment levels, reduced levels of instream large wood, and altered watershed hydrology (and natural sediment production, storage, and transportation regimes). Fish passage blocked in many streams by improperly designed culverts.
Agriculture (farming and ranching) activities that impair stream habitat	Significant amounts of 'high intrinsic potential' rearing habitat are found on private lands used for agriculture and have been destroyed or degraded by land management including reduced or eliminated riparian buffers and reduced stream complexity and rearing habitat.
Mining (gravel etc.) activities that impair stream habitat	Altered riparian function due to removal of gravel from streams has reduced rearing habitat, significantly in some areas.
Converting land to urban and residential uses and maintaining urban and residential properties that impair stream habitat	Urban and rural-residential development has caused profound changes in storm water runoff and other changes which have decreased coho salmon habitat quality and availability.
Removing beaver	Reduction in ponded habitat has caused significant loss of coho salmon rearing habitat.
All activities that affect water quality	Water quality has long been identified as a factor for decline (NMFS 1997) and a limiting factor for recovery (ODFW 2005a) for OCCS. Water quality problems largely relate to nonpoint source pollution and flow and channel modification and increased temperature has been identified as a concern, with near lethal temperatures in some streams in the summer.
Introduction of invasive species	Invasive species have disrupted native plant and animal communities.
B. Over-utilization for commercial, recreational, scientific, or educational purposes (Section 3.2.2)	
Reducing the number of spawners by catching OC coho in directed commercial and recreational fisheries, and as incidental catch in other fisheries.	Very high harvest levels (as high as 90%) greatly reduced the abundance of OC coho salmon prior to the late 1990s.
C. Disease and predation (Section 3.2.3)	

Human Activities and Natural Factors	Summary of how activities and factors contributed to listing Oregon Coast coho salmon (limiting factors)
Introducing and protecting predators	Predation on coho salmon by non-native predators (bass and other warm water non-native fishes) is considered a primary threat to the lake populations.
D. The inadequacy of existing regulatory mechanisms (Section 3.2.4)	
Multiple human activities that result in loss of habitat or direct mortality of OC coho salmon,	"Current protective efforts are insufficient to provide for freshwater habitat conditions capable of producing a viable ESU" (76 FR 35755)." … a long and growing list of secondary threats including invasions of exotic organisms, poor water quality, and land-use conversion (NMFS 2011, 76 FR 35755)
E. Other natural or human-made factors affecting the species' continued existence (Section 3.2.5)	
Changes in ocean conditions affecting survival	A twenty year-long period 'warm regime' resulted in repeated years of poor ocean survival (1977-97)
Operating coho salmon hatcheries	Very high levels of hatchery production contributed to increased risk to the natural
Effects of Climate Change	"global climate change is likely to result in further degradation of freshwater habitat conditions and poor marine survival" (NMFS 2011, 76 FR 35755)

The factors that have affected Oregon Coast coho salmon are consistent with what was happening to salmon habitat elsewhere, as the following excerpt (Roni and Beechie 2013) and Figure 3-1 explain:

> "The most severe impacts to aquatic systems in North America, Europe and elsewhere arguably occurred in the late 19th and during the 20th century. Increasingly mechanized societies channelized and degraded rivers, drained wetlands, cut down entire forests, intensified agriculture, and build dams for power, irrigation, and flood control. This history of land and water uses along with other human activities produced the degraded conditions we see on the landscape today…. The above factors, coupled with an increasing human population, have led to increased air pollution, highly modified and polluted rivers, and a rapid increase in number of threatened and endangered, or extinct species.[16]"

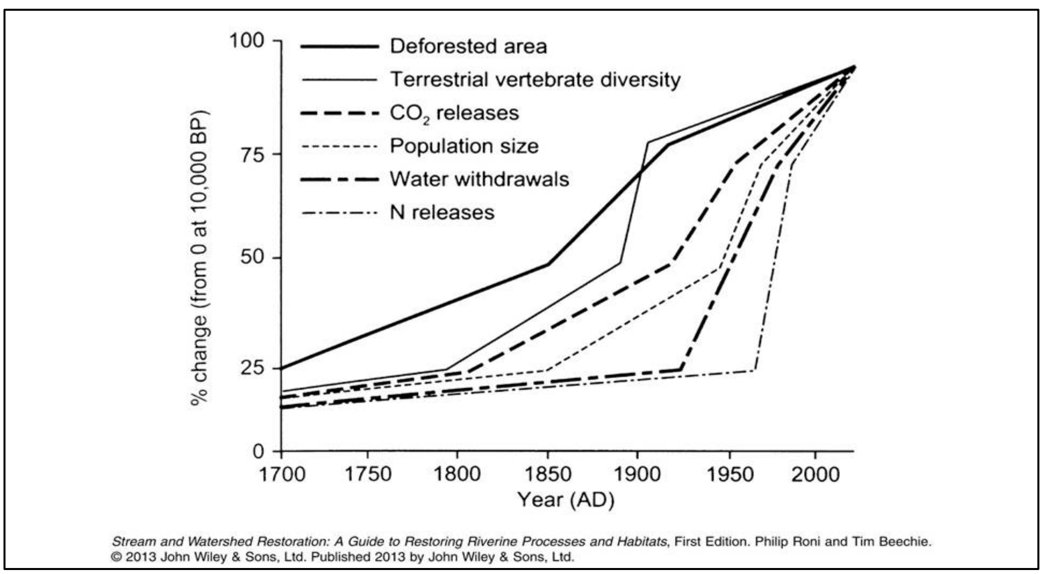


Figure 3-1. Increase in selected human impacts during the last 300 years (percent increase compared to 10,000 BP). From Roni and Beechie 2013. Reproduced by permission of John Wiley & Sons.

[16] Roni and Beechie 2013 p 4

3.3 How the Listing Factors Affect ESU Status

Since the original listing of the ESU, many of the threats that contributed to the species' listed status have been addressed and now present little harm to the ESU while others continue to threaten viability. Impacts from ocean and inriver fisheries are now better regulated through ESA-listing constraints and management agreements, significantly reducing harvest-related mortality. Hatchery-related concerns have also declined due to reduced hatchery production. There have also been improvements in habitat conditions; however, the BRT recently found that the legacy of past forest management practices combined with lowland agricultural and urban development have resulted in a situation where the areas of highest potential habitat capacity for coastal coho salmon are now severely degraded. The BRT determined that this long-term loss of high value rearing habitat had increased the vulnerability of the ESU to near-term and long-term climate effects (Stout et al. 2012).

This section discusses the remaining threats for Oregon Coast coho salmon that continue to affect ESU viability and is organized according to the five listing factors in ESA section 4(a)(1). Section 3.3.1 discusses factors that present or threaten destruction, modification, or curtailment of the species' habitat or range. Section 3.3.2 describes factors related to over-utilization for commercial, recreational, scientific, or educational purposes. Section 3.3.3 identifies factors related to disease and predation. Section 3.3.4 discusses concerns related to the inadequacy of existing regulatory mechanisms. Section 3.3.5 describes other natural or human-made factors affecting the species' continued existence. We use this same framework in succeeding sections that describe recovery goals and delisting criteria for each of the listing factors, assess the current status of the Listing Factors compared to the recovery goals and delisting criteria, and to describe strategies and actions to reach the ESA recovery goals.

Identification of limiting factors for Oregon Coast coho salmon is based on a substantial body of research on salmonids, local field data and field observations, and the considered opinions of regional experts. We identified these factors based on previous FRNs, proposed rule, previous BRT reports (Weitkamp et al. 1995; Good et al. 2005), as well as numerous other reports and assessments (ODFW 1995; ODFW 2005a; ODFW 2007) that have reviewed in detail the effects of historical and ongoing land management practices that have altered Oregon coast coho salmon habitat. We draw mainly on the BRT status review (Stout et al. 2012) that describes the factors that have led to the current degraded condition of Oregon Coast coho salmon habitat. We direct readers to this report for a more detailed discussion on the comprehensive analysis of factors affecting habitat conditions.

3.3.1 Factor A. The present or threatened destruction, modification, or curtailment of the species' habitat or range

Threat: Historical, current and future land use activities that affect watershed and estuarine functions that support habitat for CO coho salmon.

Primary related limiting factors: Reduced stream complexity, degraded water quality, and blocked/hindered fish passage.

Discussion of current concerns for Factor A:

In 2011, NMFS’ BRT expressed concern that the long-term decline in Oregon Coast coho salmon productivity reflected deteriorating conditions in freshwater habitat, and that the remaining quality of the habitat may not be high enough to sustain species productivity during cycles of poor ocean conditions (Stout et al. 2012). The BRT reviewed the factors that have led to the current degraded condition of Oregon Coast coho salmon habitat. We briefly summarize this information here and direct readers to the comprehensive analysis of factors affecting Oregon Coast coho salmon habitat in the BRT report (Stout et al. 2012) for more detail. Several other documents also discuss the effects of historical and ongoing land management practices that have altered Oregon Coast coho salmon habitat, including NMFS’ previous FRNs, proposed rule and previous BRT reports (Weitkamp et al. 1995; Good et al. 2005), as well as numerous other reports and assessments (ODFW 1995; ODFW 2005b; ODFW 2007).

In 2005, the state of Oregon conducted the Oregon Coastal Coho Assessment (ODFW 2005b). The assessment identified the following factors, identified in Table 3-2, as primary and secondary limiting factors for populations in the Oregon Coast coho salmon ESU.

Table 3-2. Primary and secondary limiting factors for independent populations (BRT Table 2, ODFW 2005b).

Population	Primary limiting factor	Secondary limiting factor
North Coast Stratum		
Necanicum	Stream complexity	None identified
Nehalem	Stream complexity	Water quality
Tillamook	Stream complexity	Water quality
Nestucca	Stream complexity	None identified
Mid-Coast Stratum		
Salmon	Hatchery impacts[17]	Stream complexity
Siletz	Stream complexity	None identified
Yaquina	Stream complexity	Water quality
Beaver	Spawning gravel	Stream complexity
Alsea	Stream complexity	Water quality
Siuslaw	Stream complexity	Water quality
Umpqua Stratum		
Lower Umpqua	Stream complexity	Water quality
Middle Umpqua	Water quantity	Stream complexity, water quality
North Umpqua	Hatchery impacts[18]	Stream complexity
South Umpqua	Water quantity	Stream complexity, water quality
Lakes Stratum		
Siltcoos	Non-native	Stream complexity, water quality
Tahkenitch	Invasive species	Stream complexity, water quality
Tenmile	Invasive species	Stream complexity, water quality
Mid-South Coast Stratum		
Coos	Stream complexity	Water quality
Coquille	Stream complexity	Water quality
Floras	Stream complexity	Water quality
Sixes	Stream complexity	Water quality

[17] Hatchery Releases of coho were terminated by ODFW in these populations.
[18] Hatchery Releases of coho were terminated by ODFW in these populations.

Historically, habitat conditions in the coastal watersheds supported productive and sustainable coho salmon populations. Natural processes created complex instream habitats with deep pools and strong connections to floodplains. Many stream channels contained abundant large wood from surrounding riparian hardwood galleries and upstream conifer forests. Stream temperatures were generally sufficient to support all coho salmon life stages throughout the year, as upland and riparian conditions allowed for the storage and release of cool water during summer months and provided shaded sufficient to keep water temperatures cool. Extensive and abundant riparian vegetation armored streambanks, providing protection against erosion.

Conditions in these tributary drainages have changed considerably over the last 150 years. Together, past land use practices across the region contributed significantly to causing the factors now limiting abundance, productivity and diversity of Oregon Coast coho salmon. In this section we describe three primary habitat-related limiting factors for coho salmon: reduced stream habitat complexity, degraded water quality, and blocked/impaired fish passage. These degraded conditions reflect changes in the watersheds due to land use practices that together have weakened natural watershed processes and functions, including loss of connectivity to historical floodplains, wetlands and side channels; reduced riparian area functions; and altered flow and sediment regimes.

Reduced habitat complexity

Loss of stream complexity was identified as a primary limiting factors for many Oregon Coast coho salmon populations by ODFW (ODFW 2005b). Oregon's assessment identified stream complexity as the primary or secondary limiting factor for all 21 independent coho salmon populations (Table 3-2). The state of Oregon also identified stream complexity as a primary limiting factor in the Oregon Coast Coho Conservation Plan (ODFW 2007).

Stream complexity refers to the ability of a stream to provide a variety of habitat conditions that support adult coho salmon spawning, egg incubation and juvenile rearing. The loss of habitat capacity and degraded conditions to support overwinter rearing of juvenile coho salmon is especially a concern. Sufficient habitat capacity and complexity is critical to produce enough recruits-per-spawner to sustain productivity, particularly during periods of poor ocean conditions. Habitat conditions that create sufficient complexity for juvenile rearing and overwintering include large wood, pools, connections to side channels and off-channel alcoves, beaver ponds, lakes, and connections to wetlands, backwater areas and complex floodplains. Many of these habitat conditions are maintained through connection to the surrounding landscape.

Several historical and ongoing land uses have reduced stream capacity and complexity in Oregon coastal streams and lakes through disturbance, road building, splash damming, stream cleaning, and other activities. Timber activities have reduced levels of instream large wood, increased fine sediment levels and altered watershed hydrology. Historical splash damming removed stream roughness elements, such as boulders and large wood, and in some cases scoured streams to bedrock. Agricultural activities altered stream stability by removing stream-side vegetation and through the building of dikes and levees that disconnected streams from their floodplains and resulted in loss of natural stream sinuosity. Instream and off-channel gravel mining removed natural stream substrates and altered floodplain function. Urban development has also led to building of roads by streams, stream channelization and loss of instream wood in some areas. Future conversion of forest and agricultural land to urban and suburban development is likely to result in an increase in these effects (Burnett et al. 2007). Agencies also added to the loss of stream complexity though past stream cleaning activities. While ODFW ended this practice, the legacy effects from the loss of large amounts of wood in coastal stream systems continues to affect habitat conditions for coho salmon.

The loss of beaver has also contributed to the degradation of stream habitat conditions. Beavers provide considerable help in maintaining proper watershed functioning in coastal Oregon streams (Stout et al. 2012). Removal of beaver from areas inhabited by coho salmon has led to reduced stream and floodplain complexity and loss of freshwater wetlands.

Overall, the BRT found that stream habitat complexity and summer parr capacity are decreasing in the Umpqua Stratum but increasing in the other strata. Winter parr capacity is trending flat in the North Coast and Mid-Coast strata, but declining in the Mid-South Coast and Umpqua strata. Large wood volume appears to be declining in the North Coast and Umpqua strata, while increasing in the Mid-Coast and Mid-South Coast strata. Large wood trends in upstream areas declined substantially in all strata.

In addition to describing the reduced stream complexity, the BRT noted that "…extensive loss of access to habitats in estuaries and tidal freshwater may have been an important factor in reducing population diversity in (OC coho salmon)." The 2012 BRT report added loss of estuarine habitat as a threat to OC coho salmon recovery (Stout et al. 2012). Types of estuarine development are discussed in the section below on blocked passage. Degraded estuarine conditions are considered an emerging issue of concern, prompted in large part by the extensive research into the role of the estuary in the Salmon River Basin.[19] Interest in the role of estuaries in the coastal ecosystem is growing along with efforts to better understand and protect the estuarine environments on the Oregon Coast. For instance, the Nature Conservancy has led the formation of the Pacific Marine and Estuarine Fish Habitat Partnership, one of 19 nationally recognized partnerships seeking to understand juvenile fish habitat. A main project of this partnership is to conduct an assessment of the role estuaries play in the life of juvenile fish.

Figure 3-2 shows that the number of smolts has stayed relatively constant since 2000, despite large variations in the number of adults. This suggests that reduced rearing habitat has limiting the number of juveniles that survive to reach the ocean, underscoring the importance of protecting and restoring rearing habitat.

[19] See for instance Jones et al 2014.

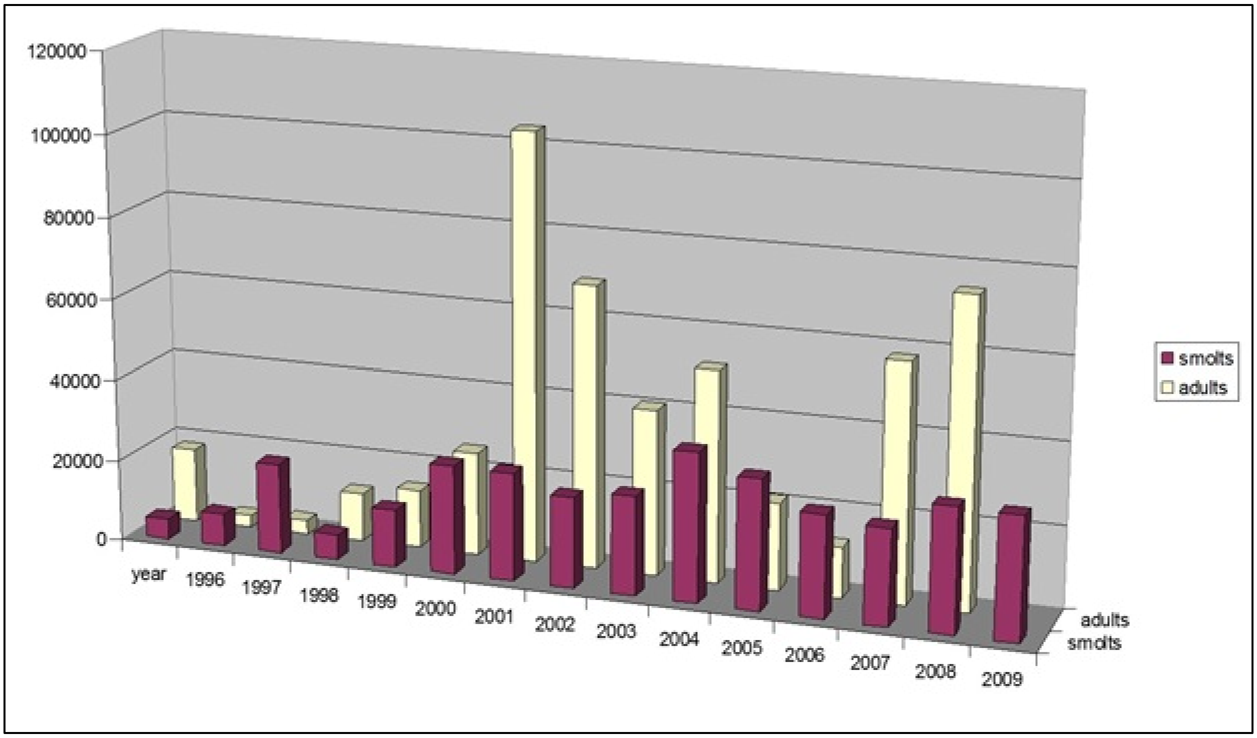


Figure 3-2. Comparison of the number of adult OC coho salmon to smolt, 1995-2009 (ODFW 2015).

Degraded water quality

Water quality has been identified as a factor for decline (NMFS 1997) and as a limiting factor for recovery (ODFW 2005b) of Oregon Coast coho salmon. In its 2005 assessment, the state of Oregon identified water quality as the primary or secondary limiting factor for 13 of the 21 coho salmon populations (Table 3-2). Primary water quality concerns include high water temperatures, increased fine sediment levels, and pollutants.

The BRT (Stout et al. 2012) determined that water temperature is the primary source of water quality impairment in the Oregon Coast coho salmon critical habitat. It found that many of the streams coho salmon juveniles inhabit are already close to lethal temperatures during the summer months. A number of streams were listed as temperature impaired by the EPA, as shown in Figure 3-3. Since that report, the list of temperature and sediment impaired streams has expanded and we will update this information in the final recovery plan.

Water temperature has been negatively correlated with coho salmon survival and abundance in freshwater (Lawson et al. 2004, Crozier et al. 2008b). Higher temperatures in the summer limit the quantity of stream habitat that is available for juvenile salmon rearing, while high temperatures in the fall can block adult migrants from reaching spawning grounds (Ebersole et al. 2006). High water temperatures can also disrupt life cycle timing, potentially leading to a mismatch between smolt outmigration timing and onset of upwelling in spring (Crozier et al. 2008b). Parasites and disease can be virulent at higher temperatures (Lawson et al. 2004). High water temperatures are also conducive to the survival and reproduction of non-native fish species such as smallmouth and largemouth bass. Consequently the BRT reached the broad conclusion that the rising temperatures anticipated with global climate change will have an overall negative effect on the status of the ESU (Stout et al. 2012). If 40 percent of the Oregon Coast coho salmon ESU is already temperature impaired (ODEQ 2007), just the effects of climate change in the absence of threats from other human activities like forestry and agriculture pose a significant risk to those systems already impaired, and increase the likelihood of temperature impairment in the rest of the aquatic systems in the ESU.

Several land use activities have contributed to increased water temperatures in coastal streams. Historical and ongoing timber harvest and road building have reduced riparian condition and stream shade. Agricultural activities have also affected water temperatures by removing riparian vegetation, reducing streamflow through water diversion, filing of wetlands and oxbows, channelizing streams to reduce meandering, and by disconnecting streams from floodplains through diking. Urbanization along stream corridors has resulted in filling in wetlands and side channels, loss of streamside vegetation and added impervious surfaces, which alter normal hydraulic processes and can increase water temperature.

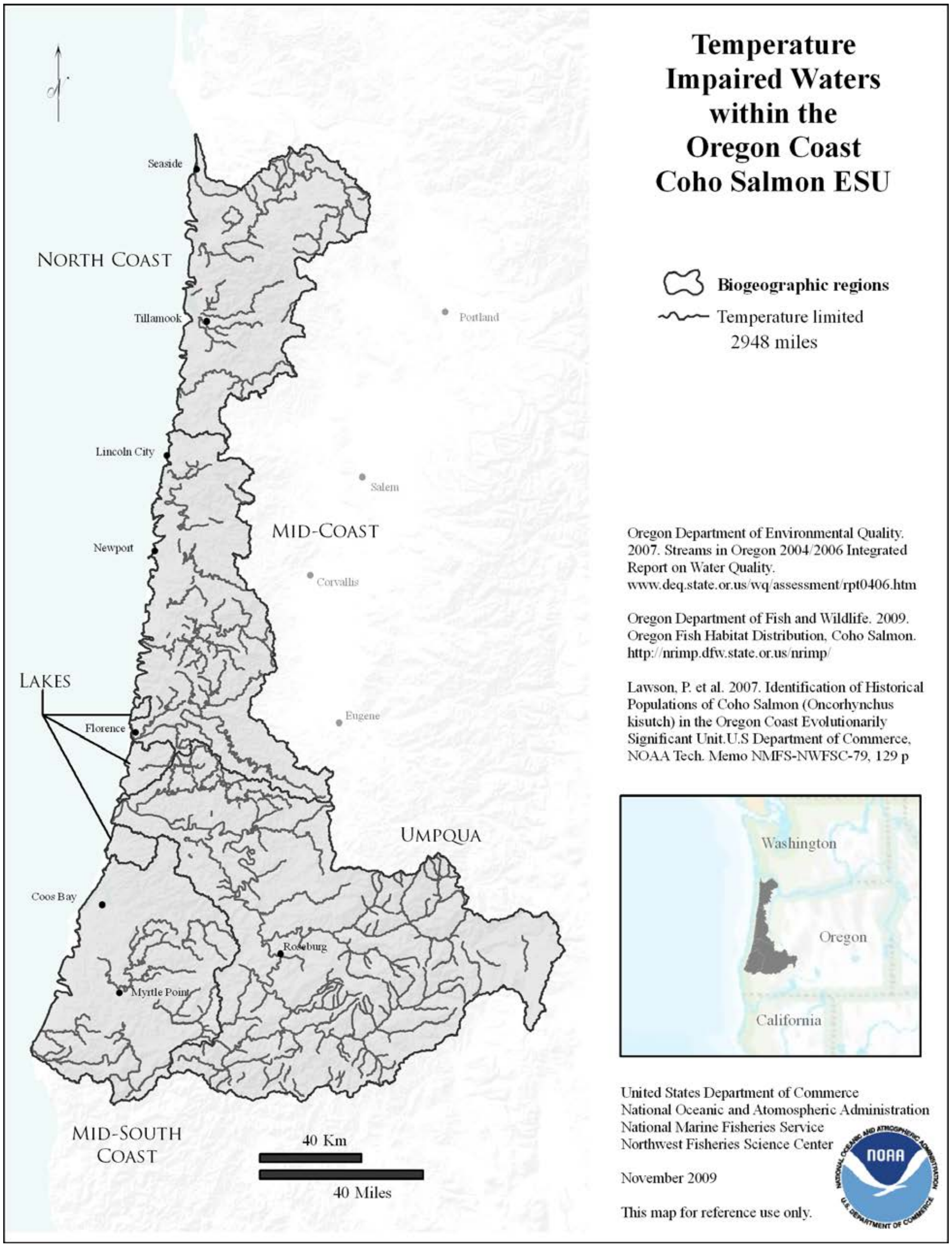


Figure 3-3. EPA 303(d) listed streams with temperature impairment. (Figure 28 in TRT Report)

Increased levels of fine sediments and pollution due to contaminants also affect coho salmon production. Increased sediment loads generally result from historical and current forest management and agricultural operations and road building that lead to erosion and allow sediments to enter streams. Further, stormwater and agricultural runoff that reaches streams is often contaminated by hydrocarbons, fertilizers, pesticides, and other contaminants.

Blocked/ impaired fish passage

There has been extensive loss of access to historical coho salmon habitats in estuaries, tidal freshwater and upstream areas. This has resulted from two sources: fish passage blocked by culverts, tidegates, etc. (i.e. figure 15 in Stout et al. 2012) and loss of habitat and good passage in estuaries (i.e. figure 26 in Stout et al. 2012). Considerable work has been done to eliminate blockages, and fish passage barriers are not considered a major limiting factor for Oregon Coast coho salmon at the ESU level; however, work continues in some areas to identify, assess, and remove barriers.

Fish passage has been restricted in portions of most estuaries by tide gates, dikes, and levees. Often, tide gates serve as a partial barrier to fish movement. Giannico and Sauder (2005) reviewed the effect of tide gates on migratory behavior of salmonids and found that tide gates had direct effects on salmonid movements through abrupt changes in salinity, elevated water velocities and turbulence, and a total physical barrier to fish passage during the time the gate is completely closed (Stout et al. 2012).

Fish passage also has been blocked in some streams by culverts and stream crossings that are not designed to allow fish passage. Many of these past barriers to coho salmon passage have been redesigned or removed to improve fish access, but coho salmon passage remains hindered in some streams by improperly designed culverts.

This loss of connectivity reduces availability habitat types and conditions that support species abundance, productivity, and spatial structure. It may also be an important factor in reducing population diversity. The loss of these areas reduced rearing capacity of coastal basins, which all terminate in tidally influenced freshwater/ brackish/ saltwater wetland or estuarine habitats. The BRT reports that the amount of tidal wetland habitat available to support coho salmon rearing has declined substantially relative to historical estimates across all of the biogeographic strata (Stout et al. 2012).

Analysis of habitat trends

In addition to identifying primary and secondary limiting factors for Oregon Coast coho salmon (Table 3-2), the BRT described vegetation disturbance (Figures 20, 21, and 22 in Stout et al. 2012) and the five habitat trends used by a Habitat Technical Work Group[20] to measure changes in habitat status for Oregon Coast coho salmon. The results of their analysis of these trends are summarized in Table 3-3. In general, the analysis shows large wood levels and channel complexity declining in several strata while fine sediment levels are on the rise. Further details are available in the full BRT Report, and we expect updated information from ODFW in the near future. In Section 4.3, we present an updated version of these trends as part of the delisting criteria.

Habitat conditions in many stream reaches continue to improve due to restoration efforts. Restoration activities to improve coho salmon habitat have been ongoing since the 1990s, supported by NMFS, OWEB, U.S. Fish and Wildlife Service (USFWS), USFS, other state and federal agencies, and many landowners and stakeholders. Together, these different projects are

[20] Stout et al. 2012, Appendix C.

restoring habitat conditions in estuarine, tidal, and freshwater areas. They are also increasing the amount of wetland and other habitat available to juvenile coho salmon. The BRT determined that if aggregated across Oregon Coast coho salmon independent populations, recent restoration efforts have targeted a total area equivalent to 14–20 percent of current baseline of tidal habitat (Stout et al. 2012). While these habitat restoration projects remain a key element in the recovery process, it remains to be seen if new voluntary measures will have sufficient effects on ecosystem function and coho salmon productivity to provide a net improvement and overcome past and ongoing degradation. Overall, the BRT's analysis of freshwater habitat trends found little evidence for an overall improving trend in freshwater habitat conditions since the mid-1990s, and evidence of negative trends in some strata (Stout et al. 2012).

Table 3-3. Graphical representation of the maximum likelihood analysis and Bayesian analysis trend results. Arrow style indicates strength of trend: black vertical arrow represents greater than 90% Bayesian probability or significance (P < 0.05) of trend; light gray vertical arrow represents greater than 65% Bayesian probability of trend; horizontal gray arrow represents lower (<65%) Bayesian probability of trend or no significant trend detected (maximum likelihood). Upward pointing arrow indicates a positive trend and downward pointing arrow indicates a negative trend. (Note: The arrows indicate the direction of the trend, not an interpretation of the trend relative to coho salmon, so up arrows indicate increasing fine sediments.) (Table 16 in Stout et al. 2012).

	Strata											
	North Coast			Mid-Coast			Mid-South			Umpqua River		
	Maximum likelihood (BRT)	Maximum likelihood (ODFW)	Bayesian probabilities	Maximum likelihood (BRT)	Maximum likelihood (ODFW)	Bayesian probabilities	Maximum likelihood (BRT)	Maximum likelihood (ODFW)	Bayesian probabilities	Maximum likelihood (BRT)	Maximum likelihood (ODFW)	Bayesian probabilities
Winter parr	↔ (gray)	↔ (gray)	↔ (gray)	↔ (gray)	↔ (gray)	↔ (gray)	↔ (gray)	↔ (gray)	↓ (black)	↔ (gray)	↔ (gray)	↓ (light gray)
Summer parr	↔ (gray)	↔ (gray)	↑ (light gray)	↔ (gray)	↔ (gray)	↑ (black)	↔ (gray)	↔ (gray)	↑ (black)	↔ (gray)	↔ (gray)	↓ (light gray)
Channel score	↔ (gray)	↔ (gray)	↑ (light gray)	↔ (gray)	↔ (gray)	↑ (light gray)	↓ (black)	↓ (black)	↓ (black)	↔ (gray)	↔ (gray)	↔ (gray)
Wood volume	↓ (black)	↓ (black)	↓ (black)	↔ (gray)	↔ (gray)	↑ (light gray)	↔ (gray)	↔ (gray)	↑ (black)	↔ (gray)	↔ (gray)	↓ (black)
% fine sediment in riffles	↔ (gray)	↔ (gray)	↓ (black)	↔ (gray)	↔ (gray)	↓ (light gray)	↑ (black)	↑ (black)	↑ (black)	↔ (gray)	↔ (gray)	↔ (gray)

3.3.2 Factor B: Over-utilization for commercial, recreational, scientific, or educational purposes

Threat: Overharvest of Oregon Coast coho salmon in ocean and freshwater fisheries.

Related limiting factors: Reduced spawning escapement and of Oregon Coast coho salmon from fishery harvest mortality.

Discussion of current concerns for Factor B

While fishery harvest in the past contributed to the decline of Oregon Coast coho salmon, the BRT (2012) concluded that reductions in harvest mortalities since 1993 have reduced the threat to the ESU and that further harvest restrictions will not reduce the risks to ESU persistence.

Today, all fisheries for Oregon Coast coho salmon continue to be managed according to the provisions set forth in Amendment 13 of the Pacific Fishery Management Council's Pacific Coast Salmon Fishery Management Plan. Amendment 13 is structured so that cumulative fishery mortality from all fisheries affecting Oregon Coast coho salmon will not impede the recovery potential for the ESU. Fishery impacts are capped at 35 percent, but typically range from 10-20 percent. Amendment 13 sets harvest impact rates using a two dimensional matrix with parental status and a marine survival index as axes. This approach allows impacts to be minimized when populations are at low abundance or where ocean conditions are poor. Harvest impacts at higher abundance may limit progress toward conservation or recovery goals, but they do not represent a threat to viability.

Amendment 13 is intended to ensure the Fishery Management Plan is consistent with NMFS advisory guidelines. The guidelines describe fishery management approaches to meet the objectives of National Standard 1 (NS1) of section 301 of the Magnuson-Stevens Fishery Conservation and Management Act, which states "Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield (OY) from each fishery for the U.S. fishing industry."

Currently, Amendment 13 protects Oregon Coast coho salmon from overutilization in commercial and recreational fisheries. Consequently, NMFS does not consider harvest a current threat to recovery of the ESU. ODFW, NMFS and others continue to adaptively manage fisheries based on Amendment 13, with annual fishery assessments based on new information and methodologies. Section 6 of this Plan provides a recovery strategy and actions to continue to protect the species from overutilization.

3.3.3 Factor C: Disease or predation

Threat: Disease and increase in parasites.

Related limiting factors: Reduced coho productivity due to increases in infection of juvenile coho salmon by parasites and disease.

Threat: Predation from birds, marine mammals and warm water fishes

Related limiting factors: Predation may reduce coho salmon productivity

Discussion of current concerns for Factor C:

Disease

ODFW (2005), in its assessment of Oregon Coast coho salmon, asserted that disease and parasitism is not an important consideration in the recovery of this ESU. More recently, however, the BRT determined that, as many of the streams coho salmon juveniles inhabit are already close to lethal temperatures during the summer months, and with the expectation of rising stream temperatures due to global climate change, increases in infection rates of juvenile coho salmon by parasites may become an increasingly important stressor both for freshwater and marine survival (Stout et al. 2012). In addition, disease and infection of juvenile coho salmon in the first few months of ocean residence is also a key concern.

Predation by birds and marine mammals

The BRT identified several bird species and marine mammals that prey on Oregon Coast coho salmon, but concluded that avian and mammalian predation may not have been a significant factor for decline when compared with other factors. More recent work showing predation by birds and marine mammals has raised concerns for some coho salmon populations in the ESU.

Predation by introduced warm water fishes

The BRT voiced more concern about predation on Oregon Coast coho salmon from introduced warm water fishes such as smallmouth bass (*Micropterus dolomieu*) and largemouth bass (*Micropterus salmoides*). These predatory fish are more abundant in the lakes and the lower, middle and south Umpqua River populations. The BRT concluded that predation and competition from exotic fishes, particularly in light of the warming water temperatures from global climate change, could seriously affect the lake and slow-water rearing life history of Oregon Coast coho salmon by increasing predation (Stout et al. 2012). Further, ODFW's conservation plan recognizes that coho salmon populations in the Lakes basins ((Tahkenitch, Siltcoos, and Tenmile) are primarily limited by interactions (including predation) with exotic (warm water) fish species. The OCCCP identifies predation as one of eight high priority topics for research and evaluation related to coastal coho salmon. Topics include "Evaluate cause and impact of marine mammal, avian and exotic fish predation on Coastal salmonids and coho in particular (ODFW 2007)."

In Stout et al 2012, the BRT noted:

> "EPA (2009) commented that non indigenous species (NIS) fish are capable of ecosystem changing effects as well of those of predation. NIS warm water fishes pose a future threat to coho rearing due to ecosystem change as well as predation if anticipated temperature rise associated with global climate change occurs. [Another review] (reference Appendix D in the BRT document) commented that predation and competition, particularly in light of the warming water temperatures from global climate change, could significantly affect the lakes and slow water rearing life history of OCCS, not only by NIS fish but by native invasions as well (Reeves et al. 1998). As water temperatures increase, NIS warm water and other native

> fish will be at an even greater advantage over OCCS in lake and slow water situations due to predation, competition, and ecosystem alterations.
>
> … in anticipating future conditions, as water temperatures increase there is greater risk to (OC coho salmon) in lake and slow water situations due to predation, competition, and ecosystem alterations. This effect on the slow water and lake life histories of (OC coho salmon) may present a significant threat to diversity of the species."

Since ESA listing, ODFW has liberalized size and bag limits on smallmouth bass in the Umpqua River Basin. In 2016 and beyond, there are no limits on the harvest of smallmouth bass throughout the basin. In addition, there are no limits on smallmouth bass that were illegally introduced in the Coquille Basin.

3.3.4 Factor D: The inadequacy of existing regulatory mechanisms

Threat: Ineffective regulatory mechanisms

Related limiting factors: The lack of adequate regulatory authority and/ or enforcement capabilities to protect long-term viability of Oregon Coast coho salmon.

Discussion of current concerns for Factor D

Several federal, state, and local regulatory mechanisms protect Oregon Coast coho salmon and their habitat. Any delisting decision would need to be supported by evidence that the threats facing the species have been ameliorated and that regulatory mechanisms are in place to continue conserving the species and habitat, and help prevent a recurring need to relist the species. NMFS' final listing determination for Oregon Coast coho salmon in 2011 stated in part:

> "Existing regulations governing coho salmon harvest have dramatically improved the ESU's likelihood of persistence. These regulations are unlikely to be weakened in the future. Many hatchery practices that were detrimental to the long-term viability of this ESU have been discontinued. As the BRT notes in its report (Stout et al. 2012), some of the benefits of these management changes are being realized as improvements in ESU abundance. However, trends in freshwater habitat complexity throughout many areas of this ESU's range remain discernibly unchanged. We remain concerned that regulation of some habitat altering actions is insufficient to provide habitat conditions that support a viable ESU."

This section discusses the adequacy of existing regulatory mechanisms to protect freshwater habitats for Oregon Coast coho salmon. As noted by the BRT in the statement above, changes in regulation of fisheries and hatchery management since ESA listing have addressed concerns so that current harvest and hatchery practices do not pose a threat to ESU viability.

Regulatory mechanisms for forestry activities

<u>State Forest Practices Act</u>

Management of riparian areas on private forest lands within the range of Oregon Coast coho salmon is regulated by the Oregon Forest Practices Act and Forest Practice Rules (ODF 2005). These rules require the establishment of riparian management areas (RMA) on certain streams that are within or adjacent to forestry operations. The RMA widths vary from 10 feet (3.05 meters) to 100 feet (30.48 meters) depending on the stream classification, with fish-bearing streams having wider RMA than streams that are not fish-bearing.

Although the Oregon Forest Practices Act and the Forest Practice Rules generally have become more protective of riparian and aquatic habitats over time, significant concerns remain over their ability to adequately protect water quality, salmon habitat (Everest and Reeves 2007; ODF 2005; IMST 1999), and allow for the restoration of natural processes that form and maintain that habitat. Particular concerns include:

1. The applied widths of RMAs likely are not sufficient to fully protect riparian functions, water quality, and stream habitats from forestry operations. For example, a significant body of science, including (a) the Oregon Department of Forestry (ODF) Riparian and Stream Temperature Effectiveness Monitoring Project (Dent et al. 2008; Groom et al. 2011a; Groom et al. 2011b); (b) A Statewide Evaluation of Forest Practices Act Effectiveness in Protecting Water Quality (ODF and ODEQ 2002); and (c) the Governor's Independent Multidisciplinary Science Team (IMST) Report on the Adequacy of the Oregon Forest Practices in Recovering Salmon and Trout (IMST 1999), indicates that riparian protection around small and medium-sized fish-bearing streams and non-fish-bearing streams in Oregon is not sufficient to achieve and maintain water quality that will protect use by salmonid fishes. The RMA widths also do not ensure full recruitment of woody material to streams, and in some cases likely are inadequate for sediment filtration.

2. Rules concerning road maintenance, particularly with respect to so-called "legacy" roads. The rules did not require that "legacy" roads (i.e., roads constructed and used prior to adoption of the FPA in 1971 and not used or maintained since) be treated and stabilized before closure. In some locations, that practice likely has resulted in significantly altered surface drainage, diversion of water from natural stream channels, and serious erosion or landslides, conditions that can degrade water quality and stream habitat. Oregon's IMST (1999, p. 47) found that "Old roads and railroad grades on forestlands, sometimes called legacy roads, are not covered by the Oregon Forest Practices Act rules unless they are reactivated for a current forestry operation or purposes. IMST believes the lack of a mechanism to address the risks presented by such roads is a serious impediment to achieving the goals of the Oregon Plan. A process that will result in the stabilization of such roads is needed, with highest priority attention to roads in core areas, but with attention to such roads and railroad grades at all locations on forestlands over time."

3. Since there are no limitations on cumulative watershed effects, road density on private forest lands, which is high throughout the range of this ESU, is unlikely to decrease. The rules are not adequate to reduce the risk of damage to fish habitat from landslides and associated debris flows. Under the rules, shallow, rapidly moving landslide hazards directly related to forest practices are addressed only as they relate to risks for loss of life and property, not for potential adverse effects on water quality or fish habitat. Logging and the construction of forest roads, when alternatives are not available, continue on high-risk landslide hazard areas as long as ODF does not consider them to pose a risk to public

safety or property.

The BRT cited Burnett et al 2007 is suggesting that the recovery of the species is unlikely unless habitat can be improved in streams with high-intrinsic-potential on non-federal lands.

State Forest Programs

Approximately 567,000 acres (2,295 square kilometers) of forest land within the range of Oregon Coast coho salmon are managed by the Oregon Board of Forestry (ODF 2005). The majority of these lands are managed under the Northwest Oregon Forest Management Plan and the Elliot Forest Management Plan.

We continue to be concerned over whether the current and proposed protective measures are sufficient to conserve Oregon Coast coho salmon and their habitat now and in the future. We are particularly concerned about the strength of these measures to provide stream shade, woody debris recruitment, and stream habitat complexity. It remains unclear that the Elliot State and the Northwest Oregon Forest Management Plans provide for Oregon Coast coho salmon habitat that is capable of supporting populations that are sustainable during both good and poor marine conditions.

Northwest Forest Plan

Since 1994, land management on Forest Service and Bureau of Land Management (BLM) lands in Western Oregon has been guided by the Federal Northwest Forest Plan (USDA and USDI 1994). The aquatic conservation strategy contained in this plan includes elements such as designation of riparian management zones, activity-specific management standards, watershed assessment, watershed restoration, and identification of key watersheds (USDA and USDI 1994).

Although much of the habitat with high intrinsic potential to support the recovery of Oregon Coast coho salmon is on lower- elevation, private lands, federal forest lands contain much of the current high- quality habitat for this species (Burnett et al. 2007). Relative to forest practice rules and practices on many non-federal lands, the Northwest Forest Plan has large riparian management zones (1 to 2 site-potential tree heights) and relatively protective, activity- specific management standards (USDA and USDI 1994). As discussed in the proposed rule, we consider the Northwest Forest Plan, when fully implemented, to be sufficient to provide for the habitat needs of Oregon Coast coho salmon habitat on federal lands. Although maintaining this high quality habitat on federal lands is necessary for the recovery of Oregon Coast coho salmon, the recovery of the species is unlikely unless habitat can be improved in streams with high-intrinsic-potential on non-federal lands (Burnett et al. 2007, quoted in Stout et al. 2012).

Currently, uncertainty exists regarding the future of the aquatic conservation strategy associated with the Northwest Forest Plan. The BLM is undergoing a western Oregon plan revision process that will replace the Northwest Forest Plan. BLM’s adopted final proposed action will determine the management of riparian forest stands, conservation efforts, and practices on BLM administered lands within the OC coho salmon ESU. Until this new plan is adopted, the future conservation role of BLM administered land will be unknown. The USDA

Forest Service continues to manage under the Northwest Forest Plan. We continue to rely on both federal land management agencies to provide for the habitat needs of Oregon Coast coho salmon. To do this, both agencies must ensure their actions protect existing high quality habitat and implement actions to restore ecological process in the short-term and long-term.

Regulatory mechanisms for agriculture activities

Across all populations, agricultural lands occupy up to 20 percent of lands adjacent to Oregon Coast coho salmon habitat (Burnett et al. 2007). Much of this habitat is considered to have high intrinsic potential (low gradient stream reaches with historically high habitat complexity) but has been degraded by past management activities (Burnett et al. 2007).

Our analyses and findings indicate that the degree of protection afforded to Oregon Coast coho salmon habitat by state and federal programs ─ agricultural water quality programs, state water quality management plans for confined animal feeding operation, state pesticide programs, federal pesticide labeling program, and irrigation and water availability regulations ─ are only partially effective at protecting Oregon Coast coho salmon habitat. Concern remains that while many of the agricultural actions that have the greatest potential to degrade coho salmon habitat, such as management of animal waste, application of toxic pesticides, and discharge of fill material, have some protective measures in place that limit their adverse effects on aquatic habitat, the deficiencies in these programs limit their effectiveness at protecting Oregon Coast coho salmon habitat. In particular, the riparian rules of the water quality management program lack clear criteria for riparian condition and this will continue to make the requirements of this program difficult to enforce. Levees and dikes can be maintained and left devoid of riparian vegetation regardless of their proximity to a stream. The lack of streamside buffers in the state's pesticide program have likely resulted in water quality impacts from the application of pesticides. In addition, although new requirements from ESA section 7 consultations on federal pesticide registration may afford more protection to Oregon Coast coho salmon, these requirements will only apply if the ESU remains listed. Although a water leasing program is available, there is much uncertainty about how this program will result in increased instream flow. The available information leads us to conclude that it is likely that the quality of Oregon Coast coho salmon habitat on private agricultural lands may improve slowly over time or remain in a degraded state; however, it is unlikely that, under the current programs, the coho salmon habitat will recover to the point that it can produce sustainable populations during both good and poor marine conditions.

Regulatory mechanisms for instream activities

<u>Federal Clean Water Act Fill and Removal Permitting</u>

Several sections of the Federal Clean Water Act, such as section 401, (water quality certification), section 402 (National Pollutant Discharge Elimination System), and section 404 (discharge of fill into waters of the United States), regulate activities that might degrade salmon habitat. Despite the existence and enforcement of this law, a significant percentage of stream reaches in the range of the Oregon Coast coho salmon do not meet current water quality standards. For instance, many of the populations of this ESU have degraded water quality identified as a secondary limiting factor (ODFW 2007). Forty percent of the stream miles inhabited by Oregon Coast coho salmon are classified as temperature impaired (Stout et al.

2012). Although programs carried out under the Clean Water Act are well funded and enforcement of this law occurs, it is unlikely that programs are sufficient to protect coho salmon habitat in a condition that would provide for sustainable populations during good and poor marine conditions.

Gravel Mining

Gravel mining occurs in various areas throughout the freshwater range of Oregon Coast coho salmon but is most common in the South Fork Coquille, Nehalem, Nestucca, Trask, Kilchis, Miami, and Wilson Rivers. The U.S. Army Corps of Engineers issues permits under section 404 of the Clean Water Act and section 10 of the Rivers and Harbors Act for gravel mining in rivers in the southern extent of the Oregon Coast coho salmon's range. Although gravel mining activities using similar methods occur across this ESU's range, the Corps of Engineers currently does not always issue permits for these activities. It is unclear why fewer permits are issued in some areas than in others. The Oregon Department of State Lands issues similar permits under both the Removal- Fill Law and the State Scenic Waterway Law.

Improperly managed gravel mining can have potential adverse effects on Oregon Coast coho salmon habitat. Gravel mining results in less complex streambed with reduced refuge areas for juvenile coho salmon. Gravel mining can alter salmonid food webs and reduce the amount of prey available for juvenile salmonids. Removal of riverbed substrates may also alter the relationship between sediment load and shear stress forces and increase bank and channel erosion. This disrupts channel form, and can also disrupt the processes of channel formation and habitat development (Lagasse et al. 1980; Waters 1995). Operation of heavy equipment in the river channel or riparian areas can result in disturbance of vegetation, exposure of bare soil to erosive forces, and spills or releases of petroleum-based contaminants.

Although gravel mining has ceased in some areas occupied by this ESU, gravel mining in the South Fork Coquille and Tillamook basins remains a concern.

ESA and Magnuson-Stevens Fishery Conservation and Management Act consultations indicate that, in some cases, the measures governing sand and gravel mining are inadequate to provide for Oregon Coast coho salmon habitat capable of producing sustainable populations during good and poor marine conditions.

Regulatory mechanisms affecting beaver management

Beavers were once widespread across Oregon. There is general agreement that beavers are a natural component of the aquatic ecosystem and beaver dams provide ideal habitat for overwintering coho salmon juveniles (ODFW 1997). Some scientists argue that restoring beavers and beaver ponds would be the single most effective habitat action that we could take to rebuild OC coho salmon populations.

Nevertheless, currently beavers in Oregon are (as a rodent) classified as a predatory species on private land by statute (ORS 610.002), so there is no closed season or bag limit - they may be killed at any time they are encountered. On public land, beavers are classified as a protected furbearers (ORS 496.004 and OAR 635-050-0050) and ODFW manages a trapping season for beavers. All current protective efforts are voluntary, and there is low certainty they will be fully implemented.

The mission of the U.S. Department of Agriculture's Animal and Plant Health Inspection Service is "To protect the health and value of American agriculture and natural resources." APHIS is authorized to remove beavers when necessary to support this mission.

NMFS Emphasis on the Need to Strengthen Regulatory Mechanisms

In summary, positive changes in the regulation and management of fisheries and hatchery production have manifested increases in coho abundance for the ESU. Benefits from these regulatory changes will likely continue. As stated in our final listing determination for Oregon Coast coho salmon in 2011: "These (harvest and hatchery regulations) are unlikely to be weakened in the future."

Despite these positive factors, however, we do not have confidence in the ability of current land use regulations to protect species viability over the long term. The 2012 status review of the species found that the legacy of past forest management practices combined with lowland agriculture, urban development, and removal of beavers has resulted in a situation in which the areas of highest habitat capacity (intrinsic potential) are now severely degraded (Stout et al. 2012). Concern remains whether existing regulations are adequate to stop habitat conditions from further decline in the future. For example, there have been recent proposals to increase timber harvest of Oregon and California railroad lands, which could result in increased destruction of Oregon Coast coho salmon habitat and thereby pose a new threat to the ESU. There is also a proposal for the state to sell the Elliot State Forest to a private sector buyer, Oregon Department of State Lands to assume removal-fill permitting from the USACE under section 404 (d) of the Clean Water Act, which could result in a reduction in habitat protection for Oregon Coast coho salmon. Such changes could pose further risk to ESU viability, particularly in the face of future climate change.

3.3.5 Factor E. Other natural or human-made factors affecting the species' continued existence

Threat: Hatchery fish interacting with natural-origin coho salmon in the wild

Related limiting factors: Influence from hatchery fish could reduce abundance, productivity, and diversity of coho salmon.

Threat: Changes in ocean conditions

Related limiting factor: Changes in ocean conditions could reduce coho survival and fitness, and thereby influence species abundance and productivity.

Threat: Climate change

Related limiting factors: Climate change could result in further degradation of freshwater habitats, and thereby affect coho salmon abundance and productivity.

Discussion of current concerns for Factor E:

Hatchery Influence

Since ESA listing, threats posed by hatchery practices have largely been addressed. ODFW has taken numerous steps to minimize adverse impacts of hatcheries on the Oregon coast coho salmon ESU. Consequently, the BRT found that hatchery practices that were detrimental to the long-term viability of this ESU have been eliminated (Stout et al. 2012). Changes in ODFW hatchery management, including the termination of coho releases from the Salmon River and North Umpqua hatcheries, have resulted in substantial decreases in the proportion of hatchery fish on the spawning grounds in the North Coast, Mid-Coast, and Umpqua Strata since 2008, the proportion of hatchery-origin coho has stabilized to very low levels for individual strata and the ESU as a whole.

ODFW's Coastal Multi-Species Conservation and Management Plan (2014) discusses hatchery production levels. Hatchery coho releases are limited to the basins supporting the Nehalem, Tillamook and South Umpqua populations. Chinook and/or steelhead, however, are being released varying numbers in the basins supporting the Necanicum, Nehalem, Tillamook, Nestucca, Siletz, Yaquina, Siuslaw, Umpqua, Tenmile, Coos Bay, and Coquille populations.

Changes in ocean conditions

Ocean conditions in the Pacific Northwest exhibit patterns of recurring, decadal-scale variability (including the Pacific Decadal Oscillation and the El Nin˜ o Southern Oscillation), and correlations exist between these oceanic changes and salmon abundance in the Pacific Northwest (Stout et al., 2012). The marine survival of Oregon Coast coho salmon has been quite variable. Survivals were relatively high in the 1970's and late 1980's, followed by extremely low survival in the mid-1990s. Survivals improved in the late 1990's through early 2000s. In considering these shifts in ocean conditions, the BRT was concerned about how prolonged periods of poor marine survival caused by unfavorable ocean conditions may affect the population viability parameters of abundance, productivity, spatial structure, and diversity. Oregon Coast coho salmon have persisted through many favorable-unfavorable ocean/climate cycles in the past. However, in the past much of their freshwater habitat was in good condition, buffering the effects of ocean/climate variability on population abundance and productivity. It is uncertain how these populations will fare in future periods of poor ocean survival when their freshwater, estuary, and nearshore marine habitats are in a degraded condition, as they were in the 1990s (Stout et al., 2012).

Effects of climate change

The potential effects of global climate change are also a concern for this species. The BRT noted that there is considerable uncertainty regarding the effects of climate change on Oregon Coast coho salmon and their freshwater, marine, and estuarine habitat. The final BRT report (Stout et al. 2012) relied on an analysis of climate effects on Oregon Coast coho salmon developed by two of its members (Wainwright and Weitkamp 2013).

Recent climate change has had widespread ecological effects across the globe, including changes in phenology; changes in trophic interactions; range shifts (both in latitude and elevation and depth); extinctions; and genetic adaptations (Parmesan 2006). These types of changes have been observed in salmon populations (ISAB 2007; Crozier et al. 2008a; Mantua et al. 2009).

Although these changes have undoubtedly influenced the observed VSP attributes of abundance, growth rate, spatial structure, and genetic diversity for the Oregon Coast coho salmon ESU, the BRT could not partition past climate effects from other factors influencing the status of the ESU. Continuing climate change poses a threat to aquatic ecosystems (Poff et al. 2002) and more locally to Pacific salmon (Mote et al. 2003).

The Oregon Coast coho salmon life cycle extends across three main habitat types: freshwater rivers and lakes, estuaries, and marine environments. In addition, terrestrial forest habitats are also essential to coho salmon because they determine the quality of freshwater habitats by influencing the types of sediments in spawning habitats and the abundance and structure of pools in juvenile rearing habitats (Cedarholm and Reid 1987). The BRT considered these four habitats, how physical climate change is expected to affect those habitats over the next 50 years, and how salmon may respond to those effects during specific life-history stages (Stout et al. 2012; Wainwright and Weitkamp 2013). Climate conditions have effects on each of these habitats, thus affecting different portions of the life cycle through different pathways, leading to a very complex set of potential effects. The BRT recognized that, while we have quantitative estimates of likely trends for some of the physical climate changes, we do not have sufficient understanding of the biological response to these changes to reliably quantify the effects on salmon populations and extinction risk. For this reason, their analysis was qualitative, summarizing likely trends in climate, identifying the pathways by which those trends are likely to affect salmon, and assessing the likely direction and rough magnitude of coho salmon population response.

Throughout the life cycle of Oregon Coast coho salmon, there are a numerous potential effects of climate change (Figure 3-4) (Stout et al. 2012; Wainwright and Weitkamp 2013). The main predicted effects in terrestrial and freshwater habitats include warmer, drier summers, reduced snowpack, lower summer flows, higher summer stream temperatures, and increased winter floods, which would affect coho salmon by reducing available summer rearing habitat, increasing potential scour and egg loss in spawning habitat, increasing thermal stress, and increasing predation risk. In estuarine habitats, the main physical effects are predicted to be rising sea level and increasing water temperatures, which would lead to a reduction in intertidal wetland habitats, increasing thermal stress, increasing predation risk, and unpredictable changes in biological community composition. In marine habitats, there are a number of physical changes that would likely affect coho salmon, including higher water temperature, intensified upwelling, delayed spring transition, intensified stratification, and increasing acidity in coastal waters. Of these, only intensified upwelling would be expected to benefit coastal-rearing salmon; all the other effects would likely be negative.

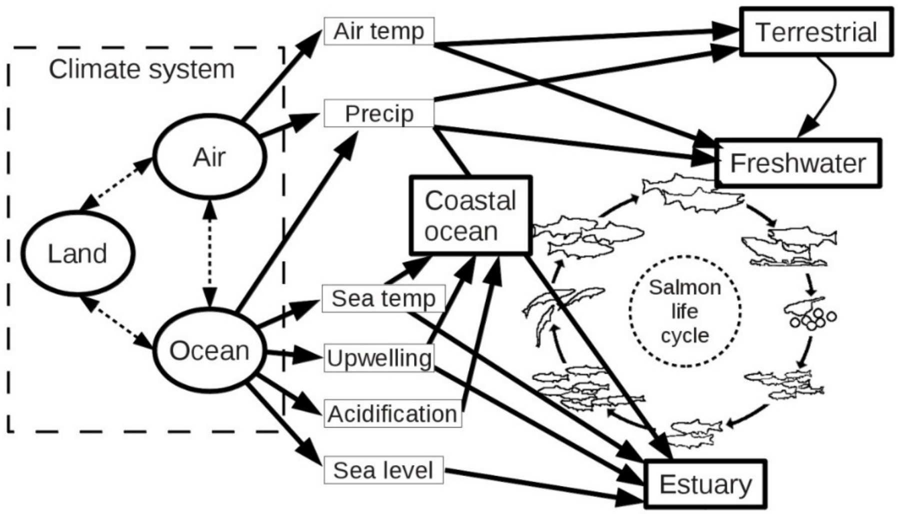


Figure 3-4. The BRT's Conceptual diagram of multiple pathways by which climate influences the salmon life cycle.

The BRT determined that the ESU remains particularly vulnerable to near-term and long-term climate effects because of the long-term loss of high quality rearing habitat. In the short term, the ESU could rapidly decline to the low abundance seen in the mid-1990s when ocean conditions cycled back to a period of poor survival for coho salmon. In the long term, global climate change could lead to a downward trend in freshwater and marine coho salmon habitat compared to current conditions. While considerable uncertainty remains about the magnitude that most of the specific effects of climate change will have on the coho salmon habitat, the BRT was concerned that most changes associated with climate change could result in poorer and more variable habitat conditions for Oregon Coast coho salmon in freshwater and marine environments (Table 3-4).

Table 3-4. Summary of effects of physical climate changes on Oregon Coast coho salmon by habitat type. Strength and direction of effects are rated from strongly positive (+ +) through neutral (0) to strongly negative (– –). (Table 14 in Stout et al. 2012, modified from Wainwright and Weitkamp 2013.)

Physical change	Certainty of change	Processes affecting salmon	Effect on salmon	Certainty of effect
Terrestrial				
Warmer, drier summers	Moderate	Increased number and intensity of fires, increased tree stress and disease affect large woody debris, sediment supplies, riparian zone structure	0 to – –	Low
Reduced snowpack	High	Increased growth of higher elevation forests affect large woody debris, sediment, riparian zone structure	+ to 0	Low
Freshwater				
Reduced summer flow	High	Less accessible summer rearing habitat	–	Moderate
Earlier peak flow	High*	Potential migration timing mismatch	0 to – (Umpqua: 0 to –)	Moderate
Increased floods	Moderate*	Redd disruption, juvenile displacement, upstream migration	0 to – (Umpqua: – to –)	Moderate
Higher summer stream temps	Moderate	Thermal stress, restricted habitat availability, increased susceptibility to disease and parasites	– to – –	Moderate
Estuarine				
Higher sea level	Moderate	Reduced availability of wetland habitats	– to – –	High
Higher water temperature	Moderate	Thermal stress, increased susceptibility to disease and parasites	– to – –	Moderate
Combined effects		Changing estuarine ecosystem composition and structure	+ to – –	Low
Ocean				
Higher ocean temperature	High	Thermal stress, shifts in migration, range shifts, susceptibility to disease and parasites	– to – –	Moderate
Intensified upwelling	Moderate	Increased nutrients (food supply), coastal cooling, ecosystem shifts; increased offshore transport	+ + to 0	Low
Delayed spring transition	Low	Food timing mismatch with outmigrants, ecosystem shifts	0 to –	Low
Intensified stratification	Moderate	Reduced upwelling and mixing lead to reduced coastal production and reduced food supply	0 to – –	Low
Increased acidity	High	Disruption of food supply, ecosystem shifts	– to – –	Moderate
Combined effects		Changing composition and structure of ecosystem, changing food supply and predation	+ to – –	Low

*Effects are strongest and most certain in higher elevation snow-fed basins.

Despite the uncertainties involved in predicting the effects of global climate change on the ESU, available information indicates that most impacts are likely to be negative. While individual effects at a particular life-history stage may be small, the cumulative effect of many small effects multiplied across life-history stages and across generations can result in large changes in salmon population dynamics (Stout et al. 2012). In its conclusion on the likely effects of climate change, the BRT expressed both positive and negative possible effects but stressed that when effects are considered collectively, their impact on ESU viability is likely to be negative despite the large uncertainties associated with individual effects.

4. Recovery Goals and Delisting Criteria for the Oregon Coast Coho Salmon ESU

In Section 3, we described the human activities and natural factors that led to listing Oregon Coast coho salmon as threatened, explained how they contributed to the listing and to the current status of the species, showed the linkages to voluntary and regulatory protective efforts, and introduced a framework to assess progress towards recovery.

In this Section we use that same framework to describe the recovery goals and delisting criteria for Oregon Coast coho salmon. In the simplest terms, we will remove the Oregon Coast coho salmon from federal protection under the ESA when we determine that:

- The species has met its biological recovery criteria, or new information indicates it has sufficient abundance, population growth rate, population spatial structure, and diversity to indicate it has met the biological recovery goals (see Section 4.2 below).
- Factors that led to listing have been reduced or eliminated to the point where federal protection under the ESA is no longer needed.

The Section describes the statutory requirements for recovery and removing Oregon Coast coho salmon from the list of threatened and endangered species (Section 4.1); the biological recovery criteria for Oregon Coast coho salmon (Section 4.2); goals and criteria for each listing factors described in Section 3, and how we intend to assess progress towards reaching each goal (Section 4.3); and the process we intend to use to consider the biological and listing factors together when making a listing determination, using framework developed in Section 3 (Section 4.4).

Our authority and discretion to manage the lists of threatened and endangered species is not limited to applying the criteria established in this section. As a result, while the recovery scenarios and criteria presented in Sections 4.2, 4.3, and 4.4 of this recovery plan illustrate possible points at which delisting is very likely, they are not necessarily the only situations in which NMFS would propose to delist. Nothing in these criteria should be understood as precluding a delisting determination under a different scenario, provided that the ESU meets the statutory and regulatory requirements for a recovered species.

In accordance with our responsibilities under section 4(c)(2) of the ESA, NMFS will conduct reviews of ESU status at least once every five years to evaluate the status of the ESU and gauge progress toward recovery. Such evaluations will take into account the following:

- The biological recovery criteria and listing factor (threats) criteria described above.
- The management programs in place to address the threats.
- Principles presented in the Viable Salmonid Populations paper (McElhany et al. 2000).

- Best available information on population and ESU status and new advances in risk evaluation methodologies.
- Other considerations, including: the number and status of extant spawning groups; the status of the five strata; linkages and connectivity among groups; the diversity of life history and phenotypes expressed; and considerations regarding catastrophic risk.

4.1 Endangered Species Act Requirements

Under the ESA,[21] NMFS can "delist" a species ─ remove it from the list of threatened and endangered species ─ when the species is no longer in danger of extinction or likely to become endangered within the foreseeable future[22]. The ESA requires that recovery plans; "…to the maximum extent practicable, incorporate objective, measurable criteria which, when met, would result in a determination in accordance with the provisions of the ESA that the species be removed from the Federal List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12)…." The terms "recovered" and "delisted" are sometimes used interchangeably. NMFS can 'delist' a species when the recovery criteria for that species have been met.

This section of the Plan presents a set of "objective, measureable criteria" for Oregon Coast coho salmon, as called for in the ESA, that include the most accurate, practicable and up-to-date information available at the time we drafted this section.

NMFS applies two kinds of ESA recovery, or delisting, criteria. The first, biological recovery criteria, examines the biological health (viability - sustainability and persistence) of the species (§4.2). The second, threats criteria, relate to the five listing factors in ESA section 4(a)(1) and describes the human activities (threats) that contributed to the decline in the status of the species. The five listing factors are discussed in Section 3 and constitute a major part of the framework for evaluating the status of the species. The threats criteria define the conditions under which the listing factors, or threats, can be considered to be addressed or mitigated. Together, the biological recovery criteria and threats criteria make up the "objective, measurable criteria" [hereinafter referred to as delisting criteria] required under section 4(f)(1)(B)(ii) for the delisting decision.

The flow diagram in Figure 4-1 shows that, in making a listing determination, we consider the status of the species (viability assessment), the five listing factors, limiting factors and threats, and actions that have been taken to help recovery the species.

[21] Federal List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12; 50 CFR 223.102 and 224.101)
[22] In this recovery plan, when considering the term 'foreseeable future' we use the DSS definition of ESU persistence: ESU will persist over the next 100 years.

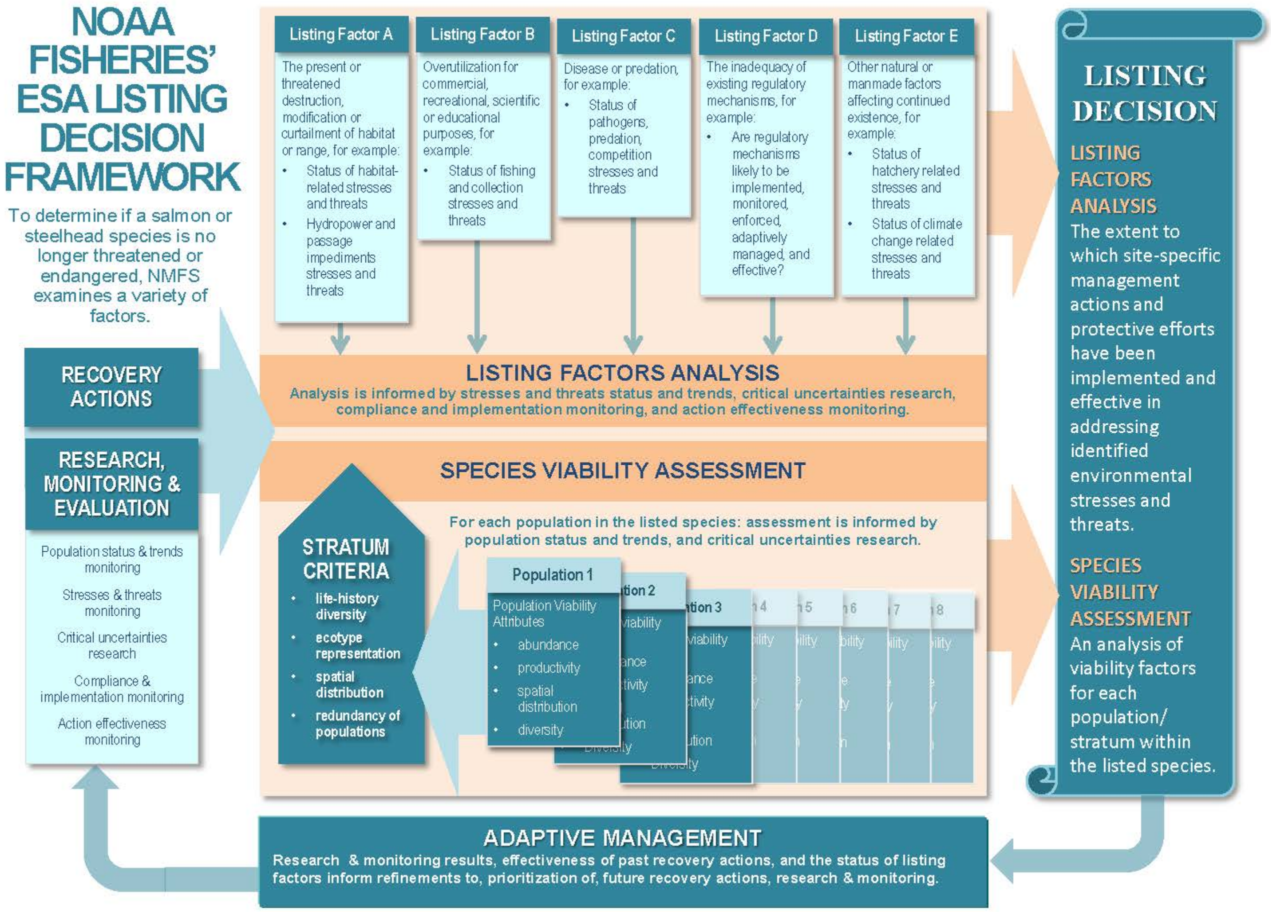


Figure 4-1. Components of a listing determination.

4.2 Biological Recovery Criteria

4.2.1 Background: General Framework for Describing Healthy (Sustainable) Salmon Populations

In its technical memorandum "Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units" (McElhany et al. 2000), NMFS introduced four measures to evaluate the viability (or sustainability, see the definitions of both terms in the glossary) of a salmon population: abundance, population growth rate, population spatial structure, and diversity. These four measures, which make up the viable salmonid population (VSP) parameters, were defined for three reasons. First, these measures are reasonable predictors of extinction risk. Second, they reflect general processes that are important to all populations of all species. Third, they are measurable. These measures form the basis for our evaluations of individual salmon populations, which comprise species under the ESA. We describe these measures below, and then in Section 4.2.2 we describe how the Oregon Coast TRT applied them to Oregon Coast coho salmon.

Abundance

Abundance refers to the number of adult fish returning to spawn, as measured over a specific number of years. This is recognized as an important measure because, all else being equal, small populations are at greater risk of extinction than large populations, primarily because several processes that affect population health operate differently in small populations than they do in large populations. The TRT described[23] two abundance levels that we think are particularly important: "viable" (meaning having a negligible risk of extinction) and "critical" (where low numbers of fish produce a high risk of extinction over a short time period).

Population growth rate or productivity

Population growth rate, or productivity over the entire life cycle, and factors that affect population growth rate provide information on how well a population is performing in all the habitats it occupies throughout the life cycle. When the ecosystem is functioning properly, growth rates can decline following peak years and still maintain a healthy population. However, estimates of productivity that indicate a population is consistently failing to replace itself are an indicator of increased extinction risk. The guidelines for population growth rate are closely linked with those for abundance. Productivity when the abundance is low is important because it is critical that a population at increased risk of extinction be able to reproduce successfully in order to rebuild to higher abundance levels.

Spatial structure

Spatial structure identifies characteristics of a fish population's geographic distribution, including the pattern of connections among patches of occupied habitats within the population. This is important both because a widespread population is more resilient to local, short-term habitat disruptions (such as floods or landslides) and because small-scale local adaptations contribute to evolutionary process that maintain adaptability of the population as a whole.

Diversity

Diversity, or variations within and among populations, refers to the distribution of traits among and within fish populations, which has important effects on population health. Some of these traits are completely genetically based, whereas others vary because of a combination of genetic and environmental factors. This latter group can include the outward appearance (shape, structure, color, patterns, etc.) of an individual salmon and the form and structure of the internal parts like bones and organs, and behavioral characteristics. Together, they can include variations in fertility, run timing, and spawn timing, juvenile behavior, age when they migrate to the ocean, age at maturity, egg size, developmental rate, ocean distribution patterns, male and female spawning behavior, physiology and molecular genetic characteristics.

Because different portions of salmon habitat can change over time, there are three general reasons why diversity is important for species and population health.

- Diversity allows a species to use a wider array of environments
- Diversity protects a species against short-term changes in the environment.

[23] Wainwright et al 2008

- Genetic diversity provides the raw material for surviving long-term environmental change.

4.2.2 Biological Recovery Criteria for Oregon Coast Coho Salmon

The TRT report describes a two-step process: (1) develop criteria and then (2) implement it in a status review of the species.

Development of Biological Recovery Criteria

The general framework described in Section 4.2.1 was intentionally general, and NMFS expected local TRTs (as described in Section 1) would apply it to a wide variety of conditions and salmon populations by developing specific delisting criteria for each protected species. At the request of the NMFS NWR Office, the Oregon and Northern California Coasts TRT[24] developed biological recovery (viability) criteria for Oregon Coast coho salmon based on the general framework described in Section 4.2.1 (Wainwright et al. 2008).[25] The TRT report and criteria provide a means to evaluate the current and future biological status of the Oregon Coast coho salmon ESU, and to assess progress toward meeting the biological recovery of the Oregon Coast coho salmon ESU.

The TRT’s criteria focus on coho salmon status at the population level, and the combined status of the populations determines the status of the ESU. Among other information, the TRT relied on the ODFW annual surveys of adult and juvenile coho salmon to provide the basic data for determining the status of each population. The TRT accomplished this by:

- identifying biological properties that are important to the health of populations;
- reviewing the data available from ODFW's monitoring programs;
- using scientific literature, recent research findings, and the knowledge of biologists most familiar with Oregon Coast coho salmon; and
- creating criteria to specifically translate monitoring data into an index of status.

The TRT created “objective and measurable” criteria that could be applied to each population to determine its status. The TRT also developed a way to “roll up” the scores for each population into a score for the whole ESU. Because populations from rivers that are close together tend to be similar, the TRT identified five groupings of similar populations, termed “strata.” The TRT approach determines the status of each individual stratum based on the status of its member populations, and then combines the status of the five strata to determine the status of the ESU. The TRT developed two principle elements within the biological criteria:

- Most (more than half) of the independent populations in each stratum had to be sustainable.
- All five strata had to be sustainable for the whole ESU to be sustainable.

In addition to these population-based criteria, the TRT considered risks that operate at the

[24] Specifically, the Oregon Coast Workgroup of the Oregon and Northern California Coasts Technical Recovery Team (TRT).
[25] Wainwright, T. C., et al. 2008. Biological Recovery Criteria for the Oregon Coast Coho Salmon Evolutionarily Significant Unit. NOAA Technical Memorandum NMFS-NWFSC-91.

broader ESU level. These risks relate to how populations interact with each other to preserve diversity and how multiple populations might be vulnerable to catastrophic events like tsunamis or volcanic eruptions. There are high levels of uncertainty associated with these issues and there is much less data than in other aspects of the biological status of the Oregon Coast coho salmon. As a result, there was no way to create specific numeric criteria for these ecosystem factors based on observed data. On the other hand, the TRT did not expect these big picture factors to change much from year to year, so the TRT created a formal process wherein a panel of experts expressed their best judgment and created an index of ESU-level factors that they applied alongside the population analysis to arrive at a final sustainability value for the ESU. Whereas most of the population-level criteria relied on annual collection of information about juvenile and adult coho salmon, the TRT decided the ESU-level factors based on expert opinion did not warrant evaluations every year.

The 2008 TRT document provides a detailed discussion that includes 29 separate criteria as components of a Decision Support System (DSS). We consider this TRT report, and the BRT status reviews, as our principle components of “best available science” on the subject of Oregon Coast coho salmon biological recovery criteria. We used these reports as the basis for our delisting criteria, which are described below. The TRT and BRT documents provide full technical discussions on the criteria and approach.

Biological Recovery Criteria for OC Coho Salmon

The TRT’s decision support tool and recommended biological recovery criteria are documented in Wainwright et al. 2008 and applied in the status review (Stout et al. 2012). They summarize the key elements of the decision support tool in two steps and six measures.

- Step 1: We assemble available information about the location of juvenile coho salmon, the location and number of adult coho salmon returning to spawn each year, and how often they are found in particular areas from ODFW field surveys.
- Step 2: Based on this information, collected over many years, we developed six measures of Oregon Coast coho salmon viability that form the basis our assessment of population, strata, and ESU health.

The six measures of Oregon Coast coho viability are introduced below, and are further described in Table 4-1.

1. Spawner abundance ─ *Are there enough coho salmon in this population?*
2. Spawner distribution ─ *How much of the spawning habitat is actually used by the population?*
3. Juvenile distribution ─ *After coho salmon spawn, in what portion of the available habitat do we find their offspring in this watershed?*
4. Critical abundance ─ *Are there enough salmon spawning in this population in ‘bad years (for instance, when the ocean survival has been low?*

5. Population productivity ─ *Do generations of salmon in this population produce enough offspring in 'bad years, for instance, when the ocean survival has been low?*

6. Artificial influence ─ *What is the proportion of hatchery produced fish spawning in this population?*

Using these six measures, the TRT created additional measures of the health of the coho salmon populations, strata and ESU, all within the framework described in Section 4.2.1. The result is a series of "scores" that indicate how well the populations, strata and the ESU are doing in terms of abundance, productivity, spatial structure and diversity.

Six questions can be used to generate this basic information:

- Has abundance been sufficient to maintain genetic diversity within the (independent) population?
- On average, are there spawning coho salmon in most of the available spawning habitat?
- Are there juvenile coho salmon in most of the available rearing habitat?
- In recent periods of low abundance, was spawning density sufficient to avoid small population risks?
- On average, were there more offspring than parents when the number of parents was low?
- Are the vast majority of naturally spawning coho salmon of natural (versus hatchery) origin?

Table 4-1 includes highlighted (underlined) criteria that indicate levels that the TRT considered certain[26] to meet the proposed biological criteria. The TRT set these levels in the context of the uncertainty regarding the data and the thresholds. If more than half the populations in every stratum meet these criteria, then that would suggest 'certainty' that the biological recovery criteria are met. If the level of certainty that the criteria have been met is good but does not reach these the level of full certainty we could still consider the recovery criteria met if we are satisfied with the status of the listing factors and protective efforts. We can use the DSS to provide the science-based answer to the question: what is the biological status of the ESU? However, science alone cannot answer the question: 'how certain do we have to be that the ESU is sustainable in order to achieve recovery?' because that answer is based in part on the status of the five listing factors and policy/legal determination that the overall result is that ESU is no longer threatened.

[26] See the discussion of certainty in Section 4.4.2.

Table 4-1. Six Measures of Biological Recovery Criteria.

What we want to know	TRT measure	Explanation
Are there enough salmon in this population?	*Spawner abundance* *PD-1*	The annual number of fish returning to spawn is the most familiar measure of the biological health of a coho salmon population. A strong score in spawner abundance is a good indication that there have been high enough numbers of spawning salmon in a population to prevent loss of the genetic variation that is important to long-term health of the population. The TRT concluded that a long-term (12-year) average of 5,000 spawners in a population provides certainty that there are enough salmon in this population.
Do we find coho salmon spawning in a large portion of the available habitat in this watershed?	*Spawner Distribution (Occupancy) (PD-3)*	This measures the proportion of spawning habitat that is actually used by the population and is an important measure of both population connectivity and habitat diversity. We use an average over four generations (12 years) to include wide variation in environmental conditions. This is measured by the average occupancy rate of watersheds during the most recent 12 years – the percentage of stream reaches in any year that have at least four spawners per mile. We consider four spawners per mile in 50% of the stream reaches to mean we are uncertain; four spawners per mile in 80% of the stream reaches, on average, provide certainty that spawners occupy a high proportion of the available spawning habitat and meet this criterion.
After coho salmon spawn, do we find their offspring in a large portion of the available habitat in this watershed?	*Juvenile Distribution (occupancy)* *(PD-4)*	This also measures the proportion of juvenile habitat actually used by the population, an important measure of both population connectivity and habitat diversity. We measure juvenile occupancy as the average occupancy rate of surveyed reaches in each watershed during the most recent 12 years – the presence of juvenile coho in at least two pools within any survey reach that contains two or more pools. We consider finding juvenile coho salmon in only 50% of the reaches to mean we are uncertain; finding juvenile coho salmon in 80% or more of the reaches, on average, provides certainty that this criterion has been reached.
Are there enough salmon spawning in this population in 'bad years (for instance, when the ocean survival has been low)?	*Critical abundance* *(PP-3)*	Critical abundance is an indication of whether the number of fish in a population has been above levels where there are risks associated with too few spawners. We measure this by the average number of adult OC coho salmon per mile (at the peak of spawning) of occupied spawning habitat in years when numbers are low. We consider 4 spawners per mile to mean we are uncertain that there are enough salmon spawning in bad years to avoid small population risks; we consider 20 or more spawners per mile, on average in 'bad' years, to provide certainty that spawners meet this criterion. (As opposed to spawner distribution above, this metric uses the years when ocean survival has been low.)
Do generations of salmon in this population replace themselves in 'bad years (for instance, when the ocean survival has been low)	*Population productivity* *(PP-1)*	A strong score in this category indicates the population is likely to rebuild itself following declines in abundance. A population can only survive if (on average) each pair of spawners produces at least one pair of spawners in the next generation. This is especially important in years of low abundance. To measure population productivity, we review the data over a number of years and identify years when the number of spawning coho salmon was low. We then examine the ratio of the number of offspring that return to spawn to the number of fish spawned in those 'bad' years. When this ratio is near one, we are uncertain if the population would rebuild; we have high statistical confidence that if the ratio is above one, then the population can rebuild and this criterion is met.
Are there too many hatchery fish spawning in this population?	*Artificial Influence (Influence of hatchery fish) (PD-2)*	A strong score here is a good indication of low risk of adverse effects from hatchery fish on naturally produced fish (those whose parents spawned in streams, not hatcheries). This is calculated as the six-year (two-generation) average of annual estimates of the proportion of naturally produced fish in spawning surveys for the population. If 90% are natural-origin spawners (less than 10% are hatchery-origin fish) to mean we are uncertain that this criterion has been met; if nearly 100% of spawners are natural origin, we are certain this criterion has been met.

Applying the Decision Support Tool and Risk Analysis

As described in detail in Stout et al 2012, one result of the BRT's DSS was that the ESU sustainability score was +0.24 which translates into a low to moderate certainty that the ESU was sustainable.

4.3 Listing Factors/Threats Criteria

4.3.1 Listing Factors from Section 4(a)(1) of the Endangered Species Act

As we discussed previously, section 4(a)(1) of the ESA includes five Listing Factors:

- The present or threatened destruction, modification, or curtailment of the species' habitat or range
- Over utilization for commercial, recreational, scientific or educational purposes
- Disease or predation
- The inadequacy of existing regulatory mechanisms
- Other natural or human-made factors affecting the species' continued existence

These factors may not all be equally important in securing the continuing recovery of a particular ESU, and each ESU faces a different set of threats from human activities. It also is possible that current perceived threats will become insignificant in the future as a result of changes in the natural environment or changes in the way threats affect the entire life cycle of coho salmon.[27] We explain our prioritization of these factors below.

4.3.2 Criteria for Assessing the Status of Listing Factors for Oregon Coast Coho Salmon

In this section we establish goals and criteria for assessing each of Listing Factors A, B, C, D and E. We discuss regulatory mechanisms that relate to Listing Factors A, B, C and E in the section on Listing Factor D.

Factor A: The present or threatened destruction, modification, or curtailment of a species' habitat or range.

Introduction: In applying the delisting framework, we emphasize the interrelatedness of the biological status and Listing Factors, as well as protective efforts that are helping to recovery OC coho. Figure 4-2 shows the relationship between ocean survival, freshwater habitat status, ESU viability and recovery. The figure is adapted from a scientific journal article, written in 1993[28] by Dr. Peter Lawson, then with ODFW and now with NOAA's NWFSC.

[27] Lower Columbia River Recovery Plan §3.2.2
[28] Lawson 1993

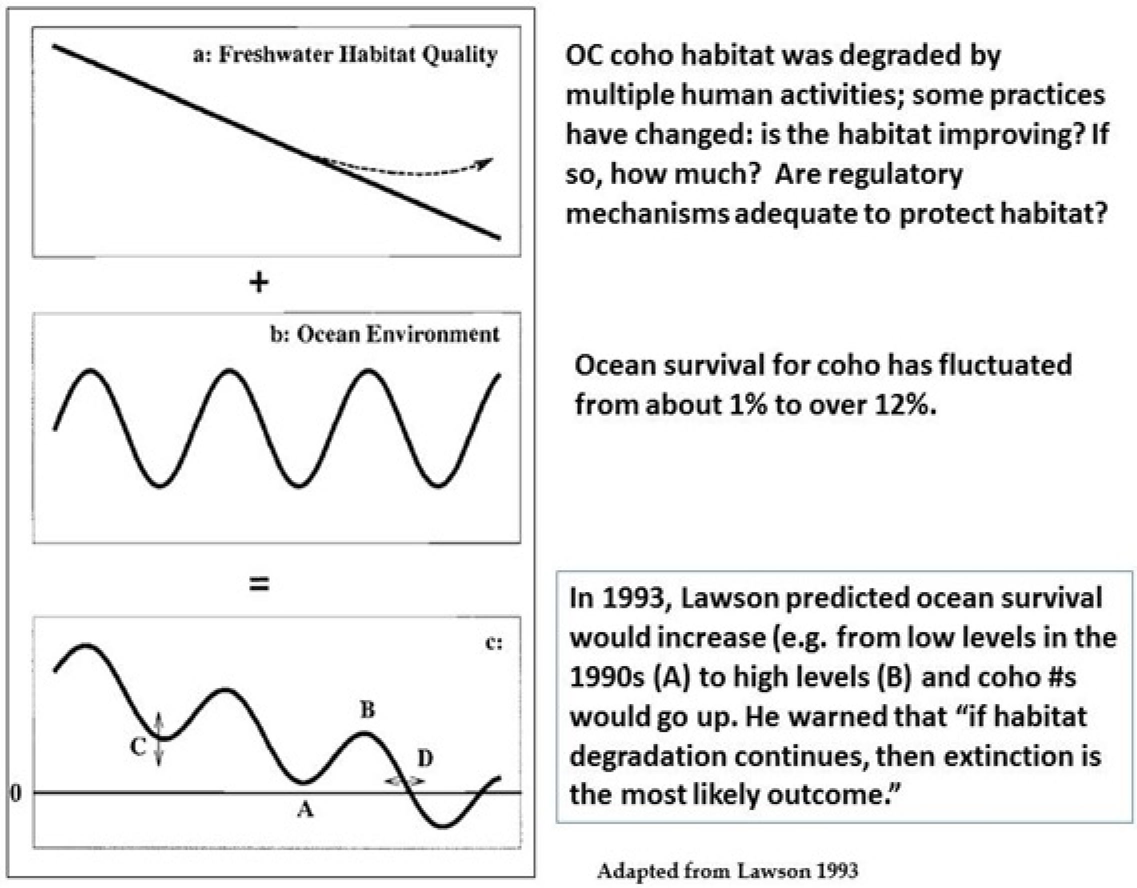


Figure 4-2. Relationship between ocean survival, freshwater habitat status, and OC coho salmon ESU viability and recovery. Adapted From Lawson 1993.

The 1993 article written by Lawson has an important message about relying too heavily on favorable ocean conditions, and not enough on freshwater habitat conditions and protections. The need for this caution has not diminished in light of more recent scientific findings and information. The warning in Text Box 4-1 exemplifies the risks associated with moving to delist the species prematurely (paraphrased from the Lawson article).

Text Box 4-1. Evaluate survival during good and poor ocean conditions (Lawson 1993):

"The risk is that with higher (ocean) survivals and more fish evident, people may see the increase in fish escapement as an indication of success and relax needed efforts and funds to improve habitat conditions before habitat restoration has been carried through to satisfactory completion to support the fish populations during upcoming periods in poor ocean conditions. The true success indicator for habitat restoration projects will come not at the peak of the next cycle of good ocean conditions, but at the following low point. If habitat quality in 20 or 40 years is no worse than it is today, then coho salmon will not become extinct in Oregon. If degradation continues, then extinction is the most likely outcome."

Listing Factor A Goals and Criteria:

Goal for Listing Factor A: Protect and restore the "physical or biological features that are essential for the conservation of the species[29]" including the primary constituent elements described in Section 2.2.5 to the point where the species is no longer threatened or endangered.

Discussion: As the record of our past listing determinations and the discussion in Section 3 describe, Oregon Coast coho salmon have suffered from widespread loss and degradation of freshwater habitat. There is considerable uncertainty whether current habitat is adequate to support the ESU when cyclic ocean and environmentally driven freshwater conditions lead to periods of low survival. As described in the 2011 listing determination: " the BRT's analysis of freshwater habitat trends for the Oregon coast found little evidence for an overall improving trend in freshwater habitat conditions since the mid-1990s, and evidence of negative trends in some strata." Considering the uncertainties about the adequacy of the habitat, we developed two options for determining if the goal for Listing Factor A has been met – one using the best available quantitative data on the status of key habitat features along with a general assessment of ecosystem processes; the other using an 'ocean test' that we introduce below. If either is met, we could consider the goal for listing factor A to have been achieved.

Listing Factor A Criteria:

Option A1:
This option includes these considerations.

1) Quantitative measures of habitat status

   We can look for evidence from the ODFW habitat monitoring programs that the habitat has improved in each of the four river-based strata (the Lakes Stratum is addressed below). There is no one "right way" to measure habitat condition, and it may be that we will have several valid options for measuring habitat condition in the future. We do, however, have a set of quantitative habitat metrics that we can use to assess habitat condition for OC coho salmon in wadable streams, based on ODFW's habitat monitoring programs, which include the Habitat Limiting Factors Model (HLFM). The HLFM was described and used in the BRT and TRT reports and formed the basis for the following metrics (the NWFSC and ODFW revised the fifth metric since the BRT report) which are, at this time, the best available quantitative approach to assess the status of Listing Factor A:

   - winter parr capacity from HLFM as populated by aquatic inventory (AQI) data
   - summer parr capacity from HLFM as populated by AQI data
   - percent of riffle that is sand/silt/organics from AQI data
   - volume of large wood per 100 m from AQI data
   - miles of modeled density greater than 2,800 parr/mi (= high quality habitat or "HQH") from HLFM as populated by AQI data.

[29] From the definition of critical habitat in Section 3 of the ESA.

One strong indication that the goal for Listing Factor A has been reached for the four river strata would be if the trends for winter and summer parr, percent of riffle and volume of large wood have been increasing for twelve years (four life cycles the length of the DSS population-level time series).

2) Ecosystem Processes

In addition to the quantitative metrics described above, NMFS will consider the larger context of the coastal ecosystem processes. As the BRT and TRT reported, human activities have resulted in significant changes in stream complexity, natural recruitment of wood into streams, removal of gravel (from splash dams and stream cleaning), temperature inputs and estuarine ecosystems. NMFS will look for evidence that these processes have been protected and the extent to which they are restored to the point that they create and maintain sufficient high quality and complex rearing habitats consistent with the recovery of OC coho salmon.

3) Water temperature

The growing body of data on climate change underscores the importance of monitoring instream temperatures.

The BRT report (Stout et al. 2012) determined that water temperature is the primary source of water quality impairment in the OC coho salmon critical habitat. Many of the streams coho salmon juveniles inhabit are already close to lethal temperatures during the summer months. A number of the streams have been listed as temperature impaired by the EPA, and recent conditions suggest water temperature continues to be an important concern.[30]

The monitoring systems in place operated by ODEQ, ODFW, USGS and other agencies have provided the data to support BRT conclusions, but they have constraints that limit the ability to provide an adequate measure of temperature as a threat to OC coho salmon relative to the ESA and the beneficial use criteria in the Clean Water Act. One of the key constraints is that the agencies have limited access to private lands from which they can take temperature measurements. In general, we need more monitoring stations collecting data for longer periods of time to provide adequate measurements of stream temperature, and the effect of elevated stream temperature on OC coho salmon, at an adequate scale. We therefore include in the criteria the establishment of a temperature monitoring system that provides a sufficient quantity and quality of information to allow state and federal agencies to accurately gauge the risk of increased water temperature on OC coho salmon.

4) For the Lakes Stratum, we propose to use three of the five trends described above, excluding the trends for winter parr capacity and miles of high quality habitat since they do not measure the status of the lakes, where most of the winter rearing takes place.

[30] http://www.deq.state.or.us/wq/assessment/rpt2012/search.asp

> Since the lakes populations did not decline as drastically during the poor marine period of the 1990's, we propose to consider the goal for Listing Factor A for the Lakes Stratum to be reached if the three trends are not declining (as opposed to increasing for the other strata).
>
> These trends can be calculated annually and included in regularly scheduled NMFS formal status reviews that take place every five years. Current assessments of these trends are statistically significant at the strata level, not at the population and watershed-levels. Assessments at these finer scales would be valuable, but the current level of monitoring effort does not provide for statistically significant results.

<u>Option A2:</u>

We could reasonably conclude that the goal for Listing Factor A has been met without applying specific quantitative measures of habitat condition like those presented in Option A1 if the ESU passes an 'ocean test' which we introduce in general terms as:

> "the ESU experiences a period of several years of poor ocean productivity and during this period demonstrates sufficient abundance, productivity, spatial structure and diversity such that we can be confident that it remains sustainable (viable)."

This option considers the fact that the ESU went through a period of poor ocean conditions culminating in the mid-1990s that contributed to the degraded biological status and listing. The cumulative effect of multiple factors at that time was that the ESU dropped to a low near 20,000 spawners in some years, and some populations dropped below 10 spawners. Since then, the ESU has improved markedly. With the reduction in threats from harvest and hatcheries, if other factors (e.g. freshwater habitat) are comparable, a reasonable hypothesis is that the ESU would perform better in the future than it did in the 1990s if faced with unfavorable marine conditions.

At the time this proposed Plan was being drafted, new scientific evidence suggested that marine and freshwater conditions had changed enough to forecast very poor survival for Oregon Coast coho salmon in the next few years. If this predicted period of poor marine and freshwater conditions indeed occurs, then it presents the opportunity to apply the 'ocean test' - will the indicators of biological status developed by the TRT indicate the ESU is strong enough to sustain itself in poor conditions better (based on TRT biological recovery criteria) than it did in the 1990s?

For purposes of this option, we could consider the goal for Listing Factor A to have been reached after considering the following, in the context of assessments of the biological criteria and other Listing Factors if, in addition to passing the 'ocean test',

- There is evidence that the threats to habitat conditions that contributed to listing OC coho salmon as threatened, including water quality, have been reduced or eliminated.
- The voluntary efforts to protect and restore ecosystem function under the OCCCP have continued and there is evidence they will continue.

Factor B: Overutilization for commercial, recreational, or educational purposes

Goal for Listing Factor B: Ensure commercial and recreational fishing activities are not impeding the recovery of Oregon Coast coho salmon.

Discussion: The BRT (Stout et al. 2012) found that harvest-related mortalities have been reduced substantially since harvest was curtailed in 1994 and that current harvest management under Amendment 13 has succeeded in maintaining a higher spawner abundance during downward trends in productivity of the stocks. The BRT determined that further harvest reductions would have little effect on spawning escapements (Stout et al. 2012).

Criteria:
To meet this criterion, harvest practices will need to remain consistent with the recovery of OC coho salmon, meaning the harvest rates in the future should not be higher than has been allowed under the current Amendment 13 harvest matrix.

Factor C: Disease or predation

Goal for Listing Factor C: Ensure that diseases and predation and their effects on reproduction and survival are not a threat to the sustainability of the Oregon Coast coho salmon ESU.

Discussion: ODFW and NWFSC identified predation by birds, marine mammals and non-native species of fish as concerns. In particular, bass introduced to the lakes were identified as primary limiting factors for the Siltcoos, Tahkenitch, and Tenmile lake populations.

Criteria:
We could consider the goal for Listing Factor C to be met if there is evidence of the following (based in part on Crawford and Rumsey 2011):

- We have adequate information to assess the impact of predation (including birds and pinnipeds) and disease on the ESU. For instance, NMFS and/or ODFW will (as resources allow) conduct, compile, and make available the status of invasive species and diseases known to affect coho salmon periodically.
- Compilation suggests that both invasive species and diseases are not present to the extent that they have significant impacts on the biological status of the ESU.
- Numbers and impacts of non-native species (i.e. bass) are not considered a significant limiting factor for the three lake populations.
- Avian and marine mammal predation impacts are not currently considered a significant limiting factor for any population in the ESU.

Factor D: The inadequacy of existing regulatory mechanisms

Goal for Listing Factor D: Ensure that regulatory mechanisms are sufficient to sustain a recovered OC coho salmon ESU so that the species will not be threatened or endangered.

Discussion:
For OC coho salmon, Listing Factor D pertains to multiple categories of regulatory mechanisms including habitat, harvest, predation, disease, hatcheries, and other factors.

Our general approach is to ensure that regulatory mechanisms are effective to the extent that each of the major threats identified at listing (or any new ones since) will be reduced or eliminated in order to maintain a recovered OC coho salmon ESU. We established goals for regulatory mechanisms and criteria for assessing their adequacy relating to OC coho salmon recovery and describe these goals and criteria in the context of the other four Listing Factors and related threats (Section 3) that may be reduced or eliminated by regulation.

Goals for Factor D related to Listing Factor A (destruction of habitat):
Regulatory mechanisms are in place that contribute to protecting and restoring OC coho salmon habitat in order to get to recovery – so OC coho salmon will not be a threatened or endangered species because of the present or threatened destruction, modification, or curtailment of its habitat or range. Once OC coho salmon are recovered and delisted, the goal is that regulatory mechanisms will be in place that contribute to protecting and restoring OC coho salmon habitat in order to stay recovered and not need protection under the ESA in the future.

Criteria*:*
In order to meet this criteria, regulatory mechanisms should be in place that:

- Are likely to be implemented (Consistent with the Policy for Evaluation of Conservation Efforts[31] which established two basic criteria: (1) The certainty that the conservation efforts will be implemented and (2) the certainty that the efforts will be effective.

- Effectively regulate human activities (threats) that are known to contribute to primary and secondary limiting factors within Listing Factor A by reducing stream complexity, water quantity, and water quality.
- Include a tracking system that records whether local and state agencies have implemented the key regulatory mechanisms and a randomized sampling program to test whether permits issued under local and state regulatory actions designed to protect riparian and instream habitat are in compliance and that the provisions have been enforced? The compliance rate should be equal to or greater than 90 percent (from Crawford and Rumsey).
- Adopt and implement:
    - improved protections for floodplain habitat, such as amending the National Floodplain Insurance Program to limit future loss of floodplain habitat,
    - changes in beaver management to allow beavers to build more dams in floodplains (an important component of OC coho rearing habitat),

[31] 60FR15100 March 28, 2003

    - changes in agricultural and rural land management to allow additional complexity (connected side channels and wetlands) and improved water quality in and around floodplains, and
    - changes in forest management that would increase the natural recruitment of large wood into streams and provide more shade to counter increasing temperatures.
- Provide for and support attainment of Listing Factor A goals as follows:
    - If the five trends described in Option A 2 are not positive, that would suggest the goal for Listing Factor A has not been reached and we should determine if the best available information indicates that human activities (threats) have contributed to the habitat trend goals not being met. If we conclude that the threats continue to contribute to non-positive habitat trends, we should conclude that the regulatory mechanisms are inadequate to protect coho salmon habitat.
    - Develop and implement, if practical, a monitoring approach that can demonstrate an increase in juvenile smolt output based upon the life-cycle monitoring sites for OC coho salmon.
    - If the five trends are positive, we could consider the goal for Listing Factor A has been reached, but we should still ask if the best available information indicates that regulatory mechanisms are adequate. Could the underlying causes of OC coho salmon habitat destruction once again lead to conditions where the habitat trend goals would not be met in the future under current regulatory mechanisms? If the answer is yes, we should consider the possibility that the regulatory mechanisms are inadequate to protect coho salmon habitat. For example, if the trends are positive and we consider the forest conditions to be consistent with good coho salmon habitat, but the primary reason the forests are in good condition is the price of logs, not adequate regulatory mechanisms, we could consider the regulatory mechanisms to be inadequate.

Text Box 4-2
Comparison of Bald Eagles and Oregon Coast Coho Salmon, Importance of Regulatory Protection.

Similar to OC coho salmon, bald eagles in the lower 48 U.S. states were once abundant, but human activities led to drastic declines in their numbers (see figure below). Both species were listed under the Endangered Species Act. Since ESA listing, the numbers of both species have increased from their lowest point. In 2007, the USFWS removed bald eagles in the lower 48 states from the list of threatened and endangered species. NMFS continues to retain the listing of OC coho salmon as threatened.

Why are OC coho still listed when bald eagles are not? The threats that led to the ESA listing of bald eagles (shooting and chemicals including DDT) have been greatly reduced, and regulatory mechanisms (two federal statutes - the Migratory Bird Act and the Bald and Golden Eagle Protection Act) continue to protect bald eagles, greatly reducing future threats to the survival of bald eagles. In comparison, while some factors leading to ESA listing of OC coho (harvest and hatcheries) have been addressed, others (habitat loss and degradation) have not been adequately reduced or addressed and continue to threaten the species. Regulatory protections for OC coho salmon need to be strengthened to reduce or eliminate remaining threats and support the sustainability and persistence of the OC coho salmon ESU, before and after delisting.

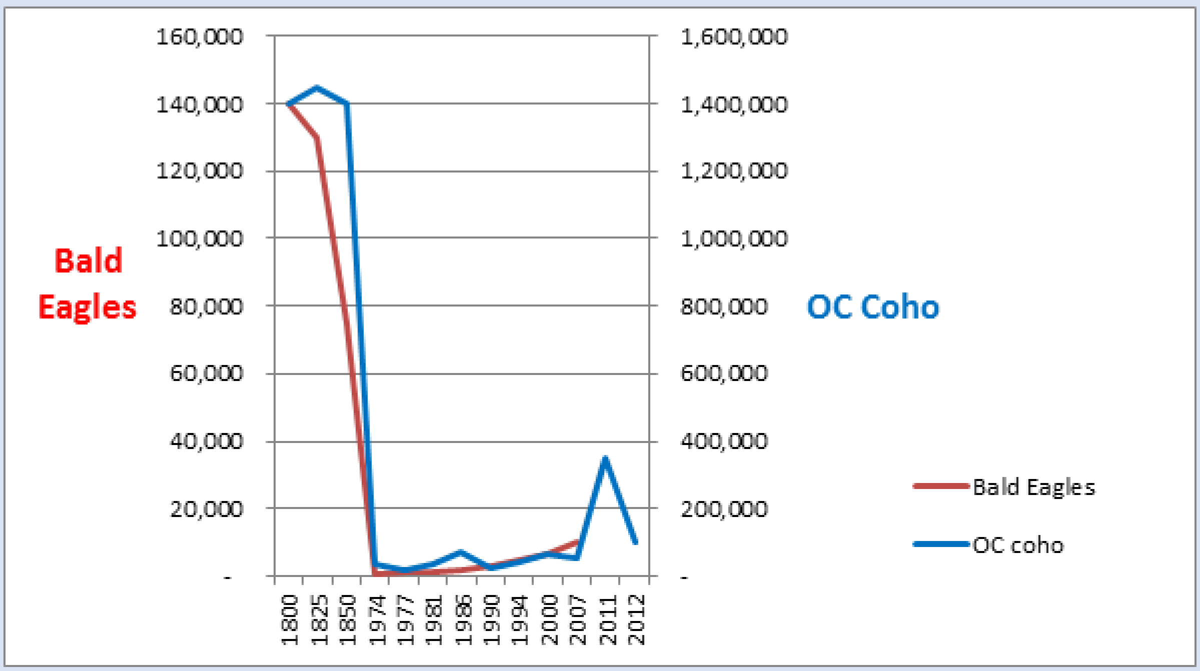


Figure: Approximate numbers of bald eagles in the lower 48 and OC coho salmon.

Goal for Factor D related to Listing Factor B (overutilization):
Regulatory mechanisms continue to ensure that OC coho salmon will not be a threatened or endangered species because of marine and freshwater harvest.

Criterion:
Harvest management (through the Pacific Fishery Management Council or other regulatory mechanism) ensure that the goals for Listing Factor B are reached.

Goal for Factor D related to Listing Factor C (disease and predation):
Regulatory mechanisms (including federal protections of birds and pinnipeds) ensure that OC coho salmon will not be a threatened or endangered species because of disease and predation.

Criterion:
Monitoring and regulatory mechanisms are in place that ensure that the goals for Listing Factor C are reached.

Goal for Factor D related to Listing Factor E (other man-made or natural factors):
Regulatory mechanisms are in place that ensure that OC coho salmon will not be a threatened or endangered species because of conditions described in Listing Factor E.

Criterion:
Hatchery management (through ODFW and NMFS section 7 regulatory mechanism) ensure that the goals for Listing Factor E relating to hatcheries are reached.

Factor E: Other natural or manmade factors affecting its continued existence

Goal 1 for Listing Factor E:
Ensure hatchery activities are not impeding the recovery of Oregon Coast coho salmon.

Discussion: The TRT and BRT both concluded that ODFW has implemented reductions and practices in hatchery operations that effectively reduced hatcheries as a threat to recovery. ODFW submits Hatchery Genetic Management Plans to NMFS associated with two facilities, for approval under the ESA limit 5 of the 4(d) rule, and NMFS is required to ensure compliance with the NEPA.

Criterion*:* To meet this criterion, hatchery practices will need to remain consistent with the recovery of Oregon Coast coho salmon. We expect that implementing the OCCCP will achieve this criteria, and will continue to work with ODFW to adaptively manage hatchery production.

Goal 2 for Listing Factor E: Evaluate Threats Due To Other Causes:
Ensure there are adequate monitoring programs in place to detect significant changes in Oregon Coast coho salmon habitat due to climate change (by monitoring changes in stream flow, temperature, and their effects upon freshwater survival at all life stages).

Discussion: While this goal is important, we do not intend this monitoring goal to be a requirement for delisting. See Section 7 for RME recommendations.

4.4 Making a Listing Determination Considering the Biological Status and the Five Listing Factors

At the time of a delisting decision for the Oregon coast coho salmon ESU, NMFS will examine whether the section 4(a)(1) listing factors have been addressed. To assist in this examination, NMFS will use the delisting framework described below and shown in Figure 4-1, in addition to evaluating the biological status relative to the recovery criteria and other relevant data and policy considerations. The threats need to have been addressed to the point that delisting is not likely to result in their re-emergence.

NMFS recognizes that perceived threats, and their significance, can change over time due to changes in the natural environment or changes in the way threats affect the entire life cycle of salmon. Indeed, this has already happened. As discussed earlier, some threats to Oregon coast coho salmon at the time of listing, such as harvest mortality and hatchery influence, have since been reduced through management adjustments and now pose less danger to species viability. Other threats, such as the condition of freshwater and estuarine habitats, continue to limit recovery progress, although conditions in some areas are improving through the work of volunteers and stakeholders (see Section 7 for a discussion of past and protected expenditures to protect and restore habitat. At the same time, new threats, such as those posed by climate change, may be emerging. During its five-year reviews, NMFS will review the biological status and listing factor criteria.

In Section 4.1, we described the ESA requirements for delisting; in Section 4.2 we described the biological recovery criteria; in Section 4.3 we described criteria for the five Listing Factors. In this section we introduced a framework for assessing the biological status and Listing Factors and apply the framework to show how we could take all these into consideration in a future listing determination, tailoring the ESA requirements to Oregon Coast coho salmon.

4.4.1 Applying the Delisting Framework for Oregon Coast Coho Salmon

The recent improvements in the biological status of Oregon Coast coho salmon have led to renewed interest in delisting the species, highlighting the importance of articulating, as clearly as possible, how we will make future listing/delisting decisions.

As described in this Section and portrayed in Figure 4-1 and Table 4-2, the delisting framework for OC coho salmon combines our assessment of biological status and the five Listing Factors. Based on the results of these assessments, we will assess the overall risk to the species in future listing determinations.

In our previous listing determination, we asked the BRT to "judge whether the ESU was at low, moderate, or high risk of extinction based on current biological status and existing and projected threats. We asked the BRT to give particular attention to the status and trend of freshwater habitat conditions and marine survival conditions."[32] The BRT report summarizes the risk matrix approach used, and the lengthy discussions, by members of the BRT that led to the conclusion that "when future conditions are taken into account, the (OC coho salmon ESU) as a whole is at

[32] Stout et al Executive Summary.

'moderate risk of extinction.' To reach this conclusion, the BRT applied a well-established risk matrix approach, considering the current or future threats to the ESU, but did not do a full assessment of all five Listing Factors (e.g. Listing Factor D).

In future listing decisions, NMFS will apply the framework using a similar or comparable process to determine the overall risk of extinction of OC coho salmon.

The challenges of applying this framework are underscored by the fact that we need to take into account which factors have contributed to the threatened status and:

- the concept of tradeoffs[33] between the various objectives and criteria and efforts,
- the TRT's description of the Oregon Coast coho salmon ESU as a complex structure with important processes operating at scales ranging from individual spawning grounds to the entire ESU,
- the threatened destruction, modification, or curtailment of its habitat,[34]
- the uncertainties described in our listing determinations and TRT and BRT reports, and
- the reality that there are multiple combinations of biological and Listing Factors and protective efforts, and there is no pre-established line between recovered and threatened status for Oregon Coast coho salmon.

Table 4-2 shows how the factors contributed to the threatened status determination in 2011. We use this same format to explain how we could make future determinations as discussed in Section 4.4.2.

[33] NMFS Recovery Guidance 2007.
[34] ESA Section 4(a)(1)(A)

Table 4-2. Framework for considering the biological and list factors for Oregon Coast coho salmon. The width of each column is an approximate indication of the weight we could apply in considering the listing status of the ESU. The listing decision is based on the risk of extinction, which is a function of the biological status and analysis of the listing factors.

Degree of certainty that criterion has been met	Biological Status (Is the ESU sustainable?)[35]	Listing Factor (LF) A Is the habitat adequate for recovery?	LF B[36]	LF C[37]	Listing Factor D The regulatory mechanisms for each listing factor (A,B,C, E) are adequate to achieve and sustain recovery				LF E Other factors[38]
					A	B	C	E	
High certainty it is met									
Moderate certainty it is met									
Low Certainty it is met									
Uncertain									
Low Certainty it is not met									
Moderate certainty it is not met									
High certainty it is not met									

[35] Based on the score for ESU sustainability (ES) from the Decision Support System (DSS) presented in Wainwright et al. 2008.
[36] Does NMFS consider overutilization to be a threat to recovery?
[37] Does NMFS consider disease & predation to be a threat to recovery?
[38] Does NMFS consider other factors to be a threat to recovery, including hatcheries and climate change?

Table 4-3. Characterization of how we evaluated the criteria leading to a "moderate risk of extinction" and threatened status determination in 2011.

Degree of certainty that criterion has been met	Biological Status (DSS results): Low to moderate certainty the ESU was sustainable[39]	Listing Factor (LF) A[40]	LF B[41]	LF C[42]	Listing Factor D Habitat regulatory mechanisms were inadequate to achieve and sustain recovery[43]				LF E Other factors[44]	
High certainty it is met										
Moderate certainty it is met										
Low Certainty it is met										
Uncertain										
Low Certainty it is not met										
Moderate certainty it is not met										
High certainty it is not met										
					A Habitat	B	C	E		

[39] Low to moderate certainty the ESU is sustainable based on the BRT scores for ESU sustainability (ES) (+0.24 and +0/28) in Stout et al 2012.
[40] NMFS was uncertain about the adequacy of the habitat based on TRT, BRT, Habitat Consultation Division and 5 year status review analyses.
[41] NMFS did not consider overutilization to be a threat to recovery (BRT).
[42] NMFS did not consider disease & predation to be a threat to recovery except predation in the Lakes Stratum.
[43] NMFS considered the inadequacy of regulatory mechanisms to be an impediment to recovery - see the Listing FRN June, 2011; BRT, TRT and other sources.
[44] Other factors: NMFS did not consider hatcheries to be a threat to recovery; we are concerned but uncertain about climate change (BRT).

We use the same framework to describe the strongest case for delisting, which would be the case if we had ‘complete certainty’ that the biological and all the Listing Factors met their respective objectives, as portrayed in Table 4-4.

Table 4-4. The strongest case for delisting would be if we had 'complete certainty' that the biological and all the Listing Factors met their respective goals and protective efforts were effective

Degree of certainty that criterion has been met	Biological Status – DSS shows the ESU is sustainable and persistent	Listing Factor (LF) A	LF B	LF C	Listing Factor D: habitat regulatory mechanisms have been strengthened and are consistent with sustained recovery				LF E Other factors	
High certainty it is met										
Moderate certainty it is met										
Low Certainty it is met										
Uncertain										
Low Certainty it is not met										
Moderate certainty it is not met										
High certainty it is not met										

However, the ESA and NMFS guidance do not require the highest level of certainty and they do not specify exactly what the status of the species and the Listing Factors must be in order to delist. For Oregon Coast coho salmon delisting criteria, we considered the relative “weight” that we should apply to the criteria ─ are they all equally important, or are some more important than others? We developed an approach to describe the difference between threatened and recovered status.

Regarding the relative importance of each of the factors for Oregon Coast coho salmon, we determined that while they must all be taken into consideration, they do not currently have the same importance for the recovery of Oregon Coast coho salmon and should therefore not be given equal “weight” in a listing determination. This could change in the future.

We propose two principles as part of the delisting framework for Oregon Coast coho salmon.

1. **The biological recovery criteria should provide at least a moderate certainty that the ESU is sustainable.** The basis for this requirement is on the concept of the ‘viable salmonid population’ described in McElhaney et al 2000. As discussed in Section 4.2, this has been a key element in the development of the “best available science”’ for our recovery framework for salmonids.

2. **We need to be reasonably certain that the relevant regulatory mechanisms are “adequate” to protect Oregon Coast coho salmon.** In other words, the goals for the elements within Listing Factor D should be achieved. A necessary step in recovering Oregon Coast coho salmon is to strengthen key regulatory mechanisms in order to “provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, (and) to provide a program for the conservation of such endangered species and threatened species.” (ESA section 2(b).

We include these two principles and in flow diagram describing the decision process we could use in a delisting determination (Figure 4-3).

Box 6 in this flow diagram describes situations where the biological goal has been reached but not all the goals for the five Listing Factors have been reached. If this is the case, we need to determine if the status of any of the five Listing Factors is inadequate to such an extent that we cannot consider the ESU recovered. We interpret the law and the science to allow multiple ways to achieve recovery and in order to clarify the multifaceted recovery criteria, we can “bracket” a hypothetical line between threatened and recovered status by describing several scenarios that we think would qualify for delisting and several that would not.

We portrayed the strongest delisting scenario in Table 4-5. Table 4-5 shows a hypothetical characterization of how we might delist even if we are not certain one criterion was not met. In this hypothetical scenario, we are confident that the biological criteria and Listing Factors B, C, D and E meet their respective objectives, however we determine that we are not sure if the habitat is currently adequate, due in part to the time required to show the results of habitat restoration projects. It is possible we could delist - if we determined that restoration activities and protective efforts will continue and regulatory protections for habitat have been established and implemented such that there was no additional risk to the ESU while the habitat improved as a result of the regulatory protections.

Table 4-6 is a hypothetical characterization of how we could delist with different combinations of certainty for biological and threats criteria. For example, if we determined there was a high certainty that the habitat and regulatory mechanisms were adequate to sustain recovery, we could consider delisting with a lower score for biological sustainability.

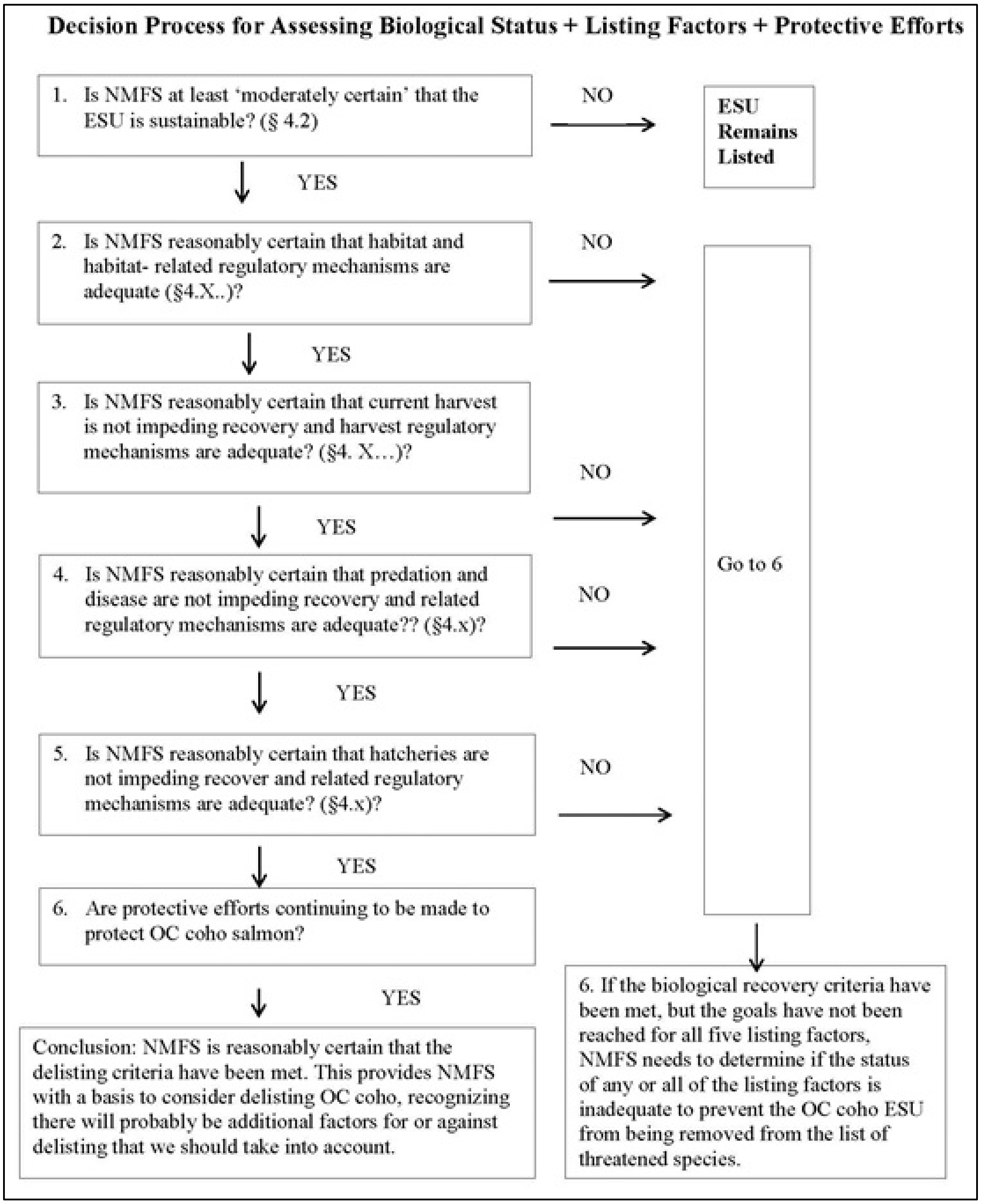


Figure 4-3. Decision process for assessing listing status.

Table 4-5. Hypothetical characterization of how we might delist even if one criterion was not met. In this hypothetical scenario, we could determine that even though we aren't certain that the habitat is adequate for recovery, the biological status is good and newly strengthened regulatory mechanisms are deemed sufficient to improve the habitat enough to warrant delisting.

Degree of certainty that criterion has been met	Biological Status: DSS shows moderate certainty that the ESU is sustainable and persistent	Listing Factor (LF) A Uncertain about adequacy of the habitat	B & C Do not impede recovery		Listing Factor D: habitat regulatory mechanisms are adequate to achieve and sustain recovery				LF E Other factors do not impede	
High certainty it is met										
Moderate certainty it is met										
Low Certainty it is met										
Uncertain										
Low Certainty it is not met										
Moderate certainty it is not met										
High certainty it is not met										

Table 4-6. Hypothetical characterization of how we could delist with different combinations of certainty for biological and threats criteria. If we determined there was a high certainty that the habitat and regulatory mechanisms were adequate to sustain recovery, we could consider delisting with a lower score for biological sustainability.

Degree of certainty that criterion has been met	Biological Status We might not need high certainty the ESU is sustainable if Listing Factors are in good shape.	Listing Factor (LF) A Certain the habitat is adequate for recovery	Certain B & C criteria are met		Certain that Listing Factor D - habitat regulatory mechanisms - are adequate to achieve and sustain recovery				LF E Other factors are consistent with recovery	
High certainty it is met										
Moderate certainty it is met										
Low Certainty it is met										
Uncertain										
Low Certainty it is not met										
Moderate certainty it is not met										
High certainty it is not met										
					A Habitat	B	C	E		

5. Current Status Relative to Recovery Goals

This section discusses the factors that led to ESA listing and the current status of the Oregon Coast coho salmon ESU relative to the recovery goals. The difference between the current status and recovery goals describes the gap, or difference, between the current status of the ESU relative to achieving the recovery goals and meeting the delisting criteria.

The good news:

- Adult returns reached a 60-year high in 2014, with approximately 350,000 spawners.
- Restoration efforts continue to contribute to improving habitat condition for Oregon Coast coho salmon; we continue to support these local and statewide efforts. (See the section below on these efforts.)
- Harvest managers continue to manage Oregon Coast coho salmon harvest in a manner that, for the most part, is consistent with recovery.
- ODFW hatchery policies and practices continue to be consistent with recovery.
- ODFW continues to implement a habitat monitoring effort that provides valuable information relative to delisting, although there are important data gaps and uncertainties that would require additional funds to resolve.
- ODFW has long held the position that the Oregon Coast coho ESU is viable and sustainable, and the ESU's biological performance has continued to improve since the downturn in the 1990s. While ODFW supports delisting of OC coho, it has also acknowledged that continued efforts through restoration and management are vital to achieving a desired status that provides substantial ecological and societal benefits.

The bad news:

- Adult returns dropped from 350,000 to about 100,000 in 2012, probably a result of a combination of marine and fresh-water conditions. This underscores the BRT's concerns about the potential for the ESU to decline quickly when poor conditions return.
- The best available scientific information suggests there have not been measurable improvements in habitat status from the degraded status that led to listing.
- There have not been any significant changes in regulatory mechanisms relating to forest and agricultural practices, water quality, beaver removal, or building in floodplains.

5.1 Summary of Current ESU Status

NMFS' biological review team's 2012 status review (Stout et al. 2012) described the status of the Oregon Coast coho salmon ESU. The BRT's findings are summarized below and described in more detail in the full report.

The BRT's review of the status of the Oregon Coast coho salmon ESU reflects results from its 2010 risk assessment for the ESU. Overall, results from the risk assessment, as discussed in the BRT status review (Stout et al. 2012), indicate that there is uncertainty about the status of the ESU, both in relation to the viability parameters (abundance, population growth rate, spatial structure, and diversity) and to the five threat categories. The BRT found that some aspects of the Oregon Coast coho salmon ESU's status have clearly improved since the initial status review in the mid-1900s; however, persistent threats continue to affect the longer-term status of the ESU.

The BRT recognized an increase in coho salmon spawner abundance since the mid-1900s. It assigned a relatively low mean risk score for abundance, noting that spawning escapements were higher in some recent years than they had been since 1970. Recent total returns (preharvest recruits) were also substantially higher than the low extremes of the 1990s, but still mostly below levels of the 1960s and 1970s. The BRT attributed the increased spawner escapements largely to a combination of greatly reduced harvest rates, reduced hatchery production, and improved ocean conditions. The team found, however, that abundance remained at approximately 10 percent of estimated historical abundance even with the recent increases. It noted that compared to the mid-1990s, the ESU contained relatively abundant natural-origin populations throughout its range, leading to a relatively low risk associated with spatial structure. The BRT also noted that hundreds of individual habitat improvement projects over the last approximately 15 years had likely benefited the ESU, although quantifying these benefits is difficult.

The BRT also discussed some ongoing positive changes that are likely to influence abundance trends for the ESU in the future. In particular, hatchery production continues to be reduced with the cessation of releases in the North Umpqua River and Salmon River populations, and the BRT expected that the near-term ecological benefits from these reductions would result in improved natural production for these populations in future. In addition, the BRT expected that reductions in hatchery releases that have occurred over the past decade may continue to produce some positive effects on the survival of the ESU in the future, due to the time it may take for past genetic impacts to become attenuated.

Despite these positive factors, however, the BRT reserved considerable concerns about the long-term viability of the ESU. The BRT continued to be concerned about the long-term decline in the productivity of the ESU from the 1930s through the 1990s. Despite some improvements in productivity in the early 2000s, the BRT was concerned that the overall productivity of the ESU remains low compared to what was observed as recently as the 1960s and 1970s. The BRT was also concerned that the majority of the improvement in productivity in the early 2000s was likely due to improved ocean conditions, with a relatively smaller component due to reduced hatchery production (Stout et al, 2012; Buhle et al. 2009).

The BRT noted that due to the legacy of past forest management practices combined with lowland agriculture and urban development, the areas of highest habitat capacity are now severely degraded. The BRT also noted that the combined ODFW/NMFS analysis of freshwater habitat trends for the Oregon coast found little evidence for an overall improving trend in freshwater habitat conditions since the mid-1990s and evidence of negative trends in some strata. The BRT was therefore concerned that when ocean conditions cycle back to a period of poor survival for coho salmon, the ESU may rapidly decline to the low abundance seen in the mid-1990s and we developed criteria in Section 4 to address this concern.

Finally, the BRT was also concerned that global climate change will lead to a long-term downward trend in freshwater and marine coho salmon habitat compared to current conditions. There was considerable uncertainty about the magnitude of the effects climate change will have on salmon habitat, but the BRT was concerned that most changes associated with climate change are expected to result in poorer and more variable habitat conditions for OC coho salmon than exist currently.

NMFS decision to retain species' threatened listing

Based on the results of the BRT status review, in June 2011 NMFS issued a final determination to retain the threatened listing for the Oregon Coast ESU of coho salmon. NMFS did not at that time have a recovery plan with delisting criteria. The following list summarizes our assessment of the criteria.

- The BRT's Decision Support System (DSS) scores for sustainability indicated low to moderate certainty the ESU was sustainable (+ 0.24).
- The BRT described low certainty that the habitat was adequate for recovery.
- NMFS had high certainty that objectives for Listing Factors B, C, and E had been met.
- NMFS had moderate certainty that the regulatory mechanisms for harvest, predation and hatcheries were adequate.
- The BRT and NMFS were moderately certain that the regulatory mechanisms for habitat were not adequate to protect the ESU (NMFS 2011).
- Restoration and protection efforts have contributed to improving the habitat condition but we recognized that it wasn't clear how much progress had been made in remedying the previous habitat destruction.
- "The BRT concluded that, when future conditions are taken into account, the (Oregon Coast coho salmon ESU) as a whole is at moderate risk of extinction."[45]

Table 5-1 provides a characterization of NMFS 2011 determination using the framework previously described in Section 4.4.1. When we present the 2011 listing determination in this framework, it is clear which factors contributed to the threatened status. We determined that the ESU should be listed as threatened due to the combination of the following:

- our assessment that the objectives for Listing Factor D had <u>not</u> been met, meaning there were inadequate protections in place for Oregon Coast coho salmon habitat;

[45] See Section 4 and BRT page 119

- the ‘weak’ scores for biological status;
- the ‘weak’ score for habitat status; and
- the lack of evidence that protective efforts, while beneficial, are yet sufficient.

Table 5–2 provides a characterization of our current assessment of the biological status and Listing Factors and the gap between current and desired conditions.

Table 5-1. Characterization of how we evaluated the criteria leading to a "moderate risk of extinction" and threatened status determination in 2011.

Degree of certainty that criterion has been met	Biological Status (DSS results): Low to moderate certainty the ESU was sustainable[46]	Listing Factor (LF) A[47]	LF B[48]	LF C[49]	Listing Factor D Habitat regulatory mechanisms were inadequate to achieve and sustain recovery[50]				LF E Other factors[51]	
High certainty it is met										
Moderate certainty it is met										
Low Certainty it is met										
Uncertain										
Low Certainty it is not met										
Moderate certainty it is not met										
High certainty it is not met										
					A Habitat	B	C	E		

[46] Low to moderate certainty the ESU is sustainable based on the BRT scores for ESU sustainability (ES) (+0.24 and +0/28) in Stout et al 2012.
[47] NMFS was uncertain about the adequacy of the habitat based on TRT, BRT, Habitat Consultation Division and 5 year status review analyses.
[48] NMFS did not consider overutilization to be a threat to recovery (BRT).
[49] NMFS did not consider disease & predation to be a threat to recovery except predation in the Lakes Stratum.
[50] NMFS considered the inadequacy of regulatory mechanisms to be an impediment to recovery - see the Listing FRN June, 2011; BRT, TRT and other sources.
[51] Other factors: NMFS did not consider hatcheries to be a threat to recovery; we are concerned but uncertain about climate change (BRT).

Table 5-2. Current assessment of the elements of the delisting criteria.

Degree of certainty that criterion has been met	Biological Status	Listing Factor (LF) A	LF B	LF C	Listing Factor D				LF E Other factors[52]
High certainty it is met									
Moderate certainty it is met	Goal: at least moderate certainty the ESU is sustainable								
Low Certainty it is met	Most recent status review: low to moderate	Concern that ecosystem processes and habitat status have not improved enough							
Uncertain									
Low Certainty it is not met					Concern that regulatory mechanisms for forest and ag practices, floodplain development, water quality, gravel mining, etc. are inadequate				
Moderate certainty it is not met									
High certainty it is not met									
			B	C	A Habitat	B	C[53]	E	

[52] Concern about the potential effects of climate change on both freshwater and marine survival.
[53] Concern about predation in some areas of the ESU.

Applying the decision process shown in Figure 4-3 to the current status, in step 1 we find that the latest DSS results show a "low to moderate" certainty that the ESU is sustainable, which does not meet the criterion of moderate certainty. In step 2, we are not reasonably certain that the habitat and habitat-related regulatory mechanisms are adequate to meet the criteria and goals described in Section 4.

5.2 Ongoing Efforts to Restore Habitat

NMFS recognizes and applauds the numerous efforts that continue to support recovery of OC coho salmon. State, federal, tribal and local governments, non-governmental organizations and private sector organizations and individuals have participated in numerous conservation and recovery efforts. In particular, ODFW's OCCCP Implementation Team includes key agencies and stakeholders, and NMFS continues to participate in and support this team. See Section 7 for a summary of expenditures to date and estimated costs to get to recovery.

- OWEB (http://www.oregon.gov/oweb/pages/index.aspx)
- ODFW (http://www.dfw.state.or.us/fish/crp/coastal_coho_conservation_plan.asp)
- NOAA Restoration Center (http://www.habitat.noaa.gov/restoration/regional/northwest.html)
- United States Forest Service
- Bureau of Land Management
- United States Fish and Wildlife Service
- Federal Emergency Management Agency
- Pacific Coast Salmon Restoration Fund
- Non-Governmental Organizations
    - The Nature Conservancy
    - Land trusts
    - Trout Unlimited
    - The Native Fish Society
    - Ford Foundation
    - Umpqua Fishing Derby
    - Many others (to be named in the final document)

5.3 Closing the Gap between ESU Current Status and Recovery

In order to close the gap between the current situation and recovery, the strategies and actions in Section 6 focus on improving the biological status of the ESU by increasing the quantity and quality of rearing habitat. In order to do this, NMFS has determined that a key strategy is to protect habitat that is currently functioning (not just restoring degraded habitat), and the most effective way to do this is to provide increased protections through regulatory mechanisms.

Since the quantitative habitat criteria described in Section 4.3.2 for ESA recovery are set at the strata level, we do not have delisting criteria for habitat at the population level. In order to provide practical guidance and targets for improving habitat at the population level, we will work with the OCCCP implementation team (including stakeholders) and others to set population-specific habitat targets. One useful metric to do this is the goals for miles of high quality habitat established for each population in the OCCCP, Appendix 2. We agree with ODFW that these targets probably exceed that which is necessary for delisting under the ESA, but setting a target for each population using this metric will provide guidance for local planning and prioritizing.

6. Recovery Strategies and Actions

This Section describes the recovery strategies and site-specific management actions for Oregon Coast coho salmon which are designed to meet the goals described in Section 4 and fill the gaps described in Section 5. We present the strategies and site-specific management actions at the ESU level for all listing factors, and at the stratum levels for habitat to provide the foundation for charting our recovery efforts. Additional activities within each stratum are presented in the Recovery Implementation Schedule.[54]

Considerable progress has been made in improving the status of Oregon Coast coho salmon over the past twenty years. Since ESA listing, threats posed by fisheries and hatcheries have largely been addressed. Changes in fishery management since 1993 significantly reduced harvest mortalities and harvest-related threats to the ESU. Steps taken by ODFW and others to improve hatchery practices have minimized adverse impacts of hatcheries on the Oregon Coast coho salmon ESU. Further, actions by state, federal, and local organizations and individuals have improved habitat access and conditions in many areas.

Oregon Coast coho salmon populations responded to favorable marine conditions and these changes in fisheries management since listing. The ESU currently remains at low to moderate certainty of sustainability.[55] While coho salmon abundance has increased, there is uncertainty about the reason for this improvement ─ is it due mostly to (and dependent on) favorable marine survival, or is it also due to improved freshwater productivity? Based on the best available science, we remain concerned that the current quality (especially temperature) and quantity of freshwater habitats leaves the ESU susceptible, particularly if global climate change leads to a long-term downward trend in freshwater and marine coho salmon habitat compared to current conditions. Uncertainty also remains concerning predation on Oregon Coast coho salmon from non-native fish species, such as smallmouth and largemouth bass, particularly in the Lakes Stratum.

6.1 Assumptions

Based on the best available science, it is our opinion that the current strengthened status of the Oregon Coast coho salmon populations is primarily due to a combination of reduced harvest and hatcheries, and high marine survival and actions to protect and restore ecological factors will result in reduced risks, increased survival and resiliency. Because of the species' complex life cycle, and the many changes that have taken place in their environment, we must address the factors limiting their survival in an integrated way. The work needs to occur at regional and state levels, in terms of commitment to actions and funding, and at the local level, population by population. Each population and stratum contributes greatly to the well-being of the species. The integration of recovery actions at the population and strata, along with broader conservation and

[54] The Recovery Implementation Schedule will be posted on the NOAA Fisheries website: http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/oregon_coast/oregon_coast_salmon_recovery_domain.html.
[55] Based on the draft June, 2015 DSS results, run as part of the 5 year status review.

recovery efforts already underway in the region, will collectively help to delist the species.

Key assumptions

In designing an effective recovery strategy, we make a number of assumptions that, if true and properly addressed, will lead to the delisting of the species. These assumptions include:

- *We have accurately identified the limiting factors and threats affecting the fish*.

  This recovery strategy reflects the best technical information available and our current understanding of the limiting factors and threats that affect ESU viability.

- *The increased viability of the ESU since the 1990s is due in part to the reduced threat from coho hatcheries production, but we do not know how large that contribution has been.*

  Because the hatchery production was curtailed without the benefit of a controlled study, we do not have a good way of knowing how much the natural productivity of coho salmon has improved. It may have been a significant contribution, and it would be very interesting if fisheries managers could conduct a controlled experiment on another species to test the effect of reducing hatchery production.

- *Addressing the limiting factors and threats will improve the viability of each population, stratum and the ESU.*

  Multiple human activities (threats) have contributed to the decline of this ESU and several categories of degraded habitat continue to limit its viability. Since hatcheries and harvest are not currently impeding recovery, the strongest case for recovery and delisting will involve reductions in multiple threats and the related limiting factors to Oregon Coast coho salmon habitat. Our strategy focuses on addressing habitat-related threats that currently impact recovery. Most of the recommended actions target the protection and restoration of freshwater and estuarine habitats. The strategy also recognizes the remaining unknowns regarding our understanding of the specific issues that affect the fish now, or might influence their recovery in the future. As a result, it includes actions to gain critical information about the factors that affect the fish, or may affect the fish given global climate change. Continuing effective research, monitoring, and evaluation is critical to our success.

- *The Plan is based on technically sound ecological principles that will allow us to meet the needs of the species.*

  Our overall recovery strategy recognizes that efforts to address habitat, harvest, and hatchery -related issues affecting Oregon Coast coho salmon need to be planned and implemented with a clear understanding of ecological processes—including both biological and habitat processes—and how past and current activities affect these processes.

- *Increasing rearing habitat capacity is the best way to improve the resilience of Oregon Coast coho salmon in the face of anticipated future reductions in marine survival and, along with improved habitat protection, could be enough to achieve species recovery.*

  This is the most important assumption in the recovery plan. Actions to protect and improve juvenile rearing habitats form the foundation of the overall recovery strategy for the Oregon Coast coho salmon ESU. Coho salmon often reside in freshwater and estuarine areas for up half of their life, so their viability is heavily influenced by the health of these ecosystems. Protecting existing high quality and good quality habitat and restoring damaged rearing habitat means that more juvenile fish will survive to migrate, and consequently more adults will return to the area. This added boost in species productivity will help ensure that the ESU can survive expected impending downturns in ocean survival.

- *Voluntary efforts to protect and restore natural watershed processes and the habitat upon which native species depend are critical and necessary for species recovery but may not, by themselves, be able to sufficiently reduce indirect and direct threats and achieve the long-term goals of the ESA.*

  In the long run, protection and restoration of salmon habitat will only be accomplished by the many volunteers who live, work, and recreate within the range of Oregon Coast coho salmon that make it a priority. We appreciate and applaud the many voluntary contributions to protect and restore salmon habitat within the ESU. However, we believe the long-term persistence of Oregon Coast coho salmon also requires improving existing regulatory habitat protection programs at the local, state and federal levels (see Section 4).

- *Long-term persistence of the Oregon Coast coho salmon ESU requires development of partnerships that integrate the needs of salmon and the environmental processes that form their habitat with the needs of communities and stakeholders.*

  For this recovery plan to be effective, we need to develop and implement a common framework that will help us frame recovery efforts so they are strategic, comprehensive and proactive. This requires a multi-faceted effort with coordination between federal, state and local agencies and the private sector, and linking efforts at the watershed, population, stratum, and ESU levels. Our long-term approach needs to be watershed process- oriented. Since changes in land use associated with human development have placed many pressures on stream and riparian ecosystems throughout the ESU, an important element in our Plan is to identify watershed-level efforts that could, if implemented, address indirect threats – the roots causes of ecosystem impairment. We intend to integrate these efforts, working with landowners, businesses, non-governmental and governmental organizations to find ways to accomplish multiple goals.

- *An effective adaptive management approach will allow us to gain an understanding of each limiting factor and the specific actions that can modify the species' environment and result in a biological response (through improvements in productivity, abundance, spatial structure, and diversity).*

The recovery strategy and subsequent actions reflect our current understanding of limiting factors and threats to Oregon Coast coho salmon at the population, strata, and ESU levels. However, we understand that actions may not yield desired results, gaps in data may emerge, and recovery efforts may need to be adapted. Acknowledging these limitations and integrating adaptive management into the recovery plan is an essential part of the recovery strategy. Through an adaptive management process, we will be able to recognize limitations and account for them in our approach, allowing recovery efforts to adjust to the uncertainty of the future. We will work with our partners to reevaluate and update the recovery strategies, actions and activities as new information becomes available.

6.2 Recovery Strategies and Actions at the ESU Level

Our overall recovery strategy for Oregon Coast coho salmon aims to establish self-sustaining, naturally spawning populations in the wild that are sufficiently abundant, productive, and diverse and no longer need Endangered Species Act protection. As the species continues to recover over time, NMFS supports the attainment of broader goals that go beyond achieving species recovery under the ESA in order to provide multiple ecological, cultural, social, and economic benefits.

Our Oregon Coast coho salmon recovery strategy has a single overriding focus: degraded habitat. Related state and federal scientific reports and findings identify reduced stream complexity, degraded water quality (especially increased temperature), reduced water quantity, and, for the Lakes Stratum populations, warm water predators as the primary and secondary factors that continue to threaten ESU viability (see Table 3-2). Our recovery strategy focuses on addressing these habitat-related limiting factors. At the same time, we will support and will continue the reforms already implemented for Oregon Coast coho salmon harvest and hatchery management, and work with ODFW and the Pacific Fishery Management Council (PFMC) to update these reforms as needed to achieve and maintain ESU viability. The comprehensive strategy for each ESA listing factor includes one or more of three basic elements: voluntary actions, regulatory mechanisms, and enforcement of laws and regulations. The following sections describe strategies and actions to address each Listing Factor. Table 6-1 at the end of this section shows potential voluntary, regulation, and enforcement strategies for each listing factor.

6.2.1 ESU Level Strategies and Actions to Improve Habitat (Listing Factors A and D) at the ESU level

Strategies that start with restoring natural watershed processes will be more effective at reaching goals than strategies that start at project-level scales. To do this, we will need to deal with both direct and indirect threats.

Studies by the NWFSC and others show that habitat conditions and aquatic ecosystem function are a result of the interaction between watershed and estuarine controls (such as geology and climate), watershed and estuarine processes (such as hydrology and sediment transport), and land use. Scientists and resource managers have recognized that restoration planning that carefully integrates watershed or ecosystem processes is more likely to be successful at restoring depleted salmonid populations (Beechie et al. 2003). Strategic restoration of natural watershed processes that form and sustain salmon habitats provides for long-term protection of salmon habitat. This principle is illustrated by the following analogy: *When you walk into a room where water is spilling onto the floor, do you start mopping it up, or do you first turn off the water?* Applying this analogy to salmon recovery, we suggest that side-stepping or ignoring impaired watershed processes and starting with site-specific, project-level proposals to restore habitat can be analogous to mopping the floor when the water is still running. In many cases, the most obvious strategy is to attempt to reduce or eliminate a direct threat, but you often get more leverage if you intervene on an indirect threat or opportunity that is part of a chain of factors affecting a direct threat.

In accordance with the ESA section 7(a)(1), we intend to work with federal agencies to find ways for them to be more proactive in increasing federal interagency contributions to conservation, protection, and recovery of species and habitat. This can be through voluntary actions and via section 7 ESA consultations.

6.2.1.1 Strategy to Improve Habitat at the ESU Level

Our habitat strategy recognizes that recovery demands the application of well-formulated, scientifically sound approaches. It is founded on the concepts presented in several salmonid habitat recovery planning documents and scientific studies (e.g., Beechie and Boulton 1999; Roni et al. 2002; Beechie et al. 2003; Roni et al. 2005; Stanley et al. 2005; Isaak et al. 2007; Roni et al. 2008; Beechie et al. 2010; Beechie et al. 2012; Roni and Beechie 2013). A review by Roni et al. (2008) of 345 studies on the effectiveness of stream rehabilitation illustrates the importance of this approach. The authors found that the failure of rehabilitation projects to achieve objectives could often be attributed to an inadequate assessment of the historical conditions and the factors limiting biotic production, a poor understanding of watershed-scale processes that influence local projects, and monitoring at inappropriate spatial and temporal scales. They suggested that as an interim approach, high-quality habitats should be protected and connectivity restored before implementing instream habitat improvement projects (NMFS 2010).

Beechie et al. (2010) outlined four principles that would ensure that river restoration is guided toward sustainable actions:

1. address the root cause of degradation,
2. be consistent with the physical and biological potential of the site,
3. scale actions to be commensurate with the environmental problems, and
4. clearly articulate the expected outcomes (NMFS 2010).

An important element in our Plan is to identify strategies that could, if implemented, address indirect threats ─ the root causes of ecosystem impairment. By reducing or eliminating indirect threats (e.g. amending statutes, regulations, policies, and economic incentives) that allow or encourage the direct threats to continue, we could make significant progress towards modifying human activities and restoring processes that form and sustain coho salmon populations.

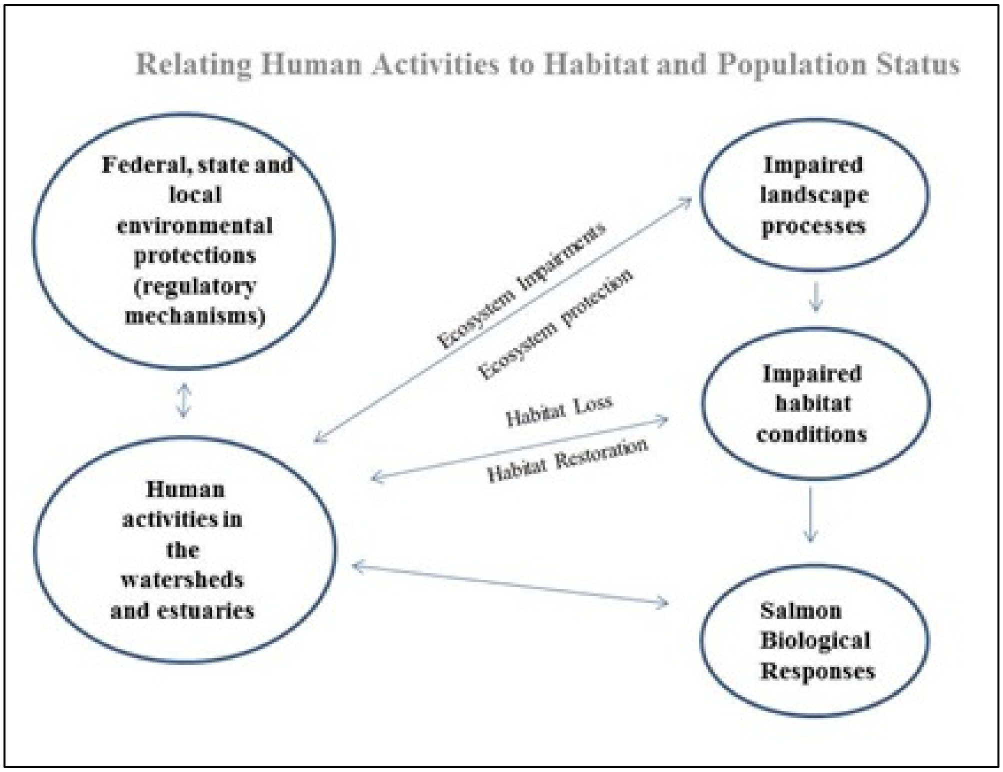


Figure 6-1. Relationships between human activities, watershed processes and fish response.

Restore watershed and estuarine processes to increase rearing habitat quality and capacity.

Research indicates that increasing rearing habitat is the best way to improve the resilience of Oregon Coast coho salmon in the face of anticipated reductions in marine survival in the future. Increasing rearing habitat capacity will reduce or eliminate the primary limitation on productivity when spawner abundance is high, and also when it is low. This will result in more smolts per spawner, which, based on our assumptions, is the best way to minimize the threat of poor ocean survival.

Although population dependent, in general, NMFS and ODFW scientists have determined that increasing over-winter rearing habitat is the top priority for ESU recovery and increasing summer rearing habitat is the second highest priority. These are the two juvenile life stages that are most limiting recovery of Oregon Coast coho salmon. New information has also focused on the estuarine life stage for juvenile coho salmon (transitioning from freshwater to saltwater) as important to recovery and maintaining diverse life history strategies.

High quality juvenile rearing habitat for coho salmon is a reflection of stream (and for many populations, estuarine) complexity, which is shaped by a combination of several key watershed processes that influence hydrologic, sediment, riparian, channel, biological, floodplain and estuarine habitat functions. High quality over-wintering habitat for juvenile fish provides refuge from high velocity flows and usually contains one or more of the following features: large wood and debris, deep pools, connected off-channel alcoves, beaver ponds, lakes, and connected floodplains and wetlands. In addition, while more than one set of habitat conditions is capable of providing over- winter habitat for juvenile survival, high quality over- wintering habitat is almost always present *only* in areas where the stream is fairly low gradient and there are broad valley areas alongside the stream. High quality summer- rearing habitat contains many of the same features as winter rearing habitat, but foremost provides refuge from high summer water temperatures.

Ensure long-term ecosystem functions and high quality habitat by reducing habitat- related threats.

Specific physical or biological features are essential to the conservation of the ESU (for example, spawning gravels, water quality and quantity, side channels, estuary habitat, forage species). These features are considered primary constituent elements (PCEs) and are essential to support one or more life stages of the Oregon Coast coho salmon ESU (sites for spawning, rearing, migration and foraging). These sites and associated features include:

- Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;
- Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks (this is the top priority for Oregon Coast coho salmon recovery);
- Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival;
- Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation; and
- Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.

Protecting and restoring these types of sites, and the features associated with them, constitutes a general recovery strategy applicable to all listed salmonid species, including Oregon Coast coho salmon.

Improve and recover the species through a common framework and innovative partnerships.

Since multiple causes are responsible for impairing population viability, disrupting ecosystem functions and contributing to habitat loss and degradation, the habitat- related threats and factors that limit Oregon Coast coho salmon viability will need to be addressed in concert.

Development and implementation of management actions that lead to recovery will require a sound understanding of conservation biology principles and ecosystem management as well as integration of planning, regulation, action implementation, funding and monitoring such that each contributes to reaching our end goal. Consequently, our recovery strategy calls for increasingly effective voluntary actions, regulatory mechanisms, and enforcement of laws and regulations.

As part of our strategy, NMFS aims to strengthen partnerships with governmental and nongovernmental organizations and others to provide collaboration toward recovery and conservation of Oregon Coast coho salmon populations. NMFS will rely on a combination of regulatory programs plus effective long-term participation in non-regulatory, voluntary conservation work to achieve ESU viability. On the regulatory front, it may be necessary to strengthen laws and/or regulations related to some habitat altering actions and/ or boost enforcement of existing regulatory mechanisms to provide habitat conditions that can support a sustainable ESU. On the non-regulatory front, we will continue to encourage and support conservation work by private landowners, local conservation groups (soil and water conservation districts, watershed councils, forestland owners, Salmon and Trout Enhancement Program (STEP) volunteers, etc.) and others to improve ecological processes and habitats, particularly in areas with the greatest potential to create and/or support high quality coho salmon rearing habitat.

The strategy calls for development of a common framework that links actions at the population and watershed level to those at the ESU level. Creating a common framework will provide standardized vocabulary, indicators, and a shared common approach to describe the natural systems and the stresses and threats that degrade them in a consistent manner across the populations, strata, and the entire ESU. This allows us to connect local, watershed-level information with stratum-level and ESU-level information. The impacts of our different conservation investments also can be added (rolled up) by measuring a common suite of indicators adopted in the framework. It provides a strategic approach to recovery that coordinates efforts to improve key watershed processes and habitats so they effectively support recovery goals for individual coho salmon populations and ESU. This consistency also improves our ability to assess the effectiveness of salmon recovery efforts, to identify uncertainties, and to update priorities and actions.

Consistent with our strategic direction for coho salmon recovery, NMFS will continue to support ongoing efforts to develop this common framework. In 2014, NMFS joined a small team of public and private to develop a common framework using the 'business plan' approach that has been used successfully throughout the country to: 1) articulate shared and achievable conservation outcomes; 2) describe a scientifically driven path for implementation priorities that can be tied to clear measures of progress; and 3) leverage and focus public and private investments. In December 2014, the project team (Team), which includes the Oregon Department of Fish and Wildlife (ODFW), NMFS, NOAA Restoration Center, National Fish and Wildlife Foundation (NFWF), Wild Salmon Center (WSC), and the Oregon Watershed Enhancement Board (OWEB) launched the business plan effort by calling for letters of interest from partnerships working on the Oregon coast to participate in the development of a common framework for use in the Oregon Coast coho salmon recovery plan and pilot strategic action plans at the population level.

The Team selected the Nehalem, Siuslaw and Elk partnerships to participate in developing pilot Strategic Action Plans (SAPs) as part of the business plan initiative. To facilitate the development of a common framework for coast coho salmon, the Team is using some element of the Open Standards for the Practice of Conservation[56] (Open Standards). Open Standards is a five-step approach used to guide decision-making that has been employed successfully in salmon recovery planning in California and Washington's Puget Sound.

The consistent terminology and metrics established through the common framework will allow funders and other stakeholders to identify common priorities among habitat restoration groups and "roll up" local implementation efforts to better evaluate cumulative impacts. The Team managing this effort seeks to advance these goals though a collaborative process that engages local communities and landowners, while promoting regional economic development.

Another key part of the recovery strategy is to support efforts implemented through the Oregon Coast Coho Conservation Plan. Consistent with sections 4 and 6 of the ESA, we are working with the state of Oregon to develop and implement site-specific actions to protect and improve habitat for Oregon Coast coho salmon. Our support for the Oregon Coast Coho Conservation Plan includes using its Implementation Team and Implementation Schedules as strategies to address degraded habitat (Listing Factor A). This avoids unnecessary duplication and enhances the effectiveness of our partnerships. We consider the excerpt from the Oregon Coast Coho Conservation Plan (page 26) shown in Text Box 6-1 to be consistent with this Federal recovery plan.

[56] Conservation Measures Partnership: Open Standards for the Practice of Conservation from Version 3.0 (April 2013) http://www.conservationmeasures.org/initiatives/standards-for-project-management.

Text Box 6-1. Related Direction in Oregon Coast Coho Conservation Plan

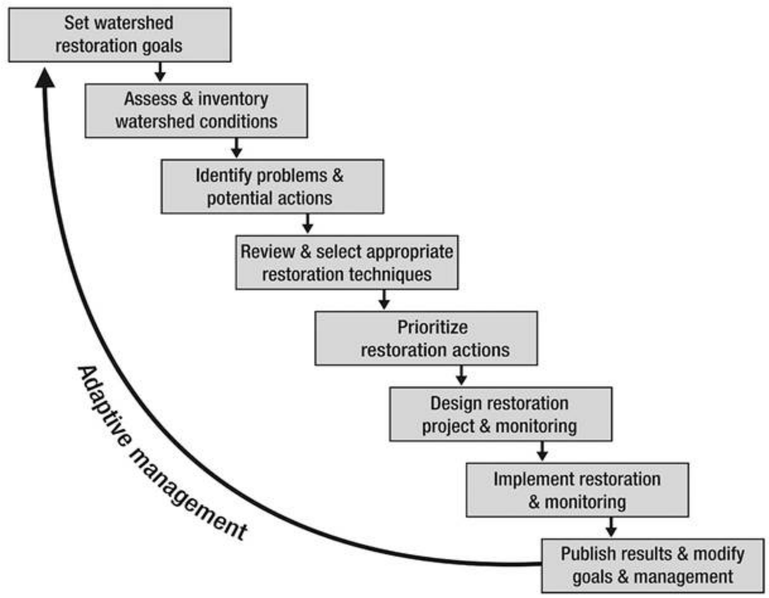
The Conservation Plan depends on a strategy of effective implementation by multiple entities, of complex programmatic and non-regulatory efforts at multiple spatial scales, including the following.

1. Continue statewide implementation of the Oregon Plan with emphasis on addressing potential limiting factors via management action across the entire freshwater, estuarine, and ocean life cycle of the species.
2. Maintain the productive capacity of the ESU and populations by conserving and increasing the amount of high quality habitat across the ESU and insuring adequate dispersal corridors between areas with high quality habitat.
3. Implement the Oregon Plan habitat strategy: (see abstracts of Agency Commitments in Section 7 and Appendix 3 of the OCCCP). The Oregon Plan habitat strategy will provide more and better technical and administrative support to local cooperative conservation work by SWCDs, watershed councils, STEP volunteers, private landowners and others.
4. Restore processes that create and sustain high quality habitat. Where necessary, implement both short term and long term habitat restoration projects. The goal of these activities is to significantly increase the productive capacity of coho salmon habitat across the ESU.
5. Provide guidance to support policy decisions regarding prioritization of conservation investments to achieve the desired status goal for the Coast coho ESU.
6. Implement ESU-wide evaluation of Coho Winter High Intrinsic Potential Habitat (CWHIP) models and mapping methodologies (see Research, Monitoring, and Evaluation section).
7. Support development – in consultation with community-based watershed entities – of long-term conservation strategies that address limiting factors at scales within populations.
8. Continue participation in regional conservation and monitoring strategies including various state and federal managers (NW Forest Plan, Pacific Northwest Aquatic Monitoring Partnership, various Oregon Conservation Strategies, etc.).

Implement an adaptive management process to track progress toward recovery, monitor and evaluate key information needs, assess results, and refine strategies and actions accordingly.

Adaptive management will play a key role in the recovery strategy for Oregon Coast coho salmon. Successful implementation of the strategy requires a process to track progress, define weaknesses, and adjust course appropriately. The ESA section 4(f) requires site-specific actions "as may be necessary to achieve the plan's goals for conservation and survival of the species." Our overarching hypothesis is that the actions recommended in this Plan will be effective in improving Oregon Coast coho salmon viability; Section 9 describes our approach to research, monitoring, evaluation and adaptive management to ensure that this hypothesis is tested and our actions are adjusted based on new information.

Our strategy includes developing a step-by-step approach to define watershed- or population-level strategies and actions that will integrate the best available science relating to salmon habitat with a structured framework that will ensure consistency for the recovery plan. The adaptive approach will also aid in defining complementary research, monitoring, and evaluation actions to improve our understanding of the species and habitat responses and management action effectiveness, and to help guide us in better defining opportunities to achieve recovery. We also employ a life cycle context to determine the best ways for closing the gap between the species' status and achieving viability objectives.



Stream and Watershed Restoration: A Guide to Restoring Riverine Processes and Habitats, First Edition. Philip Roni and Tim Beechie.

Figure 6-2. Step-by-step approach to restoring riverine processes and habitats through an adaptive management process.

ODFW has designed and implemented a habitat monitoring program, but results to date show a flat trend for key indicators at the strata level. This suggests that: 1) it may take a long time to show an upward trend, 2) the metrics may not be very sensitive to change, and/or 3) restoration activities have just kept pace with continued habitat degradation. NMFS will work with ODFW and others to improve our processes for tracking and evaluating progress toward recovery. This will include developing a means to track the net change in Oregon Coast coho salmon habitat over time. The process will be based on the principle that restoration by itself is inadequate (and a cost-ineffective approach) to ensure long-term ecosystem functions and high quality habitat, and that actions need to be continuously reassessed and improved over time.

6.2.1.2 Habitat Management Actions at the ESU Level

The following discussion identifies common approaches that can be used to alleviate or minimize the primary limiting factors and associated threats for Oregon Coast coho salmon. The actions are intended to increase productivity, abundance, and spatial structure for the fish populations by reducing or removing the existing threats causing the limiting factors. Actions taken to address the threats, and therefore the limiting factors, will be very similar across many of the coho salmon populations because of the similarity in historic land management practices. The watersheds that support populations of Oregon Coast coho salmon share many features in common, although there are some exceptions. For instance, some watersheds have ecosystem processes that are more severely impaired than others; three of the populations are lake-oriented populations; many populations have substantial estuaries, while some have minimal estuarine habitats; and there are differences in some geological features.

Because of the many similarities between the habitats of the populations, we provide a list of site-specific habitat management actions that are generally applicable to the ESU. Many of the actions aim to restore and maintain ecological processes in the watersheds that create healthy habitat conditions. They focus on adjusting land and water management activities to reduce soil erosion, regain instream habitat complexity, restore riparian and floodplain connectivity, improve water quality and streamflow. They include activities to improve stream complexity by adding large wood and other structure to create pools and cover for rearing fish. They increase salmon access to historical habitats by removing passage barriers.

The list of habitat management actions is provided as guidance and for planning purposes. The list was compiled using existing documents, including three related coho recovery plans (OCCCP, SONCC, and Lower Columbia) and the scientific literature mentioned throughout this Plan. We intend that this list serve as a ‘menu’ of the types of site-specific management actions that will contribute to the recovery of Oregon Coast coho salmon. The proposed actions do not preclude implementation of other actions that may be carried out for different purposes and goals. Further, new threats, and thus actions and priorities, may emerge in the future or as new information becomes available.

The actions will be further refined, sequenced and schedule of the OCCCP Implementation Team. The list of actions includes those for implementation at the ESU level, and at the stratum or population level. In Section 7, we provide estimates of time and costs, and the priorities for recovery actions. The Recovery Implementation Schedule describes activities designed to implement the strategies and actions in the Plan at the stratum and population levels. The Recovery Implementation Schedule will be used in securing and obligating funds, and in establishing associated regulatory and other management priorities. The Recovery Implementation Schedule, in conjunction with the actions in this Plan, provides the basis for tracking plan implementation performance.

Listing Factor A1: Habitat actions at the ESU Level

A1-1 Revise regulatory mechanisms as necessary in order to provide increased protection for Oregon Coast coho salmon habitat. Priority considerations for regulatory mechanisms include revising and implementing state and federal regulatory mechanisms to increase the protection and restoration of watershed processes that promote winter and summer rearing habitats, including:

- **A1**-1.1 Convene a multi-agency work group to develop an effective beaver pond conservation plan by considering changes to statute(s), regulations, and/or policies relating to beavers if necessary to increase the number and size of beaver ponds (which can create prime rearing habitat).

- **A1**-1.2 Oregon’s Agricultural Water Quality Management Act; improve the effectiveness of agricultural rules, plans, and implementation in order to achieve water quality goals, including quantitative, narrative, and beneficial use criteria.

A1-1.3 Oregon Forest Practices Act; reduce the negative impacts of forestry management (reduced recruitment of wood into streams, increased water temperature and fine sediment) by modifying the statute and/or regulations and policies for fish-bearing and non-fish bearing stream reaches; develop and update measures for landslide prone areas.

A1-1.4 FEMA National Floodplain Insurance Program; restrict development in the floodplains and provide for mitigation when development does occur.

A1-1.5 Develop and implement new regulatory mechanisms to protect rearing habitat in estuaries from continued loss and degradation.

A1-2 Initiate an inter-agency effort to increase collaboration in local and regional planning efforts. Recognizing that salmon recovery is one of many important goals on the Oregon Coast, we recommend that agencies consider forming a caucus or other type of arrangement to increase collaboration. Development of a coordinated strategy to leverage multiple authorities and resources (including counties and cities) can increase the number and effectiveness of ‘win-win’ successes, and NMFS would like to be a constructive partner in such and effort. This includes working with landowners, agencies, and others to find practical alternatives to removing beavers in situations where beaver ponds are likely to provide good coho salmon habitat and landowners are willing to consider options.

A1-3 Develop and update guidance for Oregon Coast coho salmon conservation and recovery.

A1-3.1 Develop and use a common framework to facilitate ‘rolling up’ the strata and population level strategies and actions ─ combining these elements with consistent terminology and approach into an internally consistent ESU-level plan. This should include habitat monitoring to ensure that local efforts are conducted and reported in a common framework to enhance the usefulness of the data collected.

A1-3.2 Develop and make available updated summaries of climate change information relevant to OC coho salmon recovery.

A1-3.3 Develop and make available updated guidance on using the best available scientific methods, tools, and approaches to prioritize and sequence activities to protect and restore habitat in the most effective manner possible. One suggestion NMFS has received is that we convene, with partners, a scientific workshop to focus available information on the specific challenge that we face with OC coho salmon – how to most effectively use available resources to improve rearing habitat to increase egg-to-smolt survival and life history diversity, especially when marine and freshwater conditions are not favorable. (See the section below on an example of a systematic approach for developing strategies and actions to protect and restore habitat.)

A1-4 Develop and refine additional tools for use by agencies and local organizations to support and enhance the protection and restoration of OC coho salmon habitat. In particular, we intend to work with agency and university scientists, agencies, and stakeholders to develop practical approaches to prioritizing habitat efforts at the watershed scale. The use of GIS tools and methods, remote sensing (e.g. LIDAR, aerial photography), and life cycle modeling are examples that have the potential to increase the sophistication and effectiveness of habitat efforts.

A1-5 Provide secure financial support to implement actions needed to achieve and sustain recovery to augment current funding sources. We encourage innovative, collaborative thinking about additional funding sources, such as sales of 'conservation licenses' (as opposed to fishing licenses), taxes or other ideas.

A1-5.1 Provide stable funding and staffing for existing programs to support achieving their mandates.

A1-5.2 Provide adequate funding to landowners and others to implement approved habitat restoration activities.

A1-5.3 Provide adequate funding and implement research needed to answer critical uncertainties and track progress toward achieving recovery goals.

Listing Factor A2: Potential site-specific management actions

A2-1 For each independent population, develop and approve scientifically credible Strategic Action Plans (SAPs) using a common framework developed for this Plan.[57] Using these plans, implement the best available science, including, when available, life cycle models and other information about life history strategies and key bottlenecks. These SAPs should include population-specific escapement and habitat protection and restoration goals.

A2-1.1 Protect the stream reaches with high intrinsic potential and good habitat condition,[58] which will be resilient in the face of climate change impacts.

A2-2 Implement the SAP in each independent population to protect and restore ecosystem functions and coho habitat, evaluating each of the following threat categories and implementing local activities consistent with the recovery strategies in this section.

A2-2.1 Agriculture (including livestock): collaborate with SWCDs and others to increase effectiveness of current agricultural water quality area rules and plans in order to meet water quality goals.

A2-2.2 Beaver management: provide support to landowners who experience beaver-related challenges in order to protect both property and beavers and their ponds.

A2-2.3 Channel modification: restore complexity by reducing armament and barriers, reconnecting side channels and wetlands, etc., especially in areas with high intrinsic potential using the latest available information specific to each location, including that provided by ODFW for each population for high intrinsic potential coho habitat, barriers, and limiting factors.[59]

A2-2.4 Estuarine habitat: Protect and restore high priority tidally influence habitats by

[57] Based on the Conservation Measures Partnership: Open Standards for the Practice of Conservation from Version 3.0 (April 2013) http://www.conservationmeasures.org/initiatives/standards-for-project-management

[58] Specific locations are identified by the ODFW Aquatic Inventories Project: http://oregonstate.edu/dept/ODFW/freshwater/inventory/op_reports.htm and other sources of information.

[59] http://www.dfw.state.or.us/fish/crp/coastal_coho_conservation_plan.asp

reconnecting intertidal wetlands and tidal channels by removing dikes, levees, and tidegates. This applies throughout the ESU, but especially to the larger estuaries, such as, but not limited to, the Coquille, Coos, Umpqua, Siuslaw, Yaquina, and Tillamook estuaries.

A2-2.5 Fire and fuel: ensure plans are in place to implement the appropriate strategies (e.g. natural fire regime, prevent or control fires in key habitat areas as appropriate).

A2-2.6 Floodplain condition and connectivity: Protect, reconnect and restore rearing habitat in the floodplains (including, but not limited to, reducing development and removing or setting back tidegates, levees, or dikes).

A2-2.7 Habitat complexity: implement a collaborative approach with NMFS, ODFW, and other scientists to identify the most effective activities to increase stream complexity in order to improve winter and summer rearing habitats.

A2-2.8 Hydrology: protect stream hydrology by protecting and restoring patterns of sediment and water runoff.

A2-2.9 Landscape patterns: agencies collaborate in leveraging authorities and resources to reduce adverse impacts to landscape patterns by promoting protective easements, purchased, and other incentives.

A2-2.10 Forest management: work with timber owners to increase recruitment of wood and reduce fine sediment water temperature.

A2-2.11 Mining: work with state agencies to protect ecosystem processes by limiting gravel and other types of mining in salmon habitat.

A2-2.12 Passage: remove or modify fish passage barriers, such as, tidegates, dams, and culverts that are reducing or prohibiting fish passage, to increase rearing habitat. Maintain existing screens and fish passage structures that currently provide free passage during all flow conditions.

A2-2.13 Residential/rural development: work with landowners and agencies to improve the protection and restoration of in-stream and riparian areas associated with residential and rural properties.

A2-2.14 Riparian condition: Improve practices (forest management, grazing, vegetation management, etc.) to restore riparian processes that increase stream complexity and bank stability, shade, and improve water quality.

A2-2.15 Roads and railroads: take steps to reduce road densities and the negative impacts of roads on salmon habitat, including increased stormwater, fine sediment, and impaired passage where roads intersect streams.

A2-2.16 Sediment (fine and coarse): develop a multiagency effort to identify and reduce the input of fine sediment into salmon habitat, while protecting and restoring spawning gravel where possible.

A2-2.17 Water quality: coordinate with ODEQ and others to implement activities to reduce impairments (especially temperature, stormwater and fine sediment) under the Clean Water Act.

A2-2.18 Water quantity: monitor plans for increased water withdrawals and collaborate to find ways to meet water demand without increasing threats to OC coho salmon.

A2-3. Develop and implement SAPs, as resources allow, for dependent populations to prevent degradation of population status.

A2-3.1 Implement the SAPs for dependent population to protect and restore ecosystem functions, prevent degradation of coho habitat, and support recovery of independent populations by implementing appropriate actions, similar to **A2-**2.1 through **A2-**2.18.

A2-4 Plan and provide public outreach.

A2-4.1 Provide education on recovery efforts and how citizens and landowners can contribute.

A2-4.2 Identify key opportunity areas to enhance winter rearing habitats for juvenile coho salmon through volunteer efforts.

A2-4.2 Develop and distribute outreach materials on the benefits of beaver dams to ecosystem functions in general and specifically to improving juvenile coho salmon rearing habitat.

A2-4.3 Promote volunteer efforts of private landowners and interest groups to implement activities that promote watershed processes and functions, increase stream complexity, reconnect off-channel and floodplain areas, and improve riparian habitat.

A2-4.4 Develop and implement outreach program providing incentives for volunteer efforts to implement activities that restore watershed processes, improve riparian value and function, reconnect off-channel and floodplain habitats, and increase stream complexity.

Listing Factor A3: Habitat Research, Monitoring, and Evaluation actions at the ESU level

A3-1 Continue to provide research, monitoring, and evaluation to track ecosystem processes and habitat conditions to inform the adaptive management of recovery implementation.

A3-2 Continue to monitor habitat conditions and trends at the strata level and if possible expand the monitoring to include non-wadable streams, wetlands, and estuaries and population-level trends.

A3-3 Develop a means to track the gain and loss of key habitat features in order to estimate net changes in coho salmon habitat at the watershed level.

A3-4 Enhance the temperature monitoring system in the basins that support OC coho salmon to better track warm water and cold-water refugia.

A3-5 Implement monitoring to track progress toward achieving recovery goals.

A3-6 Conduct climate change risk analysis for habitats in all population areas.

6.2.1.3 ESU-level Habitat-related Priorities to Support Recovery

The relative priority and timing of goals and objectives is summarized in the following order of importance:

1. Protect watershed and estuarine processes and coho salmon habitats (rearing and spawning) that are currently functioning well, especially winter and summer rearing habitat.
2. Restore watershed and estuarine processes to increase rearing habitat quality and capacity. When necessary, implement restoration actions to improve over-wintering habitat (primary priority at the ESU level) and summer rearing habitat (secondary priority at the ESU level, but water temperature may become a high priority in some areas).
3. Develop a means to track the net change in Oregon Coast coho salmon habitat over time and progress toward recovery.
4. Instream and estuarine work, including wood or boulder placement – after or in conjunction with reconnections and other efforts to restore processes.

Step-by-Step Approach for Identifying Strategies and Actions to Protect and Restore Habitat

This section describes an example of a step-by-step approach for developing strategies and actions intended to integrate the best available science relating to salmon habitat with a structured framework (Open Standards for Conservation and Miradi). The NMFS proposes to work with OWEB, ODFW, and others to develop guidelines for developing SAPs that are watershed-process oriented and apply a systematic, rigorous scientific approach to planning. This approach focuses on designing strategies and actions that take appropriate measures to address the root causes ─ indirect threats ─ and direct threats, which are causing ecosystem impairment. Applying a systematic approach like this will also help ensure internal consistency for the recovery plan.

The step-by-step approach shown here is structured to answer several key science-based questions related to salmon habitat protection and restoration (shown in Text Box 6-2). We used these questions to design an example of a ten-step process to guide the development and implementation of strategies and actions at the ESU, population, and sub-population levels. Table 6-1 summarizes these steps, links them to the key questions they address, and identifies potential related strategies and actions that could be implemented to improve habitat conditions for Oregon Coast coho salmon recovery.

Text Box 6-2

Science-based Questions related to Salmon Habitat Protection and Restoration

1. What are the science-based goals for salmon recovery in terms of biological and ecosystem status?
2. What are key life stages of Oregon Coast coho salmon?
3. In terms of landscape-scale watershed processes, which have been impaired enough to result in degraded salmon habitat? What are the most important changes from historical conditions? What metrics have we used to assess the habitat?
4. What human activities (indirect and direct threats) and natural processes caused the important changes in OC coho salmon habitat?
   4a. direct threats
   4b. indirect threats that lead to direct threats
   4c. natural processes
5. What are the linkages, as we understand them, between human activities, impaired landscape-scale watershed processes, degraded salmon habitat, and the biological health (viability or sustainability) of Oregon Coast coho salmon populations?
6. What are the basic and component strategies that NMFS recommends to reduce or eliminate habitat-related threats?
   6a. Basic strategy
   6b. Strategies to address indirect threats
   6c. strategies to address direct threats.
   6d. strategies to address natural processes
7. What measurable objectives guide the efforts to stay 'on-track' towards achieving goals?
8. Which of the several approaches to developing habitat priorities is most useful?
9. Using the approach(es) described above, what are the priority actions designed to implement the strategies?
10. What are the primary monitoring programs to track progress?
11. How will adaptive management be implemented to guide future activities?

Table 6-1. Steps in developing habitat strategies and actions for Oregon Coast coho salmon.

Questions Addressed	Step	ESU level	Population level
1. What are the science-based goals for salmon recovery?	Identify habitat goals	Protect and restore the natural watershed processes and habitats that sustain coho salmon populations.	Biological and habitat goals for each independent population.
2. What are key life stages of Oregon Coast coho salmon?	Identify key life stages	Winter and summer rearing, estuary	For most populations, same as ESU-level.
3. Which watershed processes have been impaired enough to result in degraded salmon habitat?	Identify key watershed processes and how they have changed	Key processes are hydrologic, sediment, riparian, channel, biological, floodplain, and estuarine. The most important changes include reduced channel complexity, quality of riparian habitat, instream wood, and beaver dams; loss of floodplain connectivity & wetlands; increased water temps. We track the population sustainability, # spawners, probability of persistence, R/S, distribution of spawners, miles of HQ habitat.	
4. What human activities (indirect and direct threats) and natural processes caused the important changes in OC coho salmon habitat?	Identify direct threats	Agriculture, logging, development, levees, dikes, tidegates, mining, roads, removal of beaver dams, conversion of land to urban, water withdrawals.	Direct threats vary between populations depending on land management & natural baseline.
	Identify indirect threats	Statutes, regulations, policies, economic factors that provide context for, and enable, direct threats, and ineffective implementation of current laws (e.g. CWA). Emerging indirect threats include changes in federal forest management and actions that contribute to climate change.	
	Describe key natural processes	Variable ocean survival, climate variability and change.	
5. What are the linkages?	Identify key linkages	See Figure 6-2 awaiting Abby and Susan	
6. What are the basic and component strategies?	Develop basic habitat strategy	Two-pronged strategy: improve regulatory protections and support voluntary actions.	Support OCCCP IT participants with technical and financial support.
	Develop strategies for indirect threats	Improve habitat protections in regulatory mechanisms	Engage local support for more effective regulatory protections.
	Develop strategies for direct threats	Support OCCCP voluntary actions – see section 6.2.2.6 for details.	
	Develop strategies for natural processes	Federal (NOAA) and state (ODFW) agencies continue to fund habitat monitoring (including climate change) and ocean prediction indices.	
7. What measurable objectives guide the effort?	Develop (interim) objectives	Implement monitoring that can track efforts and measure net gain or loss of habitat, in order to achieve no net loss of functioning habitat. Decrease risk to habitat for at least one indirect threat by 2016. Maintain or increase funding for ODFW monitoring programs.	No net loss of HWH; increase HQH 1% per year; reconnect 25% of floodplain in 5 years; reduce temps in 30 km of key rearing habitat with vegetation by 2018;implement NFWF business plan by 2016;
8. Which approach to developing habitat priorities is most useful?	Decide how priorities will be set	Develop list of priorities based on potential 'ecosystem uplift' to support key life stages first, then apply economic and social factors.	
9. What are the priority actions designed to implement the strategies?	Determine what should be priority actions based on the scientific approach	#1: Protect/ restore Primary Constituent Elements (see following section). # 2: Create more effective incentives for ag and timber sectors to protect salmon habitat. #3: Increase use of scientific principles in funding decisions. #4: Improve inter-agency cooperation, coordination.	#1: Complete approved strategic action plans at population level.
10. What are the primary monitoring programs to track progress? 11. How will adaptive management be implemented to guide future activities?	Develop and implement monitoring programs and adaptive management.	See Section 9	

6.2.2 ESU-wide Strategy and Actions to Address Overutilization (Listing Factors B and D)

Oregon Coast coho salmon are subject to harvest in ocean and (conditionally) in-river fisheries, and past overharvest contributed to the decline of the species. Today, fisheries for Oregon Coast coho salmon continue to be managed under Amendment 13 of the Pacific Fishery Management Council's Pacific Coast Salmon Fishery Management Plan. The primary goal of Amendment 13 is to assure that fishery-related impacts will not act as a significant impediment to the recovery of depressed Oregon Coast Northern coho and to more uniformly rebuild each component population subgroup to a higher level.

6.2.2.1 Strategy to Address Overutilization through Harvest

As part of our recovery strategy, and in order to meet the criteria in Section 4.3, NMFS will continue to participate in Pacific Fishery Management Council processes and implement the harvest consultations with ODFW required by the ESA section 4. NMFS will also conduct the assessments required by NEPA. In particular, we recommend the following:

- Fisheries managers should provide the monitoring necessary to ensure that harvest limits in the PFMC Amendment 13 are not exceeded. If budget limitations preclude adequate monitoring, managers should reduce allowable harvest rates to ensure that limits are not exceeded.
- Fisheries managers continue to improve the effectiveness of run predictions for purposes of harvest management.

6.2.2.2 Harvest Management Actions

Listing Factor B1: Harvest Actions

B1-1 Maintain abundance-based harvest management, adaptively managing to ensure harvest levels are not too high if marine survival is projected to be very low.

B1-2 Review and amend as appropriate the definition and use of 'full seeding' in harvest management.

6.2.3 ESU-Level Strategy and Actions to Address Predation and Disease (Listing Factors C and D)

Predation from introduced warm water fishes, such as smallmouth bass and largemouth bass, continues to present a threat to Oregon Coast coho salmon. The TRT and BRT identified these species as a limiting factor in the Lakes Stratum and with increasing water temperatures, these can be factors in the warmer river reaches as well.

Disease currently poses a lesser threat to ESU viability. Recent research by the BRT, however, suggests risk of disease may become a larger threat to the species in the future. Many streams inhabited by coho salmon are already approaching lethal temperatures and the fish may be at increased risk of disease if water temperatures rise further due to climate change.

6.2.3.1 Strategy to Address Predation and Disease

Our recovery strategy includes improving the management of non-native fish predation. In order to meet the criteria in Section 4.2.4.3, NMFS will continue to work with ODFW, universities, and others to assemble the resources needed to monitor the status and trends of non-native fish that prey on listed salmon, and the impact they have on Oregon Coast coho salmon populations. When there is evidence of significant adverse impacts from predation, such as from warm water fishes in the Lakes Stratum and lower Umpqua River, we recommend ODFW consider options, including but not limited to increasing the sport fisheries on non-native species, to reduce the threats to recovery.

The strategy also addresses potential threats. We recommend monitoring the predation by birds and marine mammals, and if research and monitoring shows significant threats to population viability, working with ODFW, USFWS, and others to develop and implement appropriate responses. We also recommend continuing actions to monitor the fish populations for disease and parasitism.

6.2.3.2 Predation and Disease Management Actions

Listing Factor C1: Predation and Disease Actions

C1-1 Monitor for predation, (especially in the three Lakes populations, but also for bird and marine mammal predation); disease; aquatic invasive species, and competition. Develop actions as needed.

C1-2 Develop actions to control warm water fish predation on salmonids in the three Lakes populations and elsewhere as warranted, including reducing the number of overwater structures.

C1-3 Assess the role of over-water structures in the predator-prey interaction and, when appropriate, initiate a process to reduce the threats related to over-water structures.

There is evidence that both pinniped and sea bird populations are increasing due to the success of federal protective measures. Due to this increase we suggest an increased amount of research be devoted to the effects of pinniped and sea bird predation on coho salmon.

6.2.4 ESU-level Strategy and Actions to Address Other Issues (Listing Factors E and D)

Current hatchery practices pose little risk to Oregon Coast coho salmon. Steps taken by ODFW to adjust hatchery management have been successful in significantly reducing the number of hatchery fish on spawning grounds.

6.2.4.1 Strategy to Address Other Issues: Hatcheries and Climate Change

As part of our recovery strategy, and to achieve the goal for hatcheries in Section 4.2.4.4, NMFS will continue to implement the hatchery consultations with ODFW required by the ESA section 4 and conduct the assessments required by NEPA. We recommend the following:

- ODFW continue to operate coho salmon hatcheries at no more than the current (reduced) production level, and
- NMFS, ODFW, and other interested organizations increase research on the ecological interactions between hatchery and natural-origin fish, including predation and competition for food, shelter, etc. This is relevant coast-wide, not just for OC coho salmon.

Regarding threats due to natural causes and climate change, we recommend implementation of the following strategies:

- As a hedge against climate change, implement strategies and action that increase life history strategies within populations. This includes increasing not only the quality and quantity of habitats, but also the diversity of habitat types in streams and estuaries in order to increase the number of successful pathways that coho salmon have available.
- ODFW should continue to monitor habitat conditions and, if necessary, seek additional funding to support the work performed up to this point.
- Continue to support actions that increase resilience to temperature increases (e.g. increasing shade and water quantity) NMFS should work with ODEQ, ODFW, USGS, USFS, and other agencies to ensure that water temperature monitoring is as well-coordinated and integrated as possible, to provide detailed, local, information about temperature-impaired reaches of rivers and streams that support coho salmon.

6.2.4.2 Hatchery and Climate Change Management Actions

Listing Factor E1: Hatchery Management

E1-1 Maintain current low levels of hatchery production in order to minimize genetic risks of hatchery fish interbreeding with natural-origin coho salmon.

E1-2 Maintain current low levels of hatchery production in order to minimize competition and predation risks with wild fish in tributaries and estuaries.

Listing Factor E2: Climate Change

E2-1 Monitor for increasing water temperatures (climate change) and ‘flashiness’ of streams (flashiness means that flow levels in streams increase rapidly after a rainfall, then return quickly to pre-rain conditions.)

E2-2 Use information from climate change risk analysis to identify at risk populations and habitat areas and to help prioritize actions.

E2-3 Implement actions that increase resilience to temperature increases (e.g. increase cold water refugia by increasing shade and water quantity, etc.)

Table 6-2 summarizes potential voluntary, regulatory, and enforcement strategies for recovery of Oregon Coast coho salmon under Listing Factors A through E.

Table 6-2. Summary of Recovery Strategies by Listing Factor.

Primary strategy(ies) for each listing factor			
Listing Factors:	Voluntary Efforts	Regulatory Mechanisms	Enforcement
A (and D) The present or threatened destruction, modification, or curtailment of the species' habitat or range	NMFS and ODFW Provide updated guidance to local groups on how to implement the best available science to prioritize and increase effectiveness of actions. Support implementation of OCCCP led by ODFW other agencies, watershed councils, SWCDs & others. NMFS work with other agencies to increase interagency collaboration, coordination, cooperation and 'leveraging' of agency authorities and resources to reduce threats. Ensure continued funding for habitat restoration and monitoring.	Negotiate increased protections in agricultural, forest and mining practices and other sources of water quality impairments. Address emerging threats including possible changes in managing federal timber and implementing the CZARA.	Work with federal, state and local enforcement agencies for more effective implementation and enforcement of existing regulatory mechanisms, including CWA, CZARA including temperature and sediment impairments and 404(d) permits for gravel mining in streams.
B (and D) Over-utilization for commercial, recreational, scientific, or educational purposes	Encourage continued voluntary compliance with fishing regulations; review Amendment 13 regarding full seeding.	Implement ESA §7 and NEPA; including completion of HGMPs support harvest regulations that are in place and work with ODFW to improve forecasts and in-season harvest management.	Continue to support NOAA, OSP, ODFW, ODEQ and others to enforce existing regulatory mechanisms.
C (and D) Disease or predation	Work with ODFW (e.g. predation coordinator) and others to educate citizens on how they can help avoid introduction of invasive plants and animals.	Support state regulations on invasive species; encourage more active management of warm water predators.	Support state enforcement of invasive species laws.
E (and D) Other natural or human-made factors affecting the species' continued existence	Support ODFW's previous reduction in hatchery programs; Participate in educational programs including climate change.	Implement ESA §7 and NEPA; Work with ODFW and NMFS SFD to ensure hatchery production does not increase risks to recovery.	Continue ODFW hatchery management to support recovery

6.3 Recovery Strategies and Actions at the Stratum Level (Listing Factors A and D)

This section describes habitat strategies and actions for Oregon Coast coho salmon at the strata level, and will be complemented by the Recovery Implementation Strategy, a separate document, that includes more detailed activities at the population level. We will develop and update this document in collaborate with local stakeholders, ODFW and other agencies.

6.3.1 Strategies and Actions for the North Coast Stratum

North Coast Stratum for Oregon Coast Coho Salmon

Independent Populations: Necanicum, Nehalem, Tillamook and Nestucca
Dependent Populations: Ecola, Arch Cape, Short Sands, Spring, Watseco, Netarts, Rover, Sand, and Neskowin
Current Status: Moderate level of certainty that the North Coast Stratum is sustainable
Primary Limiting Factor: Stream complexity (all North Coast Stratum populations)
Secondary Limiting Factors: Water quality (Nehalem and Tillamook populations)

Recovery Strategy for the North Coast Stratum

The basic recovery strategy for coho salmon populations in the North Coast Stratum aims to protect freshwater and estuarine reaches that currently contain high quality habitat, and restore reaches with potential for additional high quality habitat. Actions will particularly focus on increasing the amount and quality of winter rearing habitat by improving stream and estuarine habitat complexity. Efforts are needed to increase amounts of large wood and pool habitat, and to connect side channels, wetlands, and other off-channel areas. Actions will also improve water quality, especially by reducing summer water temperatures and agricultural runoff in the Tillamook population area.

Key Strategies and Actions for the North Coast Stratum

- Revise local regulatory mechanisms to increase protection and restoration of watershed processes that promote winter and summer rearing habitats including Oregon's Agricultural Water Quality Management Act, Oregon Forest Practices Act, FEMA National Floodplain Insurance Program, and state beaver statutes and administrative rules.
- Develop and approve scientifically credible, thorough Strategic Action Plans for the Necanicum, Nehalem, Tillamook, and Nestucca populations, consistent with ESU-level common framework.
- Implement the Strategic Action Plans to protect and restore ecosystem processes and functions and coho salmon habitats. Activities should include restoring habitat capacity for rearing juvenile coho salmon by increasing large wood loading, beaver habitat, and wetland/ off-channel connectivity, and by increasing native riparian vegetation to provide bank stability and shade stream reaches.
- Collaborate with governmental and non-governmental organizations and others to identify, and implement, actions that will protect and restore watershed processes, provide stream complexity for juvenile rearing, connect side channels, wetland and off-channel habitats, and reduce fine sediment levels.
- Coordinate with ODEQ, ODF, ODA and others to improve water quality, especially water temperatures, to increase carrying capacity and provide high quality summer rearing habitat for juvenile coho salmon.

- Collaborate with SWCDs, ODA, and others to increase effectiveness of current agricultural water quality area rules and plans in order to meet water quality goals in the Tillamook population area.
- As resources allow, develop and approve scientifically credible, thorough Strategic Action Plans for the Ecola, Arch Cape, Short Sands, Spring, Watseco, Netarts, Rover, Sand, and Neskowin populations, consistent with ESU-level common framework.
- Provide and support public outreach, education, and volunteer actions to protect and restore ecosystem process and functions and improve juvenile coho salmon rearing habitats.
- Improve wood recruitment to support long-term increases in habitat complexity by improving timber harvest activities and agricultural practices.
- Increase habitat complexity by increasing large wood, boulders, or other instream structure and conducting riparian planting projects.
- Improve floodplain connectivity by increasing beaver abundance and reducing or limiting development of channel confining structures, including roads and infrastructure.

Priority Watershed Actions

Agriculture Lands

1. Protect riparian areas adjacent to stream channels.
2. Plant and restore riparian vegetation adjacent to stream channels.
3. Increase habitat complexity by increasing large wood, boulders, or other instream structure.
4. Improve lateral connectivity between stream channels and adjacent wetlands.

Timber Lands

1. Increase protection of riparian reserves and no-touch buffer widths.
2. Eliminate the construction of permanent new roads.
3. Decommission roads where practicable.
4. Increase habitat complexity by increasing large wood, boulders, or other instream structure.

Secondary Watershed Actions

Beaver Management

1. Develop a beaver conservation plan.
2. Prohibit killing beaver within the range of OC coho salmon by any entity other than a state agency and only when all other options are exhausted.
3. Create a program to educate landowners and the public in general about the benefits of beaver to the health of our ecosystems, with a focus on benefits to salmonids and opportunities to conserve and manage beaver through cost effective, non-lethal management practices (Pollock et al. 2004; DeVries et al. 2012).
4. Incorporate beaver conservation into restoration actions.

Table 6-3. Habitat component specific actions to restore high quality coho salmon habitat in the North Coast Stratum.

Action id	Habitat component	Strategy	Action	Area	Priority
NCS.-1	Tributaries	Improve water quality by improving water temperature	Improve water quality by improving stream shade	Tillamook and Nehalem Populations	High
NCS-2	Tributaries	Improve water quality by improving water temperature	Improve water quality by improving stream shade	Tillamook and Nehalem Populations	Medium
NCS-3	Tributaries	Improve wood recruitment to support long-term increases in habitat complexity	Improve timber harvest activities (increased harvest buffers on private and state timberlands)	All Populations	High
NCS-4	Tributaries	Increase habitat complexity	Improve agricultural practices (disallow stream channel dredging in ESA-listed streams flowing through or adjacent to ag lands)	All Populations	Medium
NCS-5	Tributaries	Increase habitat complexity	Increase large wood, boulders, or other instream structure	All streams where coho salmon would benefit immediately	High
NCS-6	Tributaries	Increase habitat complexity	Increase large wood, boulders, or other instream structure	All Populations	Medium
NCS-7	Tributaries	Increase habitat complexity	Conduct riparian planting projects on streams that flow through or adjacent to agricultural lands to increase wood recruitment to streams	All Populations	High
NCS-8	Off-Channel	Increase habitat complexity and connectivity to side-channels	Increase large wood, boulders, or other instream structure	All Populations	Medium
NCS-9	Off-Channel and Wetlands	Increase habitat complexity and connectivity and access to alcoves, off-channel ponds, floodplains, and wetlands	Increase beaver abundance	All Populations	Medium
NCS-10	Wetlands	Improve direct and indirect wetland connectivity to streams	Reduce existing and limit development of channel confining structures including roads and infrastructure in the floodplain that disconnect wetlands from tributaries and mainstems	All Populations	Medium
NCS-11	Mainstems	Improve wood recruitment to support long-term increases in habitat complexity	Improve state agricultural practices (grazing and hay production buffers on ag land adjacent to ESA-listed streams)	Tillamook Population	High
NCS-12	Mainstems	Improve wood recruitment to support long-term increases in habitat complexity	Improve state agricultural practices (grazing and hay production buffers on ag land adjacent to ESA-listed streams)	All Populations	Medium
NCS-13	Mainstems	Improve water quality by improving water	Improve water quality by improving stream shade	Tillamook and Nehalem	High

Action id	Habitat component	Strategy	Action	Area	Priority
		temperature		Populations	
NCS-14	Mainstems	Improve water quality by improving water temperature	Improve water quality by improving stream shade	All Populations	Medium
NCS-15	Mainstems	Improve water quality by improving water temperature	Improve water quality by improving instream flows	Tillamook Population	High
NCS-16	Mainstems	Improve marginal and streambank habitat complexity	Increase large wood and marginal and streambank habitat structure	All streams where coho salmon would benefit immediately	High
NCS-17	Mainstems	Improve marginal and streambank habitat complexity	Increase large wood and marginal and streambank habitat structure	All Populations	Medium
NCS-18	Mainstems	Improve wood recruitment to support long-term increases in habitat complexity	Improve timber harvest activities (increased harvest buffers on private industrial timberlands, reduce road densities on private and federal timberlands)	All streams where coho salmon would benefit immediately	High
NCS-19	Mainstems	Improve wood recruitment to support long-term increases in habitat complexity	Improve timber harvest activities (increased harvest buffers on private industrial timberlands, reduce road densities on private and federal timberlands)	All Populations	Medium
NCS-20	Mainstems	Increase habitat complexity	Improve state and federal regulations and permitting of gravel mining (retain gravel bar form and function).	Tillamook and Nehalem Populations	Medium
NCS-21	Estuary	Increase access to sloughs, side channels, and floodplains	Reduce fish passage barriers to floodplains by managing tidegate presence and operations.	All Estuaries	High
NCS-22	Estuary	Increase access to sloughs, side channels, and floodplains	Reduce fish passage barriers to floodplains by reducing or setting dikes back.	All Estuaries	High

6.3.2 Strategies and Actions for the Mid-Coast Stratum

Mid-Coast Stratum for Oregon Coast Coho Salmon

Independent Populations: Salmon, Siletz, Yaquina, Beaver, Alsea, and Siuslaw
Dependent Populations: Devils Lake, Schoolhouse, Fogarty, Depoe Bay, Rocky, Spenser, Wade, Coal, Moolack, Big (near Yaquina), Theil, Big (near Alsea), Vinnie, Yachats, Cummins, Bob, Tenmile, Rock, Big (near Siuslaw), China, Cape and Berry
Current Status: Moderate level of certainty that the Mid-Coast Stratum is sustainable

Primary Limiting Factor: Stream complexity (Salmon, Siletz, Yaquina, Alsea and Siuslaw populations), spawning gravel (Beaver population)

Secondary Limiting Factors: Stream complexity (Beaver population), water quality (Salmon, Siletz, Yaquina, Alsea, and Siuslaw populations)

Recovery Strategy for the Mid-Coast Stratum

The primary recovery strategy for the populations in the Mid-Coast Stratum is to protect current high quality summer and winter rearing habitat (including estuarine habitat) and strategically restore habitat quality in adjacent habitat for rearing and spawning (Beaver population). Prioritize restoration of ecological processes that will improve water quality, instream habitat complexity, and spawning conditions (Beaver population). Improve water quality (temperature and dissolved oxygen), channel complexity, and available spawning gravel (Beaver population) by improving protection from adverse management practices, such as timber management, agricultural, urbanization, and beaver control. Development and implementation of a beaver conservation plan that includes reducing lethal control, improving public education and acceptance of beavers, and development of non-lethal management practices provides a long-term ecological need to address winter and summer rearing habitat for this stratum. In the estuary and low gradient freshwater reaches, increasing access to lowland habitats, such as side-channels, alcoves and floodplains improves high flow refugia and productivity of the estuary for outmigrating smolts from the upstream basin reaches and provides for life-history diversity in the lower basins.

Key Strategies and Actions for the Mid-Coast Stratum

- Revise local regulatory mechanisms to increase protection and restoration of watershed processes that promote winter and summer rearing habitats including Oregon's Agricultural Water Quality Management Act, Oregon Forest Practices Act, FEMA National Floodplain Insurance Program, and state beaver statutes and administrative rules.
- Develop and approve scientifically credible, thorough Strategic Action Plans for the Salmon, Siletz, Yaquina, Beaver, Alsea, and Siuslaw populations, consistent with ESU-level common framework.
- Implement the Strategic Action Plans to protect and restore ecosystem processes and functions and coho salmon habitats. Activities should include restoring habitat capacity

for rearing juvenile coho salmon by increasing large wood loading, beaver habitat, and wetland/ off-channel connectivity, by increasing native riparian vegetation to provide bank stability and shade stream reaches, and improving available spawning habitat to support productivity (Beaver population).

- Collaborate with governmental and non-governmental organizations and others to identify, and implement, actions that will protect and restore watershed processes, provide stream complexity for juvenile rearing, connect side channels, wetland and off-channel habitats, and reduce fine sediment levels.
- Coordinate with ODEQ, ODF, SWCDs, and others to improve water quality, especially water temperatures and fine sediment levels, increase carrying capacity, and provide high quality spawning and juvenile summer rearing habitat.
- As resources allow, develop and approve scientifically credible, thorough Strategic Action Plans for the Devils Lake, Schoolhouse, Fogarty, Depoe Bay, Rocky, Spenser, Wade, Coal, Moolack, Big (near Yaquina), Theil, Big (near Alsea), Vinnie, Yachats, Cummins, Bob, Tenmile, Rock, Big (near Siuslaw), China, Cape, and Berry populations, consistent with ESU-level common framework.
- Provide and support public outreach, education and volunteer actions to protect and restore ecosystem process and functions and improve juvenile coho salmon rearing habitats.
- Improve wood recruitment to support long-term increases in habitat complexity by improving timber harvest activities and agricultural practices.
- Increase habitat complexity by increasing large wood, boulders, or other instream structure and conducting riparian planting projects.
- Improve floodplain connectivity by increasing beaver abundance and reducing or limiting development of channel confining structures, including roads and infrastructure.

Priority Watershed Actions

Private Timber Lands

1. Increase protection of riparian reserves and no-touch buffer widths.
2. Eliminate the construction of permanent new roads. Decommission roads where practicable.
3. Increase placement of large wood into stream channels.

Agriculture Lands

1. Plant, restore, and protect riparian areas adjacent to stream channels.
2. Develop riparian buffer widths for streams that flow through agricultural lands that will improve and protect water quality.
3. Improve lateral connectivity from the stream channels to adjacent wetlands.
4. Conserve water usage to allow more instream water.

Federal Lands

1. Maintain a strong aquatic conservation strategy of some form within future management plans that protects ecological processes that form high quality coho salmon habitat.
2. Improve the transportation network that includes reducing the road network, minimizing the hydrologic connection of the roads to streams, reducing road-related fish passage barriers, and minimizing any new road development, especially in riparian zones.

Secondary Watershed Actions

Beaver Management

1. Develop a beaver conservation plan.
2. Prohibit killing beaver within the range of OC coho salmon by any entity other than a state agency and only when all other options are exhausted.
3. Create a program to educate landowners and the public in general about the benefits of beaver to the health of our ecosystems, with a focus on benefits to salmonids and opportunities to conserve and manage beaver through cost effective, non-lethal management practices (Pollock et al. 2004; DeVries et al. 2012).
4. Incorporate beaver conservation into restoration actions.

Fish Passage Access

1. Continue efforts to improve fish passage at dams, culverts, and other identified fish passage barriers in all populations. Assess remaining fish passage barriers and develop and implementation strategy and schedule.
2. Develop an estuary lowlands restoration strategy that considers improved access to historic floodplains through tidegate elimination, management, and operations; levee and dike removal; and overwater structure modifications in the Yaquina, Alsea, and Siuslaw Rivers and Beaver Creek estuaries.
3. Complete a tidegate and floodplain management strategy in the Yaquina, Siuslaw, and Siletz River estuaries.

Estuaries

1. Update estuary assessments of tidal habitats important for coho salmon rearing and development to assess status and guide future development and implementation of restoration activities.
2. Assess the contribution of pollutants associated with urbanization and industrialization to degraded water and substrate quality in the Siletz, Yaquina, Alsea, and Siuslaw River estuaries.

Table 6-4. Habitat component specific actions to restore high quality coho salmon habitat in the Mid-Coast Stratum.

Action id	Habitat component	Strategy	Action	Area	Priority
MCS-1	Tributaries	Improve wood recruitment to support long-term increases in habitat complexity	Improve timber harvest activities (increased harvest buffers on private industrial timberlands, reduce road densities on private and federal timberlands)	All populations	High
MCS-2	Tributaries	Improve wood recruitment to support long-term increases in habitat complexity	Improve agricultural practices (grazing and hay production buffers on agricultural land adjacent to ESA-listed streams)	All populations	High
MCS-3	Tributaries	Increase habitat complexity	Improve agricultural practices (disallow stream channel dredging in ESA-listed streams flowing through or adjacent to ag lands)	Siuslaw Population	High
MCS-4	Tributaries	Increase habitat complexity	Improve agricultural practices (disallow stream channel dredging in ESA-listed streams flowing through or adjacent to ag lands)	All populations	High
MCS-5	Tributaries	Increase habitat complexity	Increase large wood, boulders, or other instream structure	All populations	High
MCS-6	Tributaries	Increase habitat complexity	Increase large wood, boulders, or other instream structure	All streams where coho salmon would benefit immediately	High
MCS-7	Tributaries	Increase habitat complexity	Conduct riparian planting projects on streams that flow through or adjacent to ag lands to increase wood recruitment to streams	All populations	High
MCS-8	Tributaries	Increase habitat complexity	Conduct riparian planting projects on streams that flow through or adjacent to ag lands to increase wood recruitment to streams	All streams where coho salmon would benefit immediately	High
MCS-9	Tributaries	Increase available spawning habitat	Increase instream complexity by placing large wood, boulders, or other instream structure to create and retain spawning gravels	Beaver Creek population	High
MCS-10	Tributaries	Increase available spawning habitat	Increase instream complexity by placing large wood, boulders, or other instream structure to create and retain spawning gravels	Salmon, Siletz, Yaquina, Alsea, Siuslaw populations	Medium
MCS-11	Tributaries	Improve water quality	Develop water conservation strategies for municipal and irrigation water withdrawals to improve water quality that is sufficient for salmonid rearing and spawning	Siletz, Salmon, Yaquina, Alsea, Siuslaw populations	High
MCS-12	Tributaries	Improve water quality	Improve water quality by improving stream shade, and substrate retention.	Siletz, Salmon, Yaquina, Alsea, Siuslaw populations	High
MCS-13	Tributaries	Improve water quality	Develop water conservation strategies for municipal and irrigation	Beaver population	Medium

Action id	Habitat component	Strategy	Action	Area	Priority
			water withdrawals to improve water quality that is sufficient for salmonid rearing and spawning		
MCS-14	Tributaries	Improve water quality	Improve water quality by improving stream shade, and substrate retention.	Beaver population	Medium
MCS-15	Off-Channel	Increase habitat complexity and connectivity to side-channels	Increase large wood, boulders, or other instream structure	All populations	High
MCS-16	Off-Channel	Increase habitat complexity and connectivity to side-channels	Increase large wood, boulders, or other instream structure	All streams where coho would benefit immediately	High
MCS-17	Off-Channel and Wetlands	Increase habitat complexity and connectivity and access to alcoves, off-channel ponds, floodplains, and wetlands	Increase beaver abundance	All populations	High
MCS-18	Off-Channel and Wetlands	Increase habitat complexity and connectivity and access to alcoves, off-channel ponds, floodplains, and wetlands	Increase beaver abundance	All streams where coho will benefit immediately	High
MCS-19	Wetlands	Improve direct and indirect wetland connectivity to streams	Reduce existing and limit development of channel confining structures including roads and infrastructure in the floodplain that disconnect wetlands from tributaries and mainstems	All streams where coho salmon would benefit immediately	High
MCS-20	Wetlands	Improve direct and indirect wetland connectivity to streams	Reduce existing and limit development of channel confining structures including roads and infrastructure in the floodplain that disconnect wetlands from tributaries and mainstems	All populations	High
MCS-21	Mainstems	Improve wood recruitment to support long-term increases in habitat complexity	Improve timber harvest activities (increased harvest buffers on private industrial timberlands, reduce road densities on private and federal timberlands)	All populations	High
MCS-22	Mainstems	Improve wood recruitment to support long-term increases in habitat complexity	Improve timber harvest activities (increased harvest buffers on private industrial timberlands, reduce road densities on private and federal timberlands)	All streams where coho salmon would benefit immediately	High
MCS-23	Mainstems	Improve wood recruitment to support long-term increases in habitat complexity	Improve state agricultural practices (grazing and hay production buffers on ag land adjacent to ESA-listed streams)	All populations	High
MCS-24	Mainstems	Increase habitat	Improve state agricultural practices	Siuslaw	High

Action id	Habitat component	Strategy	Action	Area	Priority
		complexity	(disallow stream channel dredging in ESA-listed streams flowing through or adjacent to ag lands)	population	
MCS-25	Mainstems	Improve marginal and streambank habitat complexity	Increase large wood and marginal and streambank habitat structure	All populations	High
MCS-26	Mainstems	Improve marginal and streambank habitat complexity	Increase large wood and marginal and streambank habitat structure	All streams where coho salmon would benefit immediately	High
MCS-27	Mainstems	Improve water quality	Develop water conservation strategies for municipal and irrigation water withdrawals to improve water temperature and dissolved oxygen levels sufficient for salmonid rearing and spawning	Salmon, Siletz, Yaquina, Alsea, Siuslaw populations	High
MCS-28	Mainstems	Improve water quality	Improve water quality by improving stream shade, and substrate retention.	Salmon, Siletz, Yaquina, Alsea, Siuslaw populations	High
MCS-29	Mainstems	Improve water quality	Develop water conservation strategies for municipal and irrigation water withdrawals to improve water quality that is sufficient for salmonid rearing and spawning	Beaver population	Medium
MCS-30	Mainstem	Improve water quality	Improve water quality by improving stream shade, and substrate retention.	Beaver population	Medium
MCS-31	Mainstems	Increase habitat complexity	Conduct riparian planting projects on streams that flow through or adjacent to ag lands to increase wood recruitment to streams	All populations	High
MCS-32	Mainstems	Increase habitat complexity	Conduct riparian planting projects on streams that flow through or adjacent to ag lands to increase wood recruitment to streams	All streams where coho salmon would benefit immediately	High
MCS-33	Estuary	Increase access to sloughs, side channels, and floodplains	Reduce fish passage barriers to floodplains by managing tidegate presence and operations.	Salmon, Siletz, Yaquina, Alsea and Siuslaw estuaries	High
MCS-34	Estuary	Increase access to sloughs, side channels, and floodplains	Reduce fish passage barriers to floodplains by reducing or setting dikes back.	Salmon, Siletz, Yaquina, Alsea and Siuslaw estuaries	High
MCS-35	Estuary	Improve water quality	Identify sources of water pollution and develop strategies to reduce pollutants in water discharges	Salmon, Siletz, Yaquina, Alsea and Siuslaw estuaries	High

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6.3.3 Strategies and Actions for the Lakes Stratum

> **Lakes Stratum for Oregon Coast Coho Salmon**
>
> Independent Populations: Siltcoos, Tahkenitch, and Tenmile
> Dependent Populations: Sutton (Mercer Lake)
> Current Status: High level of certainty that the Lakes Stratum and the Siltcoos, Tahkenitch, and Tenmile coho salmon populations are sustainable.
>
> Primary Limiting Factor: Non-indigenous fish species
>
> Secondary Limiting Factors: Stream complexity (loss of rearing habitat) and water quality

Recovery Strategy for the Lakes Stratum

The primary recovery strategy for the populations in the Lakes Stratum is to greatly reduce summer predation rates by non-indigenous fish species. Non-indigenous fish predation of juvenile coho salmon occurs primarily during summer rearing in the lake populations reducing survival rates to the smolt stage. However, the lakes are continuing to function as important habitat for OC coho salmon smolts during the winter months as non-indigenous fish are inactive during cold water temperatures.

The secondary recovery strategy for the populations in the Lakes Stratum is to protect current high quality summer and winter rearing habitat in the tributaries of the lakes, and strategically restore the quality of adjacent habitat. Prioritize restoration of ecological processes that will improve water quantity, water quality, and instream habitat complexity. Improve water temperature, and channel complexity by improving protection from adverse management practices, such as timber management, agricultural, and beaver control.

Additionally, the lakes are showing very poor water quality from heavy nutrient loading, high water temperatures, and sediment loading, especially in the arms of the lake. Many of the actions can be addressed by restoring ecological processes in the headwaters of the lakes mentioned above, improving and maintaining streamflow, and developing improved environmental practices of lake front owners.

Key Strategies and Actions for the Lakes Stratum

- Coordinate with the Oregon Department of Fish and Wildlife to minimize predation rates by drastically reducing populations of non-indigenous fish in Siltcoos, Tahkenitch, Tenmile, and Mercer Lakes. Exploitation rates of non-indigenous fish will need to be reduced to such a level that summer rearing of juvenile OC coho salmon is restored.
- Revise local regulatory mechanisms to increase protection and restoration of watershed processes that promote winter and summer rearing habitats including Oregon's Agricultural Water Quality Management Act, Oregon Forest Practices Act, FEMA National Floodplain Insurance Program, and state beaver statutes and administrative rules.

- Develop and approve scientifically credible, thorough Strategic Action Plans for the Siltcoos, Tahkenitch, and Tenmile Lake populations, consistent with ESU-level common framework.
- Implement the Strategic Action Plans to protect and restore ecosystem processes and functions of coho salmon habitats. Activities should include restoring habitat capacity for rearing juvenile coho salmon by increasing large wood loading, beaver habitat, and wetland/ off-channel connectivity; and by increasing native riparian vegetation to shade stream reaches during warm summer months and provide long-term wood recruitment.
- Collaborate with governmental, non-governmental, and other organizations to identify and implement actions that will protect and restore watershed processes, provide stream complexity for juvenile rearing, increase shading to reduce stream temperatures, and connect wetland and off-channel habitats.
- Coordinate with ODEQ, ODF, SWCDs, Lake Front Owners Association, Watershed Councils, and others to decrease sedimentation and nutrient loading into Siltcoos and Tenmile Lake. Sedimentation of lakes has been caused by poor road management and road density, increased landslides, and poor riparian areas lacking adequate vegetative no-touch buffers.
- Provide and support public outreach, education, and volunteer actions to protect and restore ecosystem process and functions and improve juvenile coho salmon rearing habitats.
- As resources allow, develop and approve scientifically credible, thorough Strategic Action Plans for the Mercer Lake Population, consistent with ESU-level common framework.
- Improve wood recruitment to support long-term increases in habitat complexity by improving timber harvest activities and agricultural practices.
- Increase habitat complexity by increasing large wood, boulders, or other instream structure and conducting riparian planting projects.
- Improve floodplain connectivity by increasing beaver abundance and reducing or limiting development of channel confining structures including roads and infrastructure.

Priority Watershed Actions

Non-indigenous Fish Species

1. Organize an interagency team to evaluate and identify non-indigenous fish removal strategies:
    a. Evaluate the use of rotenone for complete removal.
    b. Evaluate long-term electrofishing methods.
    c. Consider a bounty program to remove warmwater fish in the lake, commercial fisheries, volunteer tournaments with prizes, eliminating bag limits, or combination of all. (Note: Implementing regulations to eliminate bag limits by themselves are not effective at removing enough non-indigenous fish to provide any meaningful summer rearing potential for juvenile OC coho salmon in the lakes.)

2. Monitor non-indigenous fish species in the lake for ongoing predation and competition with OC coho salmon.
    a. Assess summer versus winter predation and survival rates of OC coho salmon juveniles.
    b. Assess the role of over-water structures in the predator-prey interaction.

Private Timber Lands and State Lands

1. Increase protection of riparian reserves and no-touch buffer widths.
2. Increase placement of large wood into stream channels.
3. Eliminate the construction of permanent new roads. Decommission roads where practicable with emphasis on roads adjacent to riparian areas.
4. Identify landslide prone areas and avoid road building or heavy timber harvest in these risk avoidance areas.
5. Develop conservation plans for state and private forest lands.

Agriculture Lands

1. Plant, restore and protect riparian areas adjacent to stream channels. Provide minimum no-touch buffers on streams.
2. Improve lateral connectivity from the stream channels to adjacent wetlands.
3. Conserve water usage to allow more instream water.

Private Lake Front Lands

1. Improve septic drainage areas such to eliminate chemical contamination with the Lakes.
2. Evaluate the opportunity to install community sewage treatment systems.
3. Plant, restore and protect riparian areas adjacent to the lake.
4. Avoid fertilization or other chemicals from reaching the lake.
5. Do not remove downed wood from the lake.
6. Construct docks with open grates to avoid predation.

Secondary Watershed Actions

Beaver Management

1. Develop a beaver conservation plan.
2. Prohibit killing beaver within the range of OC coho salmon by any entity other than a state agency and only when all other options are exhausted.
3. Create a program to educate landowners and the public in general about the benefits of beaver to the health of our ecosystems, with a focus on benefits to salmonids and opportunities to conserve and manage beaver through cost effective, non-lethal management practices (Pollock et al. 2004; DeVries et al. 2012).
4. Incorporate beaver conservation into restoration actions. Develop a pilot demonstration effort, considering the lands on the Elliott State Forest within the Tenmile Lake populations first, and implement this integrated restoration strategy.

Federal Lands

1. Protect the estuary from any recreational use encroachment.
2. Manage recreational off-road vehicle for no entry into riparian areas.
3. Seek fish passage into Clear Lake for OC coho salmon (partnering with ODOT).

Table 6-5. Habitat component specific actions to restore high quality coho salmon habitat.in the Lakes Stratum

Action id	Habitat component	Strategy	Action	Area	Priority
LS-1	Lakes	Remove non-indigenous species	Rotenone or electrofishing to remove desired species	Tenmile, Siltcoos, Tahkenitch, and Mercer Lakes	1
LS-2	Lakes	Reduce sewer from entering lakes	Work with DEQ for specifications	Tenmile, Siltcoos, Tahkenitch, and Mercer Lakes	Medium
LS-3	Lakes	Reduce predation in lakes	Placement of grading on docks and overwater structures. Reduce the amount of structures and pilings.	Tenmile, Siltcoos, Tahkenitch, and Mercer Lakes	Medium
LS-4	Tributaries	Improve wood recruitment to support long-term increases in habitat complexity	Improve timber harvest activities (increased harvest buffers on private industrial timberlands, reduce road densities on private and state timberlands)	All streams where coho salmon would benefit immediately	High
LS-5	Tributaries	Improve wood recruitment to support long-term increases in habitat complexity	Improve state agricultural practices (grazing and hay production buffers on ag land adjacent to ESA-listed streams)	All streams where coho salmon would benefit immediately	High
LS-6	Tributaries	Improve water quality	Improve water quality by improving channel complexity, stream shade, and substrate retention.	Population wide	High
LS-7	Tributaries	Increase habitat complexity	Increase large wood, boulders, or other instream structure	All streams where coho salmon would benefit immediately	High
LS-8	Tributaries	Increase habitat complexity	Conduct riparian planting projects on streams that flow through or adjacent to ag lands to increase wood recruitment to streams	All streams where coho salmon would benefit immediately;	High
LS-9	Tributaries	Increase habitat complexity	Improve state agricultural practices (disallow stream channel dredging in ESA-listed streams flowing through or adjacent to ag lands)	All streams where coho salmon would benefit immediately;	High
LS-10	Off-Channel	Increase habitat complexity and connectivity to side-channels	Increase large wood, boulders, or other instream structure	All streams where coho would benefit immediately	High
LS-11	Off-Channel	Increase habitat complexity and connectivity and access to alcoves, off-channel ponds, floodplains, and wetlands	Increase beaver abundance	All streams where coho salmon would benefit immediately	High
LS-12	Mainstem	Improve water quality	Improve water quality by improving channel complexity, stream shade, and substrate retention.	Population wide	High
LS-13	Mainstem	Improve instream flows	Develop water conservation	Population wide	Medium

Action id	Habitat component	Strategy	Action	Area	Priority
			strategies on the upslope agricultural areas with the intent of transferring conserved water to instream flows.		
LS-14	Mainstem	Protect the mainstem below the Lakes from any encroachment	Manage recreational off-road vehicle for no entry into riparian areas.	Estuary wide	Medium
LS-15	Wetlands	Increase habitat complexity and connectivity and access to alcoves, off-channel ponds, floodplains, and wetlands	Increase beaver abundance	All streams where coho salmon would benefit immediately	High
LS-16	Wetlands	Improve direct and indirect wetland connectivity to streams	Reduce existing and limit development of channel confining structures including roads and infrastructure in the floodplain that disconnect wetlands from tributaries and mainstems	All streams where coho salmon would benefit immediately	Medium
LS-17	Estuary	Protect the estuary from any encroachment	Manage recreational off-road vehicle for no entry into estuarine areas.	Estuary wide	Medium

6.3.4 Strategies and Actions for the Umpqua Stratum

> **Umpqua Stratum for Oregon Coast Coho Salmon**
>
> Independent Populations: Lower Umpqua, Middle Umpqua, North Umpqua and South Umpqua
> Current Status: Moderate level of certainty that the Umpqua Stratum is sustainable
>
> Primary Limiting Factor: Stream complexity (Lower Umpqua, North Umpqua), water quantity and quality (Middle Umpqua and South Umpqua populations).
>
> Secondary Limiting Factors: Water quality (Lower Umpqua) Water quality and quantity (North Umpqua); stream complexity (Middle and South Umpqua populations)

Recovery Strategy for the Umpqua Stratum

The primary recovery strategy for the populations in the Umpqua Stratum is to protect current high quality summer and winter rearing habitat and strategically restore habitat quality in adjacent habitat. It prioritizes restoration of ecological processes to improve water quantity, water quality, and instream and estuarine habitat complexity. Instream flow, water temperature, and channel complexity are improved through protection from adverse management practices, such as timber management, agricultural, and beaver control. An assessment of instream flows and development and implementation of a strategic instream flow restoration plan is essential to recovery of this stratum. Development and implementation of a beaver conservation plan that includes reducing lethal control, improving public education and acceptance of beavers, and development of non-lethal management practices provides a long-term ecological need to address winter and summer rearing habitat for this stratum. In the estuary, increasing access to lowland habitats, such as side-channels, alcoves and floodplains improves high flow refugia and productivity of the estuary for outmigrating smolts from the upstream basin and provides for life-history diversity in the lower basin.

Key Strategies and Actions for the Umpqua Stratum

- Assess instream flow limitations and opportunities for water use conservation and instream flow increases, especially in the South and Middle Umpqua populations.
- Revise local regulatory mechanisms to increase protection and restoration of watershed processes that promote winter and summer rearing habitats including Oregon's Agricultural Water Quality Management Act, Oregon Forest Practices Act, FEMA National Floodplain Insurance Program, and state beaver statutes and administrative rules.
- Develop and approve scientifically credible, thorough Strategic Action Plans for the Lower, Middle, North and South Umpqua populations, consistent with ESU-level common framework.
- Implement the Strategic Action Plans to protect and restore ecosystem processes and functions and coho salmon habitats. Activities should include restoring habitat capacity for rearing juvenile coho salmon by increasing large wood loading, beaver habitat, and

wetland/ off-channel connectivity, and by increasing native riparian vegetation to shade stream reaches during warm summer months.

- Collaborate with governmental and non-governmental organizations and others to identify, and implement, actions that will protect and restore watershed processes, provide stream complexity for juvenile rearing, increase shading to reduce stream temperatures, and connect wetland and off-channel habitats.
- Coordinate with ODEQ, ODF, SWCDs, and others to improve water quality, especially water temperatures, to increase carrying capacity and provide high quality summer rearing habitat for juvenile coho salmon.
- Provide and support public outreach, education and volunteer actions to protect and restore ecosystem process and functions and improve juvenile coho salmon rearing habitats.
- Reduce predation rates by reducing populations of non-indigenous fish in the lower Umpqua River.
- Monitor and control predation, disease, aquatic invasive species, and competition.
- Improve wood recruitment to support long-term increases in habitat complexity by improving timber harvest activities and agricultural practices.
- Increase habitat complexity by increasing large wood, boulders, or other instream structure and conducting riparian planting projects.
- Improve floodplain connectivity by increasing beaver abundance and reducing or limiting development of channel confining structures including roads and infrastructure.

Priority Watershed Actions

Instream Flows

1. Organize an interagency stream flow assessment team to evaluate and identify:
    a. Refugia areas that have adequate stream flow, water temperature, and riparian protections to support coho salmon.
    b. Existing stream flow needs.
    c. A strategy to address flow restoration, which will protect existing refugia, expand refugia to adjacent reaches, and provide a connection to a larger network of refugia areas.
2. Assess the potential success of a pilot program and implement the water conservation and instream flow program in the South or Middle Umpqua populations first. Develop a pilot flow restoration effort to implement the protection and restoration strategy and test the program feasibility in the South or Middle Umpqua populations.

Private Timber Lands

1. Increase protection of riparian reserves and no-touch buffer widths.
2. Eliminate the construction of permanent new roads. Decommission roads where practicable.
3. Increase placement of large wood into stream channels.

Agriculture Lands

1. Plant, restore, and protect riparian areas adjacent to stream channels.
2. Improve lateral connectivity from the stream channels to adjacent wetlands.
3. Conserve water usage to allow more instream water.

Federal Lands

1. Maintain a strong aquatic conservation strategy of some form within future management plans that protects ecological processes that form high quality coho salmon habitat.
2. Improve the transportation network that includes reducing the road network, minimizing the hydrologic connection of the roads to streams, reducing road related fish passage barriers, and minimizing any new road development, especially in riparian zones.

Secondary Watershed Actions

Beaver Management

1. Develop a beaver conservation plan.
2. Prohibit killing beaver within the range of OC coho salmon by any entity other than a state agency and only when all other options are exhausted.
5. Create a program to educate landowners and the public in general about the benefits of beaver to the health of our ecosystems, with a focus on benefits to salmonids and opportunities to conserve and manage beaver through cost effective, non-lethal management practices (Pollock et al. 2004; DeVries et al. 2012).
3. Incorporate beaver conservation into restoration actions. Develop a pilot demonstration effort, considering the Elk Creek watershed within the South Umpqua population first, and implement this integrated restoration strategy.

Fish Passage Access

1. Continue efforts to improve fish passage at dams, culverts, and other identified fish passage barriers. Assess remaining fish passage barriers and develop and implementation strategy and schedule.
2. Develop an estuary lowlands restoration strategy that considers improved access to historic floodplains through tidegate elimination, management, and operations; levee removal; and overwater structure modifications.
3. Complete a tidegate and floodplain management strategy in the Lower Umpqua and Smith River estuary.

Table 6-6. Habitat component specific actions to restore high quality coho salmon habitat in the Umpqua Stratum.

Action id	Habitat component	Strategy	Action	Area	Priority
US-1	Tributaries	Improve instream flows	Develop water conservation strategies on the upslope agricultural areas with the intent of transferring conserved water to instream flows.	Immediate focus on identified areas with the highest water diversion.	High
US-2	Tributaries	Improve instream flows	Develop water conservation strategies on the upslope agricultural areas with the intent of transferring conserved water to instream flows.	All populations	Medium
US-3	Tributaries	Improve water quality	Improve water quality by improving instream flows, channel complexity, stream shade, and substrate retention.	All populations	High
US-4	Tributaries	Improve wood recruitment to support long-term increases in habitat complexity	Improve timber harvest activities (increased harvest buffers on private industrial timberlands, reduce road densities on private and federal timberlands)	All populations	High
US-5	Tributaries	Improve wood recruitment to support long-term increases in habitat complexity	Improve agricultural practices (for example grazing and hay production buffers on ag land adjacent to ESA-listed streams)	All populations	High
US-6	Tributaries	Increase habitat complexity	Improve agricultural practices (disallow stream channel dredging in ESA-listed streams flowing through or adjacent to ag lands)	Stratum wide	High
US-7	Tributaries	Increase habitat complexity	Increase large wood, boulders, or other instream structure	All streams where coho salmon would benefit immediately	High
US-8	Tributaries	Increase habitat complexity	Increase large wood, boulders, or other instream structure	All populations	Medium
US-9	Tributaries	Increase habitat complexity	Conduct riparian planting projects on streams that flow through or adjacent to ag lands to increase wood recruitment to streams	All streams where coho salmon would benefit immediately; specifically	High
US-10	Off-Channel	Increase habitat complexity and connectivity to side-channels	Increase large wood, boulders, or other instream structure	All streams where coho would benefit immediately	High
US-11	Off-Channel and Wetlands	Increase habitat complexity and connectivity and access to alcoves, off-channel ponds, floodplains, and wetlands	Increase beaver abundance	All streams where coho salmon would benefit immediately	High
US-12	Off-Channel	Increase habitat complexity and connectivity to side-channels	Increase large wood, boulders, or other instream structure	All populations	Medium
US-13	Off-Channel and Wetlands	Increase habitat complexity and	Increase beaver abundance	All populations	Medium

Action id	Habitat component	Strategy	Action	Area	Priority
		connectivity and access to alcoves, off-channel ponds, floodplains, and wetlands			
US-14	Wetlands	Improve direct and indirect wetland connectivity to streams	Reduce existing and limit development of channel confining structures including roads and infrastructure in the floodplain that disconnect wetlands from tributaries and mainstems	All streams where coho salmon would benefit immediately	Medium
US-15	Mainstem	Improve instream flows	Develop water conservation strategies on the upslope agricultural areas with the intent of transferring conserved water to instream flows.	All populations	High
US-16	Mainstems	Improve water quality	Improve water quality by improving instream flows, channel complexity, stream shade, and substrate retention.	All populations	High
US-17	Mainstems	Improve marginal and streambank habitat complexity	Increase large wood and marginal and streambank habitat structure	All streams where coho salmon would benefit immediately	High
US-18	Mainstems	Improve marginal and streambank habitat complexity	Increase large wood and marginal and streambank habitat structure	All populations	Medium
US-19	Mainstems	Improve wood recruitment to support long-term increases in habitat complexity	Improve timber harvest activities (increased harvest buffers on private industrial timberlands, reduce road densities on private and federal timberlands)	All streams where coho salmon would benefit immediately	High
US-20	Mainstems	Improve wood recruitment to support long-term increases in habitat complexity	Improve timber harvest activities (increased harvest buffers on private industrial timberlands, reduce road densities on private and federal timberlands)	All populations	Medium
US-21	Estuary	Increase access to sloughs, side channels, and floodplains	Reduce fish passage barriers to floodplains by managing tidegate presence and operations.	Estuary wide	Medium
US-22	Estuary	Increase access to sloughs, side channels, and floodplains	Reduce fish passage barriers to floodplains by reducing or setting dikes back.	Estuary wide	Medium

6.3.5 Strategies and Actions for the Mid-South Coast Stratum

Mid-South Coast Stratum for Oregon Coast Coho Salmon

Independent Populations: Coos, Coquille, Floras/New, and Sixes
Dependent Populations: Johnson and Twomile
Current Status: Moderate level of certainty that the Mid-South Coast Stratum is sustainable
Primary Limiting Factor: Stream complexity (all Mid-South Coast Stratum independent populations)
Secondary Limiting Factors: Water quality (all Mid-South Coast Stratum independent populations)

Recovery Strategy for the Mid-South Coast Stratum

The basic recovery strategy for coho salmon populations in the Mid-South Coast Stratum aims to protect freshwater and estuarine reaches that currently contain high quality habitat, and restore reaches with potential for additional high quality habitat. Actions will particularly focus on increasing the amount and quality of winter and summer rearing habitat by improving stream and estuarine habitat complexity ─ including increasing amounts of large wood and pool habitat, and connecting side channels, wetlands, and other off-channel areas. Collaborative actions will also focus on improving water quality, especially by reducing summer water temperatures, increasing water availability by reducing water withdrawals, reducing fine sediment levels, and increasing the amount of, and connectivity to, tidal wetland habitat.

Key Strategies and Actions for the Mid-South Coast Stratum

- Revise local regulatory mechanisms to increase protection and restoration of watershed processes that promote winter and summer rearing habitats including Oregon’s Agricultural Water Quality Management Act, Oregon Forest Practices Act, FEMA National Floodplain Insurance Program, and state beaver statutes and administrative rules.
- Develop and approve scientifically credible, thorough Strategic Action Plans for the Coos, Coquille, Floras/New, and Sixes populations, consistent with ESU-level common framework.
- Implement the Strategic Action Plans to protect and restore ecosystem processes and functions and coho salmon habitats. Activities should include restoring habitat capacity for rearing juvenile coho salmon by increasing large wood loading, beaver habitat, and wetland/ off-channel connectivity, and by increasing native riparian vegetation to provide bank stability and shade stream reaches.
- Collaborate with governmental and non-governmental organizations and others to identify, and implement, actions that will protect and restore watershed processes, provide stream complexity for juvenile rearing, connect side channels, wetland and off-channel habitats, and reduce fine sediment levels.
- Coordinate with ODEQ, ODF, SWCDs, and others to improve water quality, especially water temperatures, to increase carrying capacity and provide high quality summer rearing habitat for juvenile coho salmon.

- As resources allow, develop and approve scientifically credible, thorough Strategic Action Plans for the Johnson and Twomile populations, consistent with ESU-level common framework.
- Provide and support public outreach, education and volunteer actions to protect and restore ecosystem process and functions and improve juvenile coho salmon rearing habitats.
- Re-establish connectivity of tidal and freshwater wetlands, especially during winter. Examples include the Bandon Marsh (Ni-les'tun Tidal Marsh) restoration and the Winter Lake area, both in the Coquille basin.
- Protect and as needed, re-introduce, beaver to increase beaver dam abundance
- Establish increased riparian buffers with native riparian vegetation on agricultural and forestry lands
- Reduce or eliminate new road development on private and federal timberlands and decommission existing roads
- Reduce existing infrastructure in floodplains and limit future development
- Reduce water withdrawals, especially in gravel-bedded tributaries
- Re-establish streams to their floodplains
- Monitor predation by non-indigenous fish in the Coquille and Coos Rivers

Priority Watershed Actions

Private Timber Lands

1. Increase protection of riparian reserves and no-touch buffer widths.
2. Eliminate the construction of permanent new roads and limit placement of temporary roads. Decommission roads or relocate roads, where practicable.
3. Increase voluntary landowner placement of large wood into stream channels.

Agriculture Lands

1. Plant, restore, and protect riparian areas adjacent to stream channels.
2. Improve lateral connectivity from the stream channels to adjacent wetlands.
3. Seek opportunities to improve tidegates or floodgates to flood adjacent floodplains during the winter flows.
4. Improve natural stream channel form and function by discontinuing stream channelization and armoring of stream banks, and by placing large wood into stream channels.
5. Conserve water usage to allow more instream water.

Federal Lands

1. Maintain a strong aquatic conservation strategy of some form within future management plans that protects ecological processes that form high quality coho salmon habitat.

2. Improve the transportation network that includes reducing the road network, minimizing the hydrologic connection of the roads to streams, reducing road-related fish passage barriers, and minimizing any new road development, especially in riparian zones

Beaver Management

1. Develop a beaver conservation plan.
2. Prohibit killing beaver within the range of OC coho salmon by any entity other than a state agency and only when all other options are exhausted.
3. Create a program to educate landowners and the public in general about the benefits of beaver to the health of our ecosystems, with a focus on benefits to salmonids and opportunities to conserve and manage beaver through cost effective, non-lethal management practices (Pollock et al. 2004; DeVries et al. 2012).
4. Incorporate beaver conservation into restoration actions.

Estuary and Tidal Lands

1. Develop an estuary lowlands restoration strategy that considers improved access to historic floodplains through tidegate elimination, management, and operations; levee removal; and overwater structure modifications.

Instream Flows

1. Organize an interagency stream flow assessment team to evaluate and identify:
    a. Refugia areas that have adequate stream flow, water temperature, and riparian protections to support coho salmon.
    b. Existing stream flow needs.
    c. A strategy to address flow restoration, which will protect existing refugia, expand refugia to adjacent reaches, and provide a connection to a larger network of refugia areas.

Secondary Watershed Actions

Fish Passage and Access

1. Continue efforts to improve fish passage at dams, bridges, culverts, and other identified fish passage barriers. Assess remaining fish passage barriers and develop and implementation strategy and schedule.

Management of Fine Sediment

1. Identify upstream sources of fine sediment loads.
2. Relocate streamside roads.
3. Reduce soil compaction.
4. Identify high debris flow hazard areas (Sixes population).
5. Identify soils with high turbidity potential (Sixes population).

State Lands

1. Coordinate with NMFS to develop a Forestry Habitat Conservation plan(s) to protect and restore OC coho salmon habitat.

Table 6-7. Habitat component specific actions to restore high quality coho salmon habitat.

Action id	Habitat component	Strategy	Action	Area	Priority
MSCS-1	Tributaries	Improve instream flows	Improve water quality by developing water conservation strategies on the upslope agricultural areas with the intent of transferring conserved water to instream flows.	Coquille, Sixes	High
MSCS-2	Tributaries	Improve water quality	Improve water quality by improving instream flows, channel complexity, stream shade, and substrate retention.	All Populations	High
MSCS-3	Tributaries	Improve wood recruitment to support long-term increases in habitat complexity	Improve timber harvest activities (increased harvest buffers on private industrial timberlands, reduce road densities on private and federal timberlands)	All Populations	High
MSCS-4	Tributaries	Improve wood recruitment to support long-term increases in habitat complexity	Improve state agricultural practices (grazing and hay production buffers on ag land adjacent to ESA-listed streams)	All Populations	High
MSCS-5	Tributaries	Increase habitat complexity	Improve state agricultural practices (disallow stream channel dredging in ESA-listed streams flowing through or adjacent to ag lands)	All Populations	High
MSCS-6	Tributaries	Increase habitat complexity	Increase large wood, boulders, or other instream structure	All streams where coho would benefit immediately	High
MSCS-7	Tributaries	Increase habitat complexity	Increase large wood, boulders, or other instream structure	All Populations	Medium
MSCS-8	Tributaries	Increase habitat complexity	Conduct riparian planting projects on streams that flow through or adjacent to ag lands to increase wood recruitment to streams	All streams where coho would benefit immediately;	High
MSCS-9	Tributaries	Increase habitat complexity	Reconnect historical off channel habitat	All Populations	High
MSCS-10	Tributaries	Improve riparian forests to increase shade and reduce stream temperatures	Improve agricultural practices by protecting riparian forests and providing stream buffers sufficient for OC coho salmon recovery through protection and enhancement of shade to reduce stream temperatures and improve water quality.	All Populations	High
MSCS-11	Tributaries	Improve riparian forests to increase shade and reduce stream temperatures	Improve timber management activities, including road management, by protecting riparian forests and providing stream buffers sufficient for OC coho salmon recovery through protection and	All Populations	High

Action id	Habitat component	Strategy	Action	Area	Priority
			enhancement of shade to reduce stream temperatures and improve water quality.		
MSCS-12	Tributaries	Increase water quality by reducing fine suspended sediment loads	Improve water quality by increasing harvest buffers on private industrial timberlands and by reducing road densities on private and federal timberlands to reduce chronic erosion and sediment inputs	Sixes	High
MSCS-13	Tributaries	Increase water quality by reducing fine suspended sediment loads	Improve agricultural practices (grazing and hay production buffers on ag land adjacent to ESA-listed streams) to reduce chronic erosion and sediment inputs	Sixes	High
MSCS-14	Tributaries,	Increase habitat complexity	Improve gold placer and gold suction dredge regulations to minimize or prevent impacts to OC coho salmon; consider special closed areas, closed seasons, and restrictions on methods and activities.	Sixes, Coquille	High
MSCS-15	Off-Channel	Increase habitat complexity and connectivity to side-channels	Increase large wood, boulders, or other instream structure	All streams where coho would benefit immediately	High
MSCS-16	Off-Channel and Wetlands	Increase habitat complexity and connectivity and access to alcoves, off-channel ponds, floodplains, and wetlands	Increase beaver abundance	All streams where coho salmon would benefit immediately	High
MSCS-17	Off-Channel	Increase habitat complexity and connectivity to side-channels	Increase large wood, boulders, or other instream structure	All Populations	Medium
MSCS-18	Off-Channel and Wetlands	Increase habitat complexity and connectivity and access to alcoves, off-channel ponds, floodplains, and wetlands	Increase beaver abundance	All Populations	Medium
MSCS-19	Wetlands	Improve direct and indirect wetland connectivity to streams	Reduce existing and limit development of channel confining structures including roads and infrastructure in the floodplain that disconnect wetlands from tributaries and mainstems	All streams where coho salmon would benefit immediately	High
MSCS-20	Mainstem	Improve instream flows	Improve water quality by developing water conservation strategies on the upslope agricultural areas with the intent of transferring conserved water to instream flows.	Coquille, Sixes	High

Action id	Habitat component	Strategy	Action	Area	Priority
MSCS-21	Mainstems	Improve marginal and streambank habitat complexity	Increase large wood and marginal and streambank habitat structure	All streams where coho salmon would benefit immediately	High
MSCS-22	Mainstems	Improve marginal and streambank habitat complexity	Increase large wood and marginal and streambank habitat structure	All Populations	Medium
MSCS-23	Mainstems	Improve wood recruitment to support long-term increases in habitat complexity	Improve timber harvest activities (increased harvest buffers on private industrial timberlands, reduce road densities on private and federal timberlands)	All Populations	High
MSCS-24	Mainstems	Increase habitat complexity	Reconnect historical off channel habitat	All Populations	High
MSCS-25	Mainstems	Improve riparian forests to increase shade and reduce stream temperatures	Improve agricultural practices by protecting riparian forests and providing stream buffers sufficient for OC coho salmon recovery through protection and enhancement of shade to reduce stream temperatures and improve water quality.	Sixes, Floras	High
MSCS-26	Mainstems	Improve riparian forests to increase shade and reduce stream temperatures	Improve agricultural practices by protecting riparian forests and providing stream buffers sufficient for OC coho salmon recovery through protection and enhancement of shade to reduce stream temperatures and improve water quality.	Coos, Coquille	Medium
MSCS-27	Mainstems	Increase water quality by reducing fine suspended sediment loads	Improve water quality by increasing harvest buffers on private industrial timberlands and by reducing road densities on private and federal timberlands to reduce chronic erosion and sediment inputs	Sixes	High
MSCS-28	Mainstems	Increase water quality by reducing fine suspended sediment loads	Improve agricultural practices (grazing and hay production buffers on ag land adjacent to ESA-listed streams) to reduce chronic erosion and sediment inputs	Sixes	High
MSCS-29	Mainstems	Increase habitat complexity	Improve state and federal regulations and permitting of gravel mining (retain gravel bar form and function).	Coquille	High
MSCS-30	Mainstems	Improve riparian forests to increase shade and reduce stream temperatures	Improve timber management activities, including road management, by protecting riparian forests and providing stream buffers sufficient for OC coho salmon recovery through protection and enhancement of shade to reduce stream temperatures and improve water quality.	Sixes, Floras	High

Action id	Habitat component	Strategy	Action	Area	Priority
MSCS-31	Mainstems	Improve riparian forests to increase shade and reduce stream temperatures	Improve timber management activities, including road management, by protecting riparian forests and providing stream buffers sufficient for OC coho salmon recovery through protection and enhancement of shade to reduce stream temperatures and improve water quality.	Coos, Coquille	Medium
MSCS-32	Mainstem	Increase habitat complexity	Conduct native riparian tree planting projects on streams that flow through or adjacent to ag lands to increase wood recruitment to streams	All Populations	High
MSCS-33	Mainstem	Improve water quality	Improve water quality by improving instream flows, channel complexity, stream shade, and substrate retention.	All Populations	High
MSCS-34	Mainstems	Improve wood recruitment to support long-term increases in habitat complexity	Improve agricultural practices (grazing and hay production buffers on agricultural land adjacent to ESA-listed streams)	All Populations	High
MSCS-35	Mainstem	Increase habitat complexity	Conduct native riparian tree planting projects on streams that flow through or adjacent to ag lands to increase wood recruitment to streams	All Populations	High
MSCS-36	Estuary	Increase access to sloughs, side channels, and floodplains	Reduce fish passage barriers to floodplains by managing tidegate presence and operations.	Coos, Coquille	High
MSCS-37	Estuary	Increase habitat complexity	Seek to restore winter habitat refuge areas in the floodplains in the freshwater ecotone of the upper tidal area of the estuaries.	Coos Watershed: Palouse Creek, Larson Creek, Kentucky Creek, Willanch Creek, Catching Slough, South Slough, and tidal areas above the Millicoma River and South Coos River confluence	High
MSCS-38	Estuary	Increase habitat complexity	Seek to restore winter habitat refuge areas in the floodplains in the freshwater ecotone of the upper tidal area of the estuaries.	Coquille Watershed: from the confluence of the South Fork and North Fork below Myrtle Point downstream to Bear Creek	High
MSCS-39	Estuary	Increase access to sloughs, side channels, and floodplains	Reduce fish passage barriers to floodplains by reducing or setting dikes back.	Estuary wide	High

6.4 Potential Effectiveness of Management Actions and Need for Life Cycle Evaluations

The abundance of Oregon Coast coho salmon natural-origin returns has increased substantially since listing. The working hypothesis is that the combination of several factors ─ greatly reduced harvest rates and hatchery production levels and improved ocean survival ─ have increased coho salmon spawner abundance and improved the status of the ESU, but that persistent habitat-related threats continue to affect the long-term sustainability of the ESU. Despite improvements in some freshwater and estuarine habitat areas, many areas with the highest habitat capacity to support coho salmon remain severely degraded due to legacy forest management practices combined with lowland agricultural and urban development. The lack of high quality winter and summer rearing habitat for juvenile coho continues to be of particular concern.

The primary uncertainties for Oregon Coast coho salmon recovery are these: to what extent has reduced hatchery production improved sustainability, and can reduced hatchery production, combined with increased quantity and quality of freshwater and estuarine rearing habitat result in sufficient egg-to-smolt survival to ensure viability of the populations when marine survival drops to low levels? These uncertainties leave NMFS with inadequate confidence that the ecosystem has healed sufficiently so that the naturally produced ESU could be sustainable over the long term. NMFS recommends that continued RME will be necessary to address these uncertainties.

This recovery plan aims to address the uncertainties and target specific actions to close the gap between threatened and recovered status. The recommended actions in this Plan are intended to improve sustainability, gain key information to reduce uncertainty, and implement an effective adaptive management approach.

Evaluations across the Life Cycle

Pilot use of a multi-stage life cycle model is under development for Oregon Coast coho salmon with the goal of improving our understanding of the combined and relative effects of actions across the life cycle. We are designing this model to incorporate empirical information and working hypotheses on survival and capacity relationships at different life stages. The model will provide a valuable framework for systematically assessing the potential response of Oregon Coast coho salmon to management strategies and site-specific actions under alternative potential climate scenarios. The life-cycle model can also be used to assess the status of the ESU as a whole.

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7. Estimates of Time and Costs

ESA section 4(f)(1)(B) directs that recovery plans, to the maximum extent practicable, incorporate "estimates of the time required and the cost to carry out those measures needed to achieve the Plan's goal and to achieve intermediate steps toward that goal."

This Section describes the best available estimates of time and costs necessary to recover Oregon Coast coho salmon. As we have described in earlier Sections, there are multiple scenarios that could constitute recovery under the ESA, and a variety of strategies and actions that would lead to those scenarios. This makes it very difficult to estimate the time and costs to get to recovery, so the following sections provide a range of estimates, using several basic assumptions and based on the information currently available.

7.1 Time Estimates

The OCCCP described the desired status goal for this ESU as "ambitious." We agree with the state of Oregon's assessment that "significant changes to harvest management and hatchery programs have already been implemented and have significantly diminished harvest and hatchery management as limiting factors. Habitat remains the primary limiting factor for the majority of coho populations in the ESU that can be influenced by Oregon's management."

We also agree with the OCCCP's description of two principle factors that we need to consider in the process of predicting the time-frame required to achieve the goals for this ESU:

1. Ecological processes. Addressing habitat limiting factors (insufficient stream complexity, water quality, etc.) to achieve desired status for the ESU will require significantly increasing the productive capacity of coho salmon and their habitat. Restoration of ecological processes that support high quality habitat requires time and is constrained by patchwork landownership patterns, different regulatory structures, and historical land use practices. Even given an expected increase in the level of non-regulatory participation in habitat improvement work, it will take time to 1) produce detectable improvements in habitat quality and 2) restore the biological and ecological processes across the ESU.

2. Scientific uncertainty. There currently are many uncertainties related to the effectiveness of restoration actions; the cause and impact of predators; the relative importance of all phases of juvenile rearing and habitats; the potential role of beaver dams to increase productive capacity of coho salmon habitat; and the total amount of CWHIP actually available. These scientific uncertainties will require both funding and time to provide information that may be considered in future management programs.

Oregon used a 25-year time frame for its Management Unit Plan for the Lower Columbia River (OLCR Plan), with many recovery actions on 5-, 10-, 15-, 20-, and 25-year schedules. The

OCCCP uses three time-frame scenarios for habitat improvement work – 17, 33 and 50 years, and describes the 50 year time-frame as

> "probably the most realistic, given likely levels of funding, the time required to resolve scientific uncertainty, and the time required to restore ecological processes."

However, these time frames are the state's estimates for achieving broad sense recovery, not ESA delisting. We think ESA delisting could occur sooner than these time frames, depending on near-term conditions (marine and freshwater), which actions are implemented, and how effective they are. For instance, if the biological status were good and Oregon were to revise key regulatory mechanisms, including floodplain management, agricultural and forest practices, and water quality rules, it is possible that we could delist Oregon Coast coho salmon in relatively few years, depending on the specifics of the new mechanisms and the speed and effectiveness of implementation. On the other hand, without significant changes in regulatory mechanisms, relying for the most part on the funding and implementation of voluntary actions, and depending on marine conditions, we think it could take ten years or more to achieve ESA recovery for Oregon Coast coho salmon.

7.2 Cost Estimates

This section provides 5-year and 10-year (total) cost estimates as called for under ESA and NOAA Interim Recovery Planning Guidance, version 1.3, dated June 2010.

We have relied on the OCCCP (Section 6 and Appendix 2 and Annual Reports) and reviewed other cost estimates in recent recovery plans (the Lower Columbia River Recovery Plan, SONCC, and the CCCC). Because we determined that ODFW actions have reduced the threats from hatchery and harvest management to the point where they no longer impede recovery, we have estimated costs based on projects for active habitat restoration projects only. We have not estimated the cost of regulatory changes – any costs associated would be an indirect effect of the change in regulation and we cannot predict what those costs would be with any certainty.

The OCCCP includes three time-frame and cost scenarios for conducting habitat improvement, presented in Table 7-1 below. ODFW assumed that there would be a 30 percent increase in the availability of high quality habitat in 5 years (scenario 1), 10 years (scenario 2), and 15 years (scenario 3). These three scenarios were based on the monitoring program design (five-year rotating panel) that requires a five-year period to evaluate habitat status in each population or the ESU. Under the assumptions in each of these scenarios, the costs would be the same, but spread out over 17 years under the first scenario, 33 years under the second scenario, and 50 years under the third scenario.

For purposes of estimating costs, ODFW used key assumptions to estimate the miles of high quality habitat and funds needed to achieve the desired habitat conditions, including:

- Smolts during poor ocean conditions are only produced from high quality habitat.
- High quality habitat is defined as habitat that can produce 2,800 smolts-per-mile.

- Only instream habitat restoration work is needed to achieve high quality habitat. In other words, no benefits will accrue to the populations from recent and future modifications to harvest and hatchery management programs.
- Instream habitat complexity is the only factor limiting smolt production.
- All instream habitat restoration projects create high quality habitat.
- Habitat converted to high quality habitat is sustained for 50 years.
- From 1997 – 2003, approximately $13.2 million dollars was invested on instream habitat restoration in 524 miles of stream: a cost/mile of approximately $25,000. This cost is applicable to future habitat improvement work.

The OCCCP explained that assumptions required to calculate the values were tenuous and warranted revision based on future research and monitoring, and therefore the habitat goals and associated funding were provided as interim goals to be revised as better information became available in the future.

The Oregon Coast Coho Annual Report 2011-2012 review of management actions states in part:

> "Coast-wide habitat restoration and conservation activities by private land owners, local community based conservation/restoration groups, state and federal agencies has been under way since 1995.The Oregon Watershed Enhancement Board (OWEB) funds and tracks restoration projects and expenditures in their Oregon Watershed Restoration Inventory (OWRI) database. Data from the OWRI … indicates that between 1995 and the end of 2012, approximately $164,354,795 in cash and $25,600,813 as in-kind expenditures was spent on 6,738 different restoration projects within the OCN coho ESU."

Comparing the OCCCP estimates (published in 2007) for the 17 year scenario with the annual report tally shows that actual expenditures in the OC coho ESU areas - in cash and in-kind services - totaled approximately $189 million, many times the 2007 estimate.

The facts that expenditures have already far exceeded the OCCCP cost estimates and the habitat monitoring has yet to show significant improvements underscore the difficulty in developing reliable cost estimates. Furthermore, there is no good way to estimate how many of the costs estimated to achieve the state's goals for broad sense recovery will be necessary to achieve ESA delisting.

NMFS supports implementation of the Oregon Plan for Salmon and Watersheds, and estimates that the cost of recovery will be based on continued expenditures at approximately the same level as in the last 17 years. Based on these assumptions, we estimate the cost of recovery efforts in the next 5 years to be approximately $55 million and $110 million, depending greatly on the ability to target habitat restoration activities to areas where the greatest gains can be made in improving winter and summer rearing habitats. The cost will also depend on success in improving laws and regulations to protect coho salmon habitat, and then enforcing them. These numbers do not include potential direct and opportunity costs to private sector businesses, depending on the actions and regulatory mechanisms implemented, nor do they include financial benefits that we expect to result from successful rebuilding of the Oregon Coast coho salmon ESU.

Table 7-1. Three time-frame and cost scenarios under which habitat improvement work may be conducted across the ESU, by population, to achieve the desired status goal for the ESU. Under the assumptions in each of these scenarios, desired status would be achieved in 17 years under scenario 1, 33 years under scenario 2 and 50 years under scenario 3. In each scenario, the total cost is estimated to be about $62,000,000. Based on the assumptions in scenario 2 in this table, the cost estimate for 5 years would be about $18,000,000. These costs are all in 2007 dollars. (Table 5 in the OCCCP).

Population	New Miles HQH Needed	Scenario 1		Scenario 2		Scenario 3		Total Cost
		Miles/ year	Cost per Biennium	Miles/ year	Cost per Biennium	Miles/ year	Cost per Biennium	
Necanicum	41	2.4	$120,179	1.2	$61,910	0.8	$40,861	$1,021,518
Nehalem	311	18.3	$915,880	9.4	$471,817	6.2	$311,399	$7,784,982
Tilllamook	126	7.4	$371,276	3.8	$191,263	2.5	$126,234	$3,155,844
Nestucca	45	2.6	$131,510	1.4	$67,748	0.9	$44,714	$1,117,838
Salmon	16	0.9	$46,821	0.5	$24,120	0.3	$15,919	$397,982
Siletz	79	4.6	$231,714	2.4	$119,368	1.6	$78,783	$1,969,570
Yaquina	136	8.0	$400,122	4.1	$206,123	2.7	$136,042	$3,401,038
Beaver	11	0.7	$33,647	0.3	$17,333	0.2	$11,440	$286,001
Alsea	129	7.6	$378,881	3.9	$195,181	2.6	$128,820	$3,220,493
Siuslaw	381	22.4	$1,120,602	11.5	$577,280	7.6	$381,005	$9,525,115
Lower Umpqua	195	11.5	$574,484	5.9	$295,946	3.9	$195,325	$4,883,117
Middle Umpqua	301	17.7	$886,116	9.1	$456,484	6.0	$301,280	$7,531,990
North Umpqua	51	3.0	$150,635	1.6	$77,600	1.0	$51,216	$1,280,399
South Umpqua	349	20.5	$1,025,551	10.6	$528,314	7.0	$348,687	$8,717,182
Coos	58	3.4	$169,318	1.7	$87,224	1.2	$57,568	$1,439,203
Coquille	213	12.5	$626,301	6.5	$322,640	4.3	$212,942	$5,323,561
Floras	42	2.5	$123,481	1.3	$63,612	0.8	$41,984	$1,049,593
Sixes	16	1.0	$48,387	0.5	$24,926	0.3	$16,451	$411,287
Total	2,501	147.1	$7,354,907	75.8	$3,788,892	50.0	$2,500,668	$62,516,711

8. Implementation

This section presents our vision for recovery plan implementation and describes implementation and oversight of the implementation team and additional efforts.

Recovery plan implementation involves many entities and stakeholders, and the needs for coordination are complex and occur at multiple levels. For instance, implementation and coordination needs exist at the regional, state, ESU, population and watershed level and involve government entities at the federal, state, tribal, and local levels and also non- governmental entities.

Coordination needs may differ depending on the type and scale of action in question. Habitat actions require extensive local coordination but also coordination at the ESU level to ensure that overall recovery needs are being met. Similarly, although many funding decisions are made locally, there is a need for coordination of funding sources at the ESU and population levels to ensure the most effective use of limited funds. Recovery strategies and actions related to harvest and hatcheries are another example of actions that require coordination at both state and ESU levels with ODFW, NMFS, and other entities.

8.1 Our Vision for Recovery Implementation

In general, our vision for recovery implementation is that recovery plan actions will be carried out in a cooperative and collaborative manner so that multiple agencies and stakeholders can leverage each other's information and resources to achieve multiple goals as efficiently and cost-effectively as possible. We intend to be an active participant and leader, with ODFW, in conservation and recovery activities.

Our strategic goals to achieve that vision are as follows:

- Improve the effectiveness of NMFS as a collaborating partner with other agencies and stakeholders in order to implement recovery actions while supporting other public purposes.
- Sustain local support and momentum for recovery implementation.
- Encourage others to use their authorities to implement recovery plan actions.
- Ensure that the implemented actions contribute to recovery.
- Provide accurate assessments of species status and trends, limiting factors, and threats.

Our approach to achieving these goals is as follows:

- Work with the Oregon Governor's Office and state and federal agencies to develop improved collaboration on the Oregon Coast.

- Support local efforts through the OCCCP Implementation Team, which includes watershed councils, SWCDs. State and federal agencies, private landowners, and other established processes.
- Use this Plan and the OCCCP to guide regulatory decision making.
- Provide leadership in regional forums to develop research, monitoring, and evaluation processes that track recovery action effectiveness and status and trends at the population and ESU levels.
- Provide periodic reports on species status and trends, limiting factors, threats, and plan implementation status.
- Staff and support the OCCCP Implementation Team.

8.2 Implementation and Oversight of the Recovery Plan

As we have explained previously, we are actively partnering with Oregon to integrate the implementation of this recovery plan with the OCCCP, including the development of site-specific management actions. We therefore provide excerpts from the OCCCP below as part of our implementation strategy (recognizing that some of the details in these excerpts are subject to adaptive management by the state of Oregon).

> "Effective implementation of this Conservation Plan requires leadership at the community level, by individuals with local knowledge and passion for salmon, watersheds, and their local communities. The desired status goal of this Conservation Plan will not be achieved under existing regulatory programs, but by a combination of these *plus* significant and effective non-regulatory cooperative conservation efforts. Successful implementation of this Conservation Plan depends on achieving a productive balance where state and federal government provides science analysis, policy guidance, and technical expertise that strengthens the existing community-based cooperative conservation work in non-regulatory settings…
>
> Implementation of this Conservation Plan will focus on efforts to address key factors that limit the productivity of coho and will utilize the existing Oregon Plan infrastructure. Most of these efforts will start at the local level with landowners or the general public contacting watershed groups, or groups contacting landowners, to develop projects to protect or enhance coho habitat. Natural resource agencies may provide technical support to help develop a project proposal or provide matching funds to implement the project. These projects will then be brought to funding entities, such as OWEB, to fund. Once funded, the project will be implemented by the local group, the landowner or their agent."

NMFS will collaborate with the Oregon Plan Core Team, or its successor, for implementation of the OCCCP and with the Implementation Team, comprised of state, federal, and tribal management staff and local restoration organizations (e.g., watershed councils, Soil and Water Conservation Districts). As explained in the OCCCP, this team will be responsible for coordinating and tracking implementation actions and preparing reports of progress described as part of Oregon's adaptive management commitment in this Plan."

Implementation Funding

NMFS will continue to administer the Pacific Coast Salmon Restoration Fund (PCSRF) with OWEB in support of salmon recovery on the coast and statewide, in addition to other sources of funding.

8.2.1 Additional Implementation Efforts

NOAA Northwest Fisheries Science Center (NWFSC)

In order to implement this Plan, we will continue to work closely with the NWFSC to ensure effective implementation of the biological recovery criteria (Section 4.2), RME programs, and other important aspects of this Plan. We expect continued partnership between the NWFSC scientists from other agencies, including ODFW and other Oregon state agencies, USFS, EPA, USACE, and others.

Implementation Coordinators

The NMFS recovery coordinator for Oregon Coast coho salmon will continue to work closely with the ODFW implementation coordinator who will serve as Oregon's management unit lead for OCCCP implementation.

NMFS Role

Our role in the recovery of Oregon Coast coho salmon is twofold. Our first role is to ensure that the agency's statutory responsibilities for recovery under the ESA are met. In this capacity, we are responsible for the following:

- Ensuring that the recovery plan meets ESA statutory requirements, tribal trust and treaty obligations, and agency policy guidelines.
- Developing ESU-wide performance measures consistent with the recovery strategies outlined in Section 6.
- Conducting five-year status reviews.
- Making delisting determinations.
- Coordinating with other federal agencies to ensure compliance under the ESA.
- Implementing recovery plans.

The second role is to serve as a partner to ODFW to implement the OCCCP. We intend to provide leadership in implementing the Plan, working closely in collaboration with all members of the implementation team and other stakeholders.

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9. Research, Monitoring, and Evaluation and Adaptive Management[60]

The long-term success of recovery efforts for Oregon Coast coho salmon will depend on the strategic use of research, monitoring, and evaluation (RME) to provide useful information to decision makers within an adaptive management framework. Research, monitoring, and evaluation programs associated with recovery plans need to gather the information that will be most useful in tracking and evaluating implementation and action effectiveness and assessing the status of listed species relative to recovery goals. Planners and managers then need to use the information collected to guide and refine recovery strategies and actions. These elements of recovery plans are crucial for salmon because of the complexity of the species' life cycles, the range of factors affecting survival, and the limits on our understanding of how specific actions affect species' characteristics and survival.

We intend to continue to work closely with ODFW and other state and federal agencies to implement this Section, which contains specific recommendations based on the current status of the Oregon Coast coho salmon ESU and habitat and regional guidance. This section provides the following information:

- A brief description of the concept of adaptive management and overview of Oregon Coast coho salmon recovery plan RME needs,
- A summary of regional guidance for adaptive management and RME,
- An overview of the RME components of the Plan, and
- An overview of RME regional coordination efforts and needs.

9.1 Overview of Adaptive Management and RME Needs

Adaptive management is the process of adjusting management actions and/or overall approach based on new information as it relates to management questions and goals. Adaptive management works by coupling decision making with data collection and evaluation. Most importantly, it works by offering an explicit process through which alternative approaches and actions can be proposed, prioritized, implemented, and evaluated (NMFS 2007). Successful adaptive management requires that monitoring and evaluation plans be incorporated into overall implementation plans for recovery actions. These plans should link monitoring and evaluation results explicitly to feedback on the design and implementation of actions. In adaptive management, recovery strategies are treated like working hypotheses that can be acted upon, tested, and revised (Lee 1999). Figure 9-1 illustrates the adaptive management process.

[60] We have used material from the OCCCP and the ESA Recovery Plan for Lower Columbia River Coho Salmon, Lower Columbia River Chinook Salmon, Columbia River Chum Salmon, and Lower Columbia River Steelhead for much of this section.

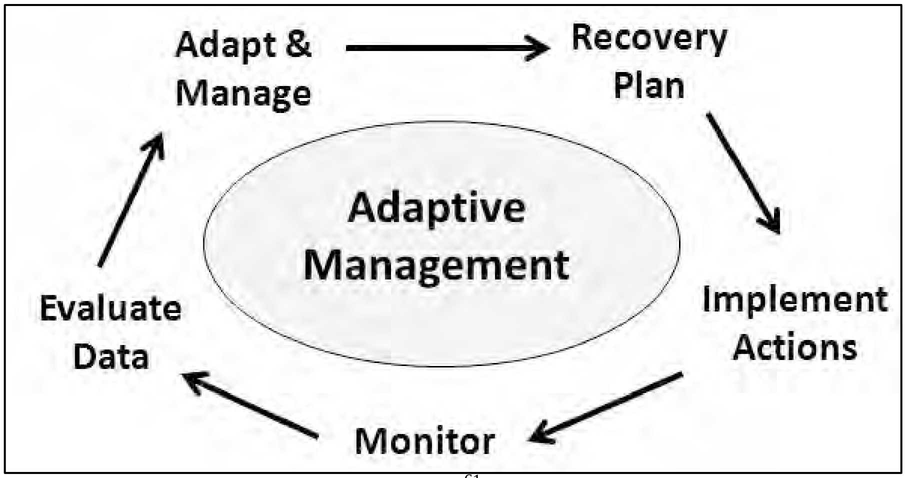

Figure 9-1. The Adaptive Management Cycle.[61]

Several types of monitoring can support adaptive management and help managers make sound decisions:

- Implementation monitoring and compliance monitoring, which are used to evaluate whether recovery plan actions are being implemented as directed.
- Status and trend monitoring, which assesses changes in the status of an ESU and its component populations, and changes in the status or significance of the threats to an ESU. (We applaud ODFW's continued work in this category.)
- Effectiveness monitoring, which tests hypotheses about cause-and-effect relationships and determines via research whether an action is effective and should be continued.

It is also important to explicitly address the many unknowns in salmon recovery—the "critical uncertainties" that make management decisions much harder. Doing so will involve prioritizing critical uncertainties and ensuring that appropriate research is conducted that can inform managers on the questions (NMFS 2007).

The most important critical uncertainties at the time of writing the proposed Plan include the condition (including net change) of freshwater rearing habitat and the influence of near-term ocean conditions on population sustainability.

In particular, the potentially negative effects of climate change are important for each habitat and life history stage. We need to consider the cumulative impacts across the coho salmon life cycle and across multiple generations. Because these effects are multiplicative across the life cycle and across generations, small effects at individual life stages can result in large changes in the overall dynamics of populations. Despite large uncertainties surrounding specific effects at individual life stages, expectations for increasing air and water temperatures, drier summers, higher incidence of flooding, and altered estuarine and marine habitats lead us to expect increasingly

[61] This figure and substantial information in this section comes from the Lower Columbia Recovery Plan, June 2013.

frequent years with low survival, resulting in an overall increase in risk to the ESU from climate change over the next 50 years.

Additional uncertainties that warrant attention include:

- The cumulative impacts to the ecosystem, across the coho salmon life-cycle and across multiple generations (including freshwater habitat, disease and parasitism) related to the expected temperature effects of global climate change on Oregon Coast coho salmon.
- Predation, especially in the lakes, where warm water fish are a threat.
- Pinniped and seabird predation has been identified as a potential threat to salmon recovery. How significant of a threat these species pose to salmon recovery however has not been clearly identified due to insufficient research and data.
- Some studies suggest that poor ocean conditions may increase the risks to salmon associated with predation. Forage fish are an essential food source for pinniped predators and decreased availability due to poor ocean conditions may lead to increased pressure on salmon as a food source. Poor ocean conditions may also reduce the growth rate of salmonid smolts making it harder for them to avoid predators and susceptible to predation for a longer period of time.
- A decrease in high quality habitat is another factor that may lead to increased predation risk. When the quantity and quality of habitat decreases it confine both predators and prey to a smaller area, which gives salmon fewer places to hide and allows easier access by predators.

9.2 Guidance for Adaptive Management and RME

NMFS and other entities have developed documents to guide and coordinate salmon and steelhead RME efforts throughout the Pacific Northwest. Overall, the goal of these guidance documents is to ensure that monitoring programs are designed to provide the information we and others need to understand the effects of recovery actions and evaluate the status of salmon and steelhead populations and the threats they face. Another objective of the guidance documents has been to ensure that data is managed, shared, and integrated in a cost-effective manner. The primary guidance documents are described briefly below.

- In 2007, the NMFS Northwest Region released *Adaptive Management for ESA-Listed Salmon and Steelhead Recovery: Decision Framework and Monitoring Guidance* (NMFS 2007). This document describes the questions we ask in evaluating species status and making listing and delisting decisions. It offers conceptual-level guidance, not specific instructions, on gathering the information that will be most useful in tracking progress and assessing the status of listed species.

  The document emphasizes that adaptive management is an experimental approach in which the assumptions underlying recovery strategies and actions are clearly stated and subject to evaluation (NMFS 2007). It further states that a monitoring and evaluation plan to support adaptive management should provide (1) a clear statement of the metrics and indicators by which progress toward achieving goals can be tracked, (2) a plan for tracking such metrics and indicators, and (3) a decision framework through which new information from monitoring and evaluation can be used to adjust strategies or actions aimed at achieving the Plan's goals. This framework for Oregon Coast coho salmon was described in Section 4.

The document also discusses the various types of monitoring needed for salmon recovery, categorized as status and trend monitoring, effectiveness monitoring, validation monitoring, implementation monitoring, and research on critical uncertainties.

There have been numerous additions to the scientific literature on habitat protection and restoration and related RME in recent years. We recommend that RME programs for OC coho incorporate new guidance as it becomes available. One example that is very pertinent to the Oregon Coast coho salmon habitat effort is Section 8, "Monitoring and Evaluation of Restoration Actions" in *Stream and Watershed Restoration* by Roni and Beechie.[62]

- The NMFS Northwest Region document, *Guidance for Monitoring Recovery of Pacific Northwest Salmon and Steelhead* (Crawford and Rumsey 2011), builds on the 2007 adaptive management guidance document with specific recommendations for monitoring, data collection, and reporting ESA information (Crawford and Rumsey 2011). We incorporated a number of suggestions from this document in our Listing Factors/Threats Criteria Component of the Delisting Criteria (Section 4.3).

  Recommendations include monitoring that addresses all of the viable salmonid population (VSP) criteria and the threats to salmon and steelhead (organized under the five ESA listing factors). The guidance also makes recommendations for setting up regional databases and coordinating regional data collection so that the various agencies and tribes involved in salmon recovery can share data and report it efficiently to NMFS and others.

- The Salmon Monitoring Advisor is a website developed by the Pacific Northwest monitoring community in the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) to provide a comprehensive, technically rigorous framework to help practitioners, decision makers, and funders design monitoring programs. The monitoring advisor is a web-based system that synthesizes a wide array of information into a systematic framework that offers an organized, structured procedure to help users efficiently design and implement reliable, informative, and cost-effective salmon monitoring programs. It provides advice and guidelines to help users systematically work through the numerous steps involved in designing, implementing, and analyzing results from monitoring programs to meet particular monitoring objectives. The address for this site is http://www.monitoringadvisor.org/.

[62] Roni and Beechie 2012.

9.3 Adaptive Management and RME for Oregon Coast Coho Salmon Recovery

9.3.1 Implement the OCCCP Adaptive Management and RME Programs

We applaud Oregon for taking the lead in developing and implementing the RME and adaptive management programs in the OCCCP, which are among the most comprehensive and informative of any salmon recovery efforts. We will continue to support those programs, including Oregon's long-term monitoring programs; recognizing that monitoring programs are expensive, we underscore the importance of continued funding for long-term conservation and recovery needs.

Long-term monitoring programs

Currently, Oregon implements long-term programs that monitor the status and trend of coastal coho salmon populations and their habitat. NMFS intends to collaborate and support these programs and, resources permitting, augment these with additional data management and modeling. The current programs are described in the OCCCP.

9.3.2 Develop life-cycle model to identify and assess potential factors that could limit sustainability of Oregon Coast coho salmon, including effects under current climate change projection scenarios.

A multi-stage life cycle model is being developed that could improve our understanding of the combined and relative effects of actions across the life cycle. The model will provide a valuable framework for systematically assessing the potential response of Oregon Coast coho salmon to alternative management strategies and actions under alternative climate scenarios, and help in identifying key research, monitoring, and evaluation priorities to improve future decision making.

9.3.3 Management Questions, Draft Hypotheses and Recommendations to Help Guide OC Coho RME and Adaptive Management

In order to ensure that we apply the guidance and programs described above to high priority recovery issues, we used the uncertainties described previously and the delisting criteria presented in Section 4 of this Plan to pose several management questions in order to help guide future RME and adaptive management, including the following:

- Is the status of the ESU improving?
- Is the freshwater habitat good enough to support OC coho salmon productivity during expected periods of poor ocean survival in the future?
- Is the habitat at the ESU, strata and population levels getting better?
- Are the regulatory mechanisms pertaining to land use and water quality contributing to the reduction or elimination of limiting factors? Or to meet ESA requirements?
- Are the current RME efforts adequate to answer these questions?

We recommend that ODFW, NMFS, and our other partners consider these questions and adapt or revise them as appropriate when implementing this Plan and the OCCCP to ensure that RME efforts are focused on the highest priority issues. We also recommend the RME program include testable hypotheses related to key management questions. We drafted the following hypotheses, questions and recommendations as a starting point.

Draft hypothesis #1:

Habitat protection and restoration will increase survival and numbers of OC coho salmon.[63]

Draft hypothesis #2:

With the reduction in threats from harvest and hatcheries, if other factors (e.g. freshwater habitat) are comparable, we expect that the ESU will perform better in the future than it did in the 1990s when faced with unfavorable marine and freshwater conditions.

Questions:

1-1 What analyses are available to test this hypothesis?

1-2 Are the current RME programs adequate to test this hypothesis?

RM&E recommendations:

RME 1. If the current RME is adequate, we should make it a high priority to continue funding.

RME 2. If not, we should make it a high priority to provide funding for needed RME to test this hypothesis.

Draft hypothesis #2:

The current regulatory mechanisms are adequate to prevent further degradation of Oregon Coast coho salmon habitat.

Questions:

2-1 What does the latest habitat monitoring tell us about habitat trends and the role of regulatory mechanisms?

2-2 Are the current RME programs adequate to test this hypothesis?

RME recommendations:

RME 3. If the RME programs are adequate to test hypothesis #2, we should make it a high priority to continue funding.

RME 4. If not, we should make it a high priority to provide funding for needed RME.

[63] Phil Roni, Cramer Fish Sciences, Presentation September 2015.

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