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

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WEST COAST REGION

NOAA FISHERIES

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Acronyms and Abbreviations

APHIS	Animal and Plant Health Inspection Service (part of the U.S. Department of Agriculture)
AQI **BLM**	Aquatic Inventories Project Bureau of Land Management
BOEM	Bureau of Ocean Energy Management
BMP	Best Management Practice
BRT	Biological Review Team
BLM	U.S. Bureau of Land Management
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 Segment
DSL	Department of State Lands
DSS	Decision Support System
EPA	U.S. Environmental Protection Agency
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-Indigenous 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 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
ONCC TRT	Oregon/Northern California Coasts Technical Recovery 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
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
SAP	Strategic Action Plan
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

Glossary of Terms and Definitions

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. It is a process for adjusting actions and/or direction based on new information. 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 Oregon Coast 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.
Beaver Dam Analogues	Human-made, channel-spanning structures that mimic or reinforce beaver dams (Pollock et al. 2015).
Broad Sense Recovery Goal	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.
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.
Co-managers	Federal, state, and tribal agencies that cooperatively manage salmon in the Pacific Northwest.
Critical Habitat	Critical habitat includes: (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 (listing factor 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 (Distinct Population Segment)	A distinct population segment (DPS) is a listable entity under the ESA that meets tests of discreteness and significance according to USFWS and NOAA Fisheries policy. A population is considered distinct (and hence a 'species' for purposes of conservation under the ESA) if it is discrete from and significant to the remainder of its species based on factors such as physical, behavioral, or genetic characteristics, it occupies an unusual or unique ecological setting, or its loss would represent a significant gap in the species' range. See also **ESU**.

DSS (Decision Support System)	For *decision support system* (DSS). 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.
Ecosystem	A complex system, or group, of interconnected elements and processes and functions, formed by the interaction of a community of organisms with their environment
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**.
Endangered Species Act	Passed by Congress in 1973, its purposes include providing 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.
Evolutionarily Significant Unit	An Evolutionarily Significant Unit (ESU) represents a distinct population segment of Pacific salmon that (1) is substantially reproductively isolated from conspecific populations and (2) represents an important component of the evolutionary legacy of the species. Equivalent to a distinct population segment (DPS) and treated as a species under the Endangered Species Act.
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	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.
Flashy	A term that describes a river that is prone to reach high peak discharge in a short time frame and be more likely to flood.
Floodplain	A nearly flat plain along the course of a stream or river that is naturally subject to flooding, or using geological terms, a depositional landform in alluvial basins.
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 Oregon Coast coho salmon, it refers to habitat quality sufficient for spawners to replace themselves when marine survival is 3 percent and is based on early models of juvenile rearing capacity.
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.
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 collection of one or more local breeding units whose population whose dynamics or extinction risk over a 100-year period 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).
Integrated Hatchery	A hatchery program, such as in the case of the Cow Creek Hatchery Program, where wild coho salmon are regularly taken into the hatchery program's brood stock. Typically more than 10 percent of the brood stock annually is of wild fish origin. In some years, 100 percent of the brood stock 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	The estimated relative suitability of a habitat for spawning and rearing of anadromous salmonid species under historical conditions inferred from stream characteristics including channel size, 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	Impaired physical, biological, or chemical features (e.g., inadequate spawning habitat, high water temperature, insufficient prey resources) that result in reductions in viable salmonid population (VSP) parameters (abundance, productivity, spatial structure, and diversity).
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
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**.
Natural Return Ratio (NRR)	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]"
OCSRI	For *Oregon Coastal Salmon Restoration Initiative*, which is 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.
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]
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.
PECE Criteria	Policy for Evaluation of Conservation Efforts When Making Listing Decisions' (PECE) criteria are used in assessing the extent to which habitat-related limiting factors and threats have been reduced or eliminated.
Persistent Population	A population 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.

[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).

Phenology	The science dealing with the influence of climate on the recurrence of annual phenomena of animal and plant life (including the migration of salmon).
Phenotype	Any observable characteristic of an organism, such as its external appearance, development, biochemical or physiological properties, or behavior.
Piscivorous	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	Includes measures of age, density, and growth of fish populations.
Potentially Independent	A 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.
Practicable	Capable of being put into practice or of being done or accomplished: feasible.
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[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	An administrative unit for recovery planning defined by NMFS based on ESU boundaries, ecosystem boundaries, and existing local planning processes. Recovery domains may contain one or more listed ESUs.
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, site-specific management actions as may be necessary to achieve the plan's goal, and an estimate of the time and cost required to carry out the actions.
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.
Resilience	A measure of the ability of a population or ESU to rebound from short-term environmental or anthropogenic perturbations.
Run Timing	The time of year (usually identified by week) when spawning salmon return to the spawning beds.
Salmonid	Fish belonging to, or characteristic of, of the family Salmonidae, which includes salmon, steelhead, trout, char, and whitefish.
Section 7	This term is often used in reference to Section 7 (a) (2) of the Endangered Species Act; it directs each Federal agency to consult with NMFS (or USFWS)
Significant	Biological significance refers to an effect that has a noteworthy impact on health or survival.
Smolt	A life stage of juvenile 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.

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

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.
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.
Strata	The plural form of **stratum**. Refers to a grouping, more than one individual stratum.
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	A population 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	A Technical Recovery Teams (TRT) convened by NMFS to develop technical products related to recovery planning. 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. 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, and 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**.
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	Criteria defined by NOAA Fisheries-appointed Technical Recovery Teams based on the biological parameters of abundance, productivity, spatial structure, and diversity, which describe a viable salmonid population (VSP) (an independent population with a negligible risk of extinction over a 100-year time frame) and which describe a general framework for how many and which populations within an ESU should be at a particular status for the ESU to have an acceptably low risk of extinction. See SCA section 7.3 for a discussion of how TRT information is considered in these Biological Opinions.
Viable Salmonid Population	A viable salmonid population (VSP) is 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 (random or directional) over a 100-year time frame.
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

Oregon Coast coho salmon (*Oncorhynchus kisutch*) are protected under the Endangered Species Act (ESA). The fish spawn and rear in rivers, streams, and lakes along Oregon's coastline, from the Necanicum River near Seaside on the north to the Sixes River near Port Orford on the south (Figure S-1). NOAA's National Marine Fisheries Service (NMFS) first listed Oregon Coast coho salmon as a threatened species under the ESA in 1998. NMFS relisted the species in 2008 and reaffirmed the listing in 2011.

This recovery plan (Plan) provides guidance to improve the viability of the species to the point that it meets the delisting criteria and no longer requires ESA protection. Under ESA direction, we need to resolve threats to the species and ensure the long-term persistence of naturally self-sustaining populations in the wild.

Recovery direction for Oregon Coast coho salmon has one central overriding theme: to protect and restore the freshwater and estuarine rearing habitats that support juvenile survival and overall productivity.

The Plan builds on past and current efforts to restore the coho salmon. In particular, this plan calls for continued actions to repair the ecosystem processes that influence the health and stability of the rearing habitats for juvenile coho salmon. The actions will also benefit many other fish and wildlife species, and could provide aid to land owners and local communities

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

Perspective: Past and Current Coho Salmon Runs

During the 1800s and early 1900s, strong runs of coho salmon returned each year to rivers and lakes along the Oregon coast. State and federal scientists estimate that one to two million adult coho salmon returned during periods of favorable ocean conditions, often creating concentrations of several hundred spawners per mile in coastal rivers. These mighty runs supported commercial and recreational fisheries, and helped anchor local economies up and down the coast, but began to decline in the mid-1900s and the total number of returning native coho salmon dropped to below 14,600 fish in 1983. The native coho salmon runs then improved for a few years before declining again to near 21,000 fish in 1990 and to below 24,000 fish in 1997 (See Figure S–2). The decline led NMFS to list the fish under the ESA in 1998; attributing the species' decline to multiple factors: high harvest rates, high hatchery production, significantly degraded habitat, and periods of poor ocean conditions.

Today, thanks largely to improvements made by multiple parties over the last twenty years, more native coho salmon return to the Oregon Coast than at the time of listing ─ though annual returns fluctuate greatly with variable ocean conditions. Recent native coho salmon returns hit modern-era highs of over 350,000 spawners in 2011 and 2014, but slumped to lows of 99,000 spawners in 2012 and, most recently, to 57,000 spawners in 2015 (ODFW 2016). These sharp fluctuations indicate that positive Oregon Coast coho salmon abundance trends are tied largely to favorable marine survival, which can change quickly, creating uncertainty about whether recent levels of abundance can be retained, especially since recent projections by NMFS' Northwest Fisheries Science Center (NWFSC) indicate that a new period of poor ocean conditions is possible, which could result in reduced ocean survival rates and decreased sustainability. This suggests that more actions are needed to ensure the species is sustainable and no longer needs ESA protection.

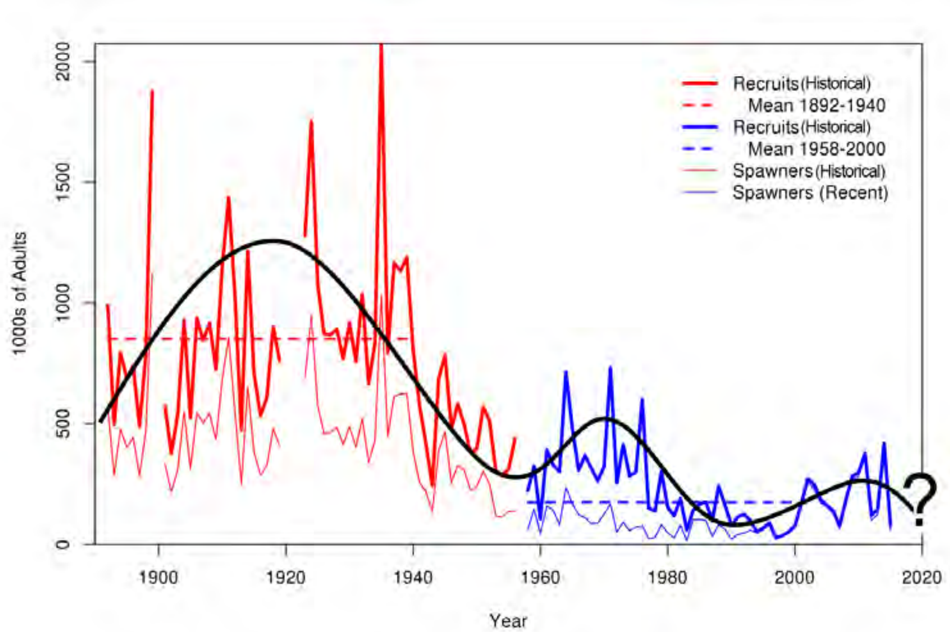

Figure S-2. Comparison of historical (1892–1956) and recent (1958–2015) estimates of spawner abundance and pre-harvest recruits. Horizontal dotted lines are the geometric mean recruits for 1892–1940 and 1960–2009. Analysis based on data from Cleaver 1951, Mullen 1981a, and Mullen 1981b; recent data from Wainwright et al. 2008 and ODFW 2016. Dark line is one interpretation of the long-term trend.

Oregon Coast Coho Salmon and Habitat

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.

Pacific coho salmon (*Oncorhynchus kisutch)* are a wide-ranging species that spawns in rivers and rear in streams and estuaries around the Pacific Rim from Monterey Bay in California north through the Aleutian Islands to Point Hope, Alaska; and from the Anadyr River in Russia south to Korea and northern Hokkaido, Japan.

The Oregon Coast coho salmon evolutionarily significant unit (ESU) includes the Pacific Ocean and the freshwater and estuarine habitat (rivers, streams and lakes) along the Oregon Coast from the Necanicum River on the north to the Sixes River on the south. Rivers in the 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.

Oregon Coast Coho Salmon Life Cycle

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. Juveniles generally spend one summer and a winter in these rearing areas before migrating towards the ocean as smolts in the spring, typically from late April until early June.

Migration strategies are an important feature of life history diversity. Coho salmon smolts may be present in estuaries for a period of weeks to a month or more during their migration to the ocean. They seek out low-salinity gradients during their stay in the estuaries where they can grow and slowly acclimate to saltwater. They also reside in shallow areas, side 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 S-3). The early ocean life 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.

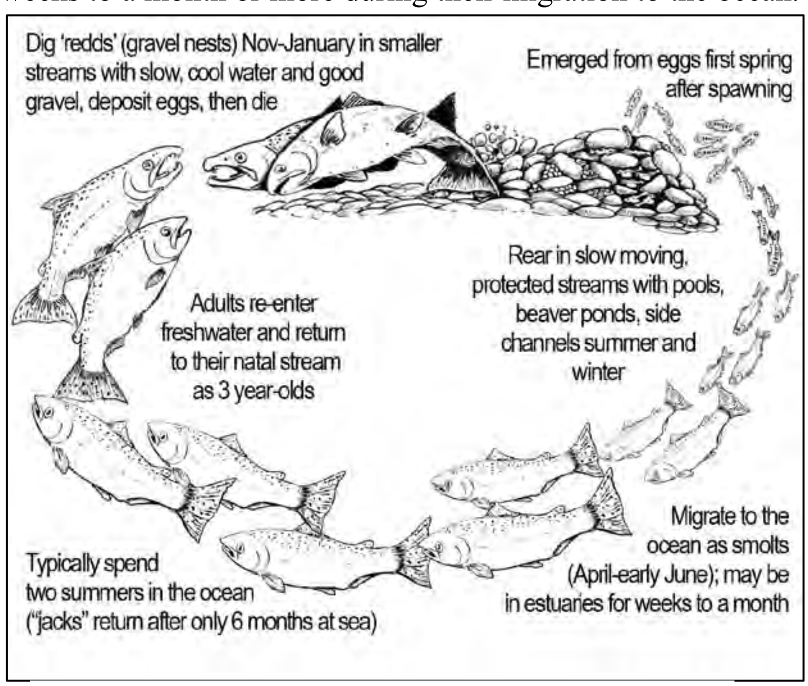

Figure S-3. Oregon Coast coho salmon life cycle.

Endangered Species Act Requirements

The ESA requires NMFS to develop and implement plans for the conservation and survival of species listed as endangered or threatened under the ESA. This Plan provides the required information. It describes (1) measureable criteria which, when met, will result in a determination that the species be removed from the list; (2) site-specific management as may be necessary to achieve the Plan's goal for conservation and survival of the species; and (3) estimates of the time required and cost to carry out the actions. It also describes threats and factors that affect the species.

Scientific Foundation of Recovery Plan

The recovery plan is based on the best available science about the Oregon Coast coho salmon ESU. It builds on the work of the Oregon/ Northern California Coasts Technical Recovery Team, a team of scientists from NMFS, states, tribes, and academic institutions. The team identified the historical populations comprising the species, as well as the larger groupings 'strata' that combine populations with geographic and genetic similarities within the ESU (See Figure S-1).

The team also recommended biological recovery criteria that evaluate two general conditions that imply different levels of risk: Persistence, the ability of the ESU to persist over a 100-year period without artificial support; and Sustainability, the ability of the ESU to maintain its genetic legacy and long-term adaptive potential for the foreseeable future. The criteria were used to evaluate six measures of population, stratum and ESU health: spawner abundance, spawner distribution, juvenile distribution, critical abundance, population productivity, and artificial influence.

Recovery Goals and Delisting Criteria

The Plan (Chapter 4) provides recovery goals and criteria that NMFS will use in future reviews of the status of the Oregon Coast coho salmon ESU.

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: In the simplest terms, NMFS will remove the ESU from ESA listing when we determine that:

- The species has achieved a biological status consistent with recovery ─ the best available information indicates it has sufficient abundance, population growth rate, population spatial structure, and diversity to meet its biological recovery goal.
- Factors that led to ESA listing (described in Chapter 3) have been reduced or eliminated to the point where federal protection under the ESA is no longer needed, and there is reasonable certainty that the relevant regulatory mechanisms are adequate to protect Oregon Coast coho salmon sustainability.

The biological recovery criteria include two principle elements for ESA recovery:

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

Threats and Limiting Factors Analysis

Federal and state scientists used a substantial body of technical research and data about Oregon Coast coho salmon to identify threats and limiting factors that have hindered the species' ability to be naturally self-sustaining. This section summarizes findings discussed in Chapter 3 regarding key factors that led to the species' decline and continue to affect it today.

Factors Leading to ESA Listing

In 1998, NMFS determined that many human activities had contributed to the decline of the ESU to threatened status: "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." Subsequent status reviews found that risks posed by hatchery fish and fisheries had been greatly remedied, however, continued uncertainty remained about the ESU's long-term status due to persisting threats from habitat degradation and climate change that were predicted to degrade in the future (NMFS 1998; Good et al. 2005; Stout et al. 2012).

What are threats and limiting factors?

Threats are human activities or natural events, such as floodplain development or drought, which cause or contribute to limiting factors.

The term 'threats' carries a negative connotation, but they are often legitimate and necessary human activities that at times may have unintended negative consequences on fish. The activities can be managed to minimize or eliminate the negative impacts.

Limiting factors are biological and physical conditions and related ecological processes and interactions that limit a species' viability. Primary limiting factors have the greatest impacts on a population's ability to reach the desired status. Stresses, a term used in a common framework approach to ecosystem management, are ecological attributes that have been altered and limit a species' viability.

Factors Affecting ESU Status Today

Today, Oregon Coast coho salmon are primarily affected by threats that reduce the quantity and quality of coho salmon rearing habitat. Reviews by NMFS' biological review teams in 2011 and 2015 found that the long-term decline in Oregon Coast coho salmon productivity reflected deteriorating conditions in freshwater habitat, and that the remaining habitat may not be high enough to sustain the species productivity during cycles of poor ocean conditions (NWFSC 2015; Stout et al. 2012).

Primary Limiting Factors:

1. **Reduced amount and complexity of habitat.** Loss of stream complexity, including connected floodplain habitat, is a primary limiting factor for many coho salmon populations and overwinter rearing of juvenile coho salmon is especially a concern. 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 debris structures, 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. Beaver provide considerable help in providing this connection and in maintaining proper watershed functioning in Oregon coast streams.

2. **Degraded water quality.** Reduced water quality, including high water temperatures and increased fine sediment levels affect coho salmon production in several populations. Increased water temperature is the primary source of water quality impairment for Oregon Coast coho salmon, and rising water temperatures due to climate change could add to this problem. Land use activities have contributed to increased water temperatures in coastal streams by removing riparian vegetation, disconnecting streams from floodplains, and reducing streamflow through water diversions

3. **Blocked/impaired fish passage.** There has been extensive reduction in connectivity and access to historical estuarine and freshwater coho salmon habitats. This has been the results of two primary sources: (a) Fish passage blocked or partially blocked by culverts, tidegates, bridges, dams, dikes, and levees and (b) the loss of estuarine and tidal habitats.

4. **Uncertainty that there is an adequate combination of voluntary and regulatory mechanisms to ensure success**. Along with numerous voluntary efforts, several federal, state, and local regulatory mechanisms protect Oregon Coast coho salmon and their habitat. Currently it is unclear that the existing voluntary and regulatory mechanisms are adequate to protect habitat conditions that conserve the long-term sustainability of the species.

Coho salmon populations in coastal lake areas and some lower stream reaches are also affected by predation from introduced warm-water fishes such as smallmouth and largemouth bass, and in some cases from birds and marine mammals. Concerns posed by summer water temperatures and predation may increase in the future due to climate change.

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

Threat	Primary Limiting factors	Current level of Concern
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
Overharvest of OC coho salmon in ocean and freshwater tributaries	Reduced abundance and productivity due to harvest mortality	Low
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
Ineffective regulatory mechanisms	Inadequate long-term habitat protection	High
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 Strategy — Conservation Partnerships

Our recovery strategy for Oregon Coast coho salmon focuses on restoring and conserving the ecosystems upon which the species depend so the ESU is naturally self-sustaining and persistent in the wild and no longer needs federal protection under the ESA. We will also continue to participate with partners to ensure that fisheries and hatcheries are managed to protect Oregon Coast coho salmon.

Since ESA listing, the status of Oregon Coast coho salmon has improved. The most recent status review update of the ESU (NWFSC 2015) determined that there is a moderate certainty that the ESU is now sustainable. Nevertheless, it is NMFS' opinion that the current strengthened status of the Oregon Coast coho salmon populations is primarily due to a combination of reduced harvest and hatchery production and high marine survival. Based on the best available science, we remain concerned that the current quality (especially temperature) and quantity of freshwater habitats leaves the ESU at risk of becoming an endangered species, particularly if global climate change leads to a long-term downward trend in freshwater and marine coho salmon habitat compared to current conditions. Thus, we recommend that efforts continue to protect and restore freshwater and estuarine habitat.

The Plan (Chapter 6) provides a suggested roadmap to address remaining threats to the species' viability. It describes alternate routes (strategies and actions) to get to recovery, but also calls for refinement of actions through collaboration because there is no one 'right' way to get success. In particular, the strategy promotes the creation of partnerships that integrate the needs of coho salmon with the needs of local communities and stakeholders. We intend to support partnerships with landowners, businesses, non-governmental and governmental entities, and others to shape practicable solutions that fit the long-term recovery of the species while also supporting sustainable communities in coastal Oregon and meeting the needs of local residents. For more than twenty years, voluntary actions by state, federal, and local organizations and individuals have been improving habitat access and conditions in many areas. The Plan builds upon and complement these efforts.

NMFS' overall recovery direction for Oregon Coast coho salmon centers on restoring degraded habitats and the ecosystem processes and functions that affect those habitats, and protecting habitats that are currently functioning through an effective combination of voluntary and regulatory programs. The primary focus is to protect and restore freshwater and estuarine rearing habitats upon which egg-to-smolt survival, and overall productivity, depends. We also recommend continued, and enhanced, monitoring (as resources are available) to gain critical information about the factors that affect the fish, or may affect the fish given climate change, and to quantify net changes in key habitat features in response to implemented actions.

Strategies to Improve Habitat — Developing Scientifically Sound, Coordinated Approaches

Coho salmon recovery demands the application of well-formulated, scientifically sound approaches. The Plan identifies several key steps to improve and protect habitats:

1. **Restore watershed and estuarine processes to increase rearing habitat quality and capacity.** Natural watershed-level and reach-level physical and biological processes form the habitat features that salmon need. The habitat strategy promotes actions that address the root

causes of ecosystem impairment, such as by re-establishing floodplain connectivity. High quality overwintering habitat for juvenile fish is almost always found in areas where the stream is low gradient and connected with its floodplains. This habitat shelters the fish from high velocity flows and usually contains one or more of the following features: connected floodplains and wetlands with attached off-channel alcoves, beaver dams and ponds, lakes, and channels with large wood and debris and deep pools. High quality summer-rearing habitat contains many of the same features as winter rearing habitat, but foremost provides refuge from high summer water temperatures. (See Figure S-4.)

2. **Ensure long-term ecosystem functions and high quality habitat by reducing habitat-related threats and encouraging formation of beaver dams and beaver dam analogues.**
   High quality juvenile rearing habitat for coho salmon is a reflection of stream and estuarine complexity, which is shaped by several combined watershed processes that influence hydrologic, sediment, riparian, channel, biological, floodplain and estuarine habitat functions. NMFS supports using a collaborative process to enhance the effectiveness of voluntary programs and ensure that regulatory backstop mechanisms and other approaches are in place to protect natural watershed-scale and reach-scale physical and biological processes and functions, such as the re-establishment of connected floodplain habitats.

3. **Improve and recover the species through a common framework and innovative partnerships.**
   NMFS aims to strengthen partnerships with governmental and nongovernmental organizations, landowners, and others to encourage collaboration toward recovery and conservation of Oregon Coast coho salmon populations. We recommend a common framework used in population level plans to provide an integrated, strategic approach that directs and coordinates voluntary efforts to improve key watershed processes and habitats so they effectively support recovery goals for individual coho salmon populations and ESU.

4. **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 plays a key role in the recovery strategy for Oregon Coast coho salmon. The strategy requires a process to track progress, define uncertainties and weaknesses, and adjust our course appropriately. Our strategy includes collaborations to develop a step-by-step approach to define watershed- or population-level strategies and actions that will integrate the best available science.

Management Actions

Several site-specific management actions are generally applicable to restore degraded habitats and the ecosystem processes and functions that support those habitats across the ESU.

Voluntary actions. Protection and restoration of salmon habitat will only be accomplished if the people who call the area home make that a priority. We encourage and support conservation work by private landowners, local groups, and others to improve ecological processes and habitats, particularly in areas with the greatest potential to create high quality coho salmon rearing habitat.

Regulatory actions. An important element in our plan is to integrate voluntary and regulatory efforts to address indirect threats ─ the roots causes of ecosystem impairment. We need to be confident that regulatory backstops ensure compliance with adequate laws and regulations to provide habitat conditions that can support a sustainable ESU.

Research, monitoring and evaluation actions. Continuing the effective research, monitoring and evaluation efforts will be critical to success. In particular, we will continue to work with partners to develop the most cost-effective means to monitor the status and trends of habitat conditions.

In summary, NMFS' recovery direction for Oregon Coast coho salmon focuses on turning degraded habitat into good habitat, and protecting habitats that are currently functioning. As illustrated in Figure S-4, improving bad salmon habitat centers on restoring the ecosystem processes and functions that affect those habitats.

Figure S-4. Examples of bad and good freshwater rearing habitat for Oregon Coast coho salmon.

Implementation

Ultimately, recovery of Oregon Coast coho salmon depends on the commitment and dedicated actions of the many individuals and entities who share responsibility for the stewardship of the species' future, and NMFS looks forward to partnering with them in a collaborative effort. The recovery of Oregon Coast coho salmon will depend on the collaboration of partners at the regional, state, ESU, population, and watershed levels.

Chapter 8 proposes an integrated public-private implementation approach to achieve Oregon Coast coho salmon recovery. As discussed earlier, we need to restore and protect freshwater habitats to improve the overall status of the species in the face of anticipated future reductions in marine survival associated with climate change. Accomplishing this goal can be accomplished through a combination of successful locally supported voluntary programs, with regulatory backstops. Supporting partnerships among stakeholders can help shape practicable solutions that fit the long-term recovery of the species while also supporting sustainable communities in coastal Oregon.

Photo courtesy of Lower Columbia River Estuary Partnership.

NMFS encourages efforts to enhance voluntary conservation programs, create new innovative voluntary incentive programs, and improve the effectiveness of existing regulatory programs. Together, such programs would help halt the net loss of juvenile coho salmon rearing habitat and create additional juvenile rearing habitat.

We will continue to work with agencies, tribes, and local stakeholders to implement coordinated and collaborative programs and projects. In particular, the Plan anticipates the development of the Coho Business Plan (a public-private partnership described in Chapter 8) and population-level Strategic Action Plans, which will serve as a nexus between federal, state and local efforts. We will also actively partner with Oregon to integrate implementation of this recovery plan with related state efforts, and work to align federal programs that provide technical and financial assistance and regulatory assurances to private landowners where possible.

Time and Cost Estimates

NMFS estimates that if the strategies and actions identified in this Plan are implemented in a timely manner, and marine survival is not too low, we will be able to delist Oregon Coast coho salmon within the next 10 years. However, we recognize that the time needed to recover the species under the ESA depends on near-term conditions (marine and freshwater), the types of actions and rate of implementation, and how effectively the actions address remaining limiting factors and threats.

Based on current expenditure levels, NMFS estimates the cost of recovery for the next five and ten years to be approximately $55 million and at approximately $110 million to achieve recovery. This depends 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, and on success in providing the regulatory backstops to protect coho salmon habitat over the long term. Chapter 7 discusses our time and cost estimates.

1. Background

This is an Endangered Species Act (ESA) recovery plan (or Plan) for Oregon Coast coho salmon (or 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 (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 (76 FR 35755).

1.1 Purpose of Recovery Plan

NMFS' primary goal is to improve the viability of the Oregon Coast coho salmon ESU to the point that the species has met the delisting criteria and no longer requires protection under the Endangered Species Act. The recovery plan also supports federal efforts to fulfill obligations to Northwest Indian tribes, as well as aiming to support efforts to achieve broader ecological, social, economic, and cultural goals identified by the state of Oregon that surpass ESA recovery and delisting.

The 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 available at the time. 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 abundant and healthy runs of coho salmon. The Oregon Department of Fish and Wildlife (ODFW) estimated that pre-development (circa 1850) 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 1983, the total number of native spawners was down to 14,600 (ODFW 2016) and in 1997 the total population (pre-harvest) was down to 26,200 (ODFW 2016). 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 freshwater habitat (rivers, streams, and lakes) from the Necanicum River near Seaside on the north coast 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 River 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, NMFS 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:

1. The Oregon Coast Domain Workgroup of the Oregon and Northern California Coasts Technical Recovery Team (ONCC TRT),
2. NOAA Fisheries' Oregon Coast Coho Biological Review Team (BRT) and Northwest Fisheries Science Center (NWFSC) staff,
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) (completed in June, 2014),
5. Non-governmental organizations and local habitat restoration efforts, and
6. Other federal agencies and the state of Oregon.

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 update completed in 2015 (NWFSC 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

May 2016	NMFS issues 2016 5-Year Review: Summary and Evaluation of Oregon Coast Coho Salmon
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. NMFS designates critical habitat for Oregon Coast coho salmon.
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 to develop biologically based delisting criteria and recovery goals, and serve 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).

The Oregon Coast Coho Conservation Plan is Oregon's conservation plan for coastal coho salmon populations; it is not a federal ESA recovery plan. As the above chronology shows, the Oregon Coast coho salmon ESU was not listed as a threatened species under the ESA until several months after ODFW published the conservation plan. The plan was not intended to provide all the information needed to achieve ESA delisting.

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 most 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. This suggests that efforts to achieve the conservation plan's broader goals will support ESA recovery.

Overall, 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. Thus, we believe that achieving 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.

Relationship to Other Recovery Planning Efforts

For the purpose of recovery planning for the listed salmon and steelhead species, the NMFS designated eleven geographically based 'recovery domains' (Figure 1-2). We delineated these domains by considering ESU or DPS boundaries, ecosystem boundaries, and local planning units. The Oregon Coast coho salmon ESU is one of 19 evolutionarily significant units (ESUs) and distinct population segments (DPSs) of salmon and steelhead in the Pacific Northwest that are listed as threatened or endangered under the ESA. One other listed ESU of salmon also spawns and rears 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).

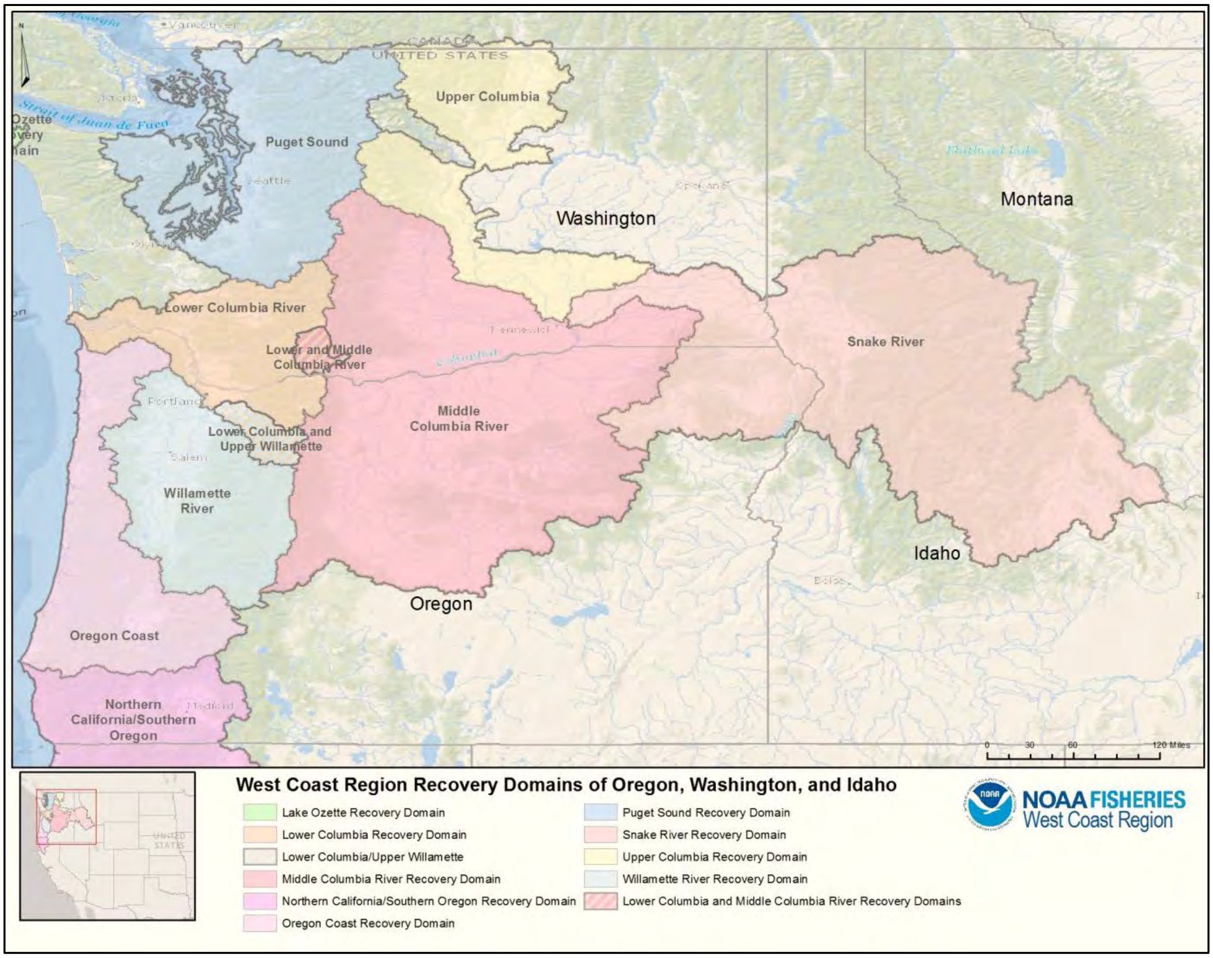

Figure 1-2. NMFS West Coast Region Recovery Domains.

For each domain, NMFS appointed a team of scientists, called a technical recovery team, with geographic and species expertise to provide a solid scientific foundation for recovery plans. The charge of each technical recovery team 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/ Northern California Coasts Technical Recovery Team (ONCC TRT) in the fall of 2001 and created two main workgroups, one for the Oregon Coast recovery domain and another for the Southern Oregon/ Northern California Coast domain. Team representatives included staff from the Northwest Fisheries Science Center, ODFW, U.S. Forest Service (or USFS), Oregon Watershed Enhancement Board (OWEB), and a private consultant.

Each technical recovery team 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 technical recovery team 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 team members' collective experience and expertise. Although NMFS encouraged the technical recovery teams to develop regionally specific approaches for evaluating viability and identifying factors limiting recovery, each team was working from a common scientific foundation to ensure that the recovery plans are scientifically sound, and based on consistent biological principles.

We used technical recovery team 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 Chapter 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; and
- 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; and
- 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; and
- 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. NMFS is 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 supports goals for Indian harvest during and after recovery in a manner that is consistent with recovery of naturally spawning populations. NMFS believes that our relationship with the Pacific Northwest tribes is critically important to the success of recovery efforts. 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."

1.6 Other Species that Could Benefit from this Plan

A major component of this Plan is the protection and restoration of the ecosystem functions and local habitat that are critical for Oregon Coast coho salmon recovery. Other species are likely to benefit from improved natural ecosystem function as well, including eulachon, Pacific lamprey, green sturgeon, spring and summer Chinook salmon, chum salmon, winter and summer steelhead, cutthroat trout, and others. 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.

2. Description of Species and Habitat

This Chapter provides a brief summary of the geographic setting and the features that describe Oregon Coast coho salmon and the species' freshwater, estuarine, and marine habitats. Chapter 5 includes a more detailed description of the current status of the species and its habitat.

2.1 Geographical Setting

Coho 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). The EPA described the historical setting of the Coast Range ecoregion as displaying 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. Today, Douglas-fir plantations are prevalent on the intensively logged and managed landscape. 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, *Oncorhynchus kisutch*, are also known as silver salmon. 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

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

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/ Northern California Coast coho, completed in 2014, discusses coho salmon 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 Oregon 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 (ODFW 2007).

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 (ODFW 2007).

NMFS' 2012 biological review team (BRT) that evaluated the status of the ESU (Stout et al. 2012) discussed historical 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).

NMFS presents these 'very rough' estimates as our approximation of the historical abundance of Oregon Coast coho salmon. We recognize that the accuracy of the available data, and the

[7] NMFS 2013
[8] NMFS 2014

methods used to interpret the data, have varied over time and that there is some dispute about the reliability of these estimates. It is important to understand that NMFS did not use these estimates in setting the recovery goals and delisting criteria described in Chapter 4.

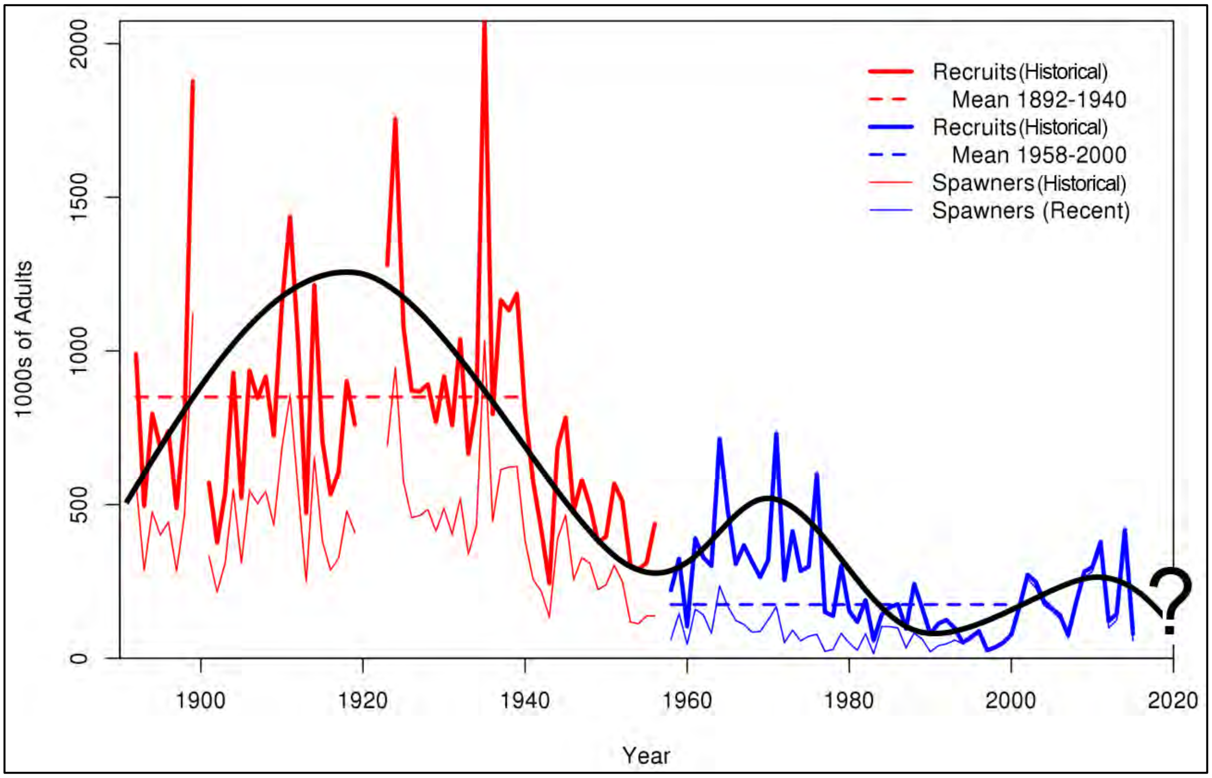

Figure 2-1.[9] Comparison of historical (1892–1956) and recent (1958–2015) estimates of spawner abundance and pre-harvest recruits. Horizontal dotted lines are the geometric mean recruits for 1892–1940 and 1960–2009. Analysis based on data from Cleaver 1951, Mullen 1981a, and Mullen 1981b; recent data from Wainwright et al. 2008 and ODFW 2016. Dark line is one interpretation of the long-term trend.

According to the 2012 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 2016).

[9] Adapted from Figure 6 in the BRT Report (Stout et al. 2012).
[10] Table 3 in Stout et al. 2012.

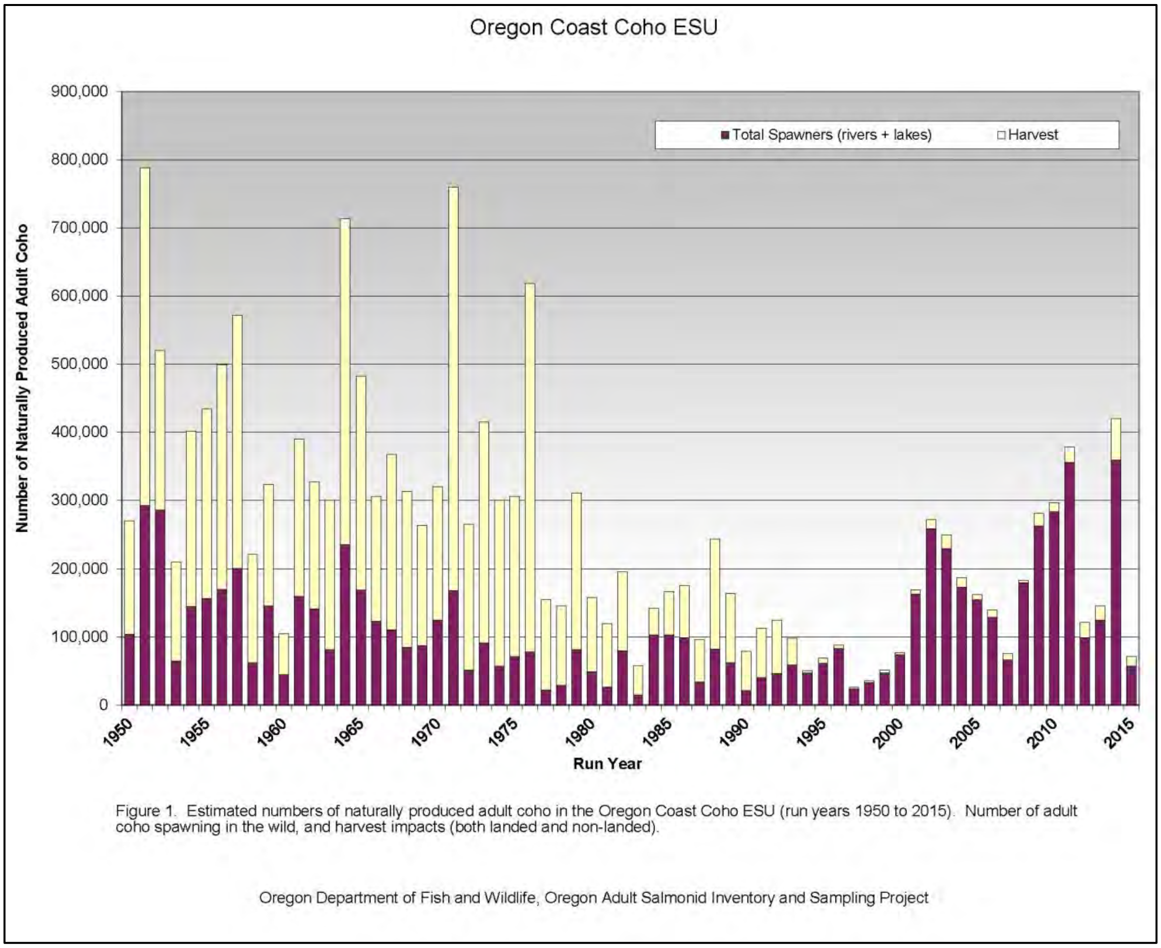

Figure 2-2. Estimated number of naturally produced adult Oregon Coast coho salmon (1950 to 2015). Number of adult coho salmon that spawned and those that were caught in fisheries.

2.2.2 Life History

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. 2012). Current production of coho salmon smolts in the Oregon Coast coho salmon ESU is particularly limited by the availability of complex stream habitat that provides the shelter for overwintering juveniles during periods when flows are high, water temperatures are low, and food availability is limited (ODFW 2007). 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.

The ONCC TRT and BRT reports described Oregon Coast coho salmon as following a yearling-type life history strategy, with most juvenile coho salmon migrating to the ocean as smolts in the spring, typically from as late as March into June (Table 2-1). Coho salmon smolts outmigrating from freshwater reaches may feed and grow in lower mainstem and estuarine habitats for a period of days or weeks before entering the nearshore ocean environment. The areas can serve as acclimation areas, allowing coho salmon juveniles to adapt to saltwater.

Research shows that substantial numbers of coho fry may also emigrate downstream from natal streams into tidally influenced lower river wetlands and estuarine habitat (Chapman 1962; Koski 2009; Bass 2010). The BRT (Stout et al. 2012) reported at least three discrete life history strategies involving coho fry and presmolt migrations into lower river habitats: (1) late fall migration into side-channel or pond habitats connected to lower mainstem reaches from mainstem summer rearing habitats, (2) lower mainstem and estuarine summer rearing followed by upstream migration for overwintering, and (3) lower mainstem and estuarine rearing followed by subyearling outmigration to ocean. The relative contribution of these alternative life history pathways to either current or historical adult coastal coho salmon populations is not known (Stout et al. 2012).

The conventional view has been that adult coho salmon return to natal tributaries from September to November, and normally spawn in relatively small tributaries with low to moderate gradient stream reaches close to where they were hatched. This life history subjects the young fish to variability in climate patterns affecting rainfall and temperature, estuarine habitats, catastrophic events like floods and fire. It also exposes them to the effects of land modifications and uses adjacent to streams, including roads, culverts, rural residential, agricultural, and other uses that may degrade habitat conditions or access.

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

Time Period	Coho Life History Stage
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.

In recent years, there has been important research on the life history of Oregon Coast coho salmon. The following excerpts from Koski 2009 and Jones et al. 2014 provide an introduction to how this research is changing how scientists view the importance of life history diversity in the recovery of Oregon Coast coho and other salmon species.

Excerpt from Koski (2009) article, *The fate of coho salmon nomads: the story of an estuarine-rearing strategy promoting resilience,* in Ecology and Society:

> "Adult coho salmon (*Oncorhynchus kisutch*) typically enter small coastal streams or tributaries of larger rivers in fall and usually ascend to the headwaters to spawn enabling their progeny to fill habitats throughout the system. Conventional understanding of coho salmon life history presumes that, following emergence from the redd in spring, coho fry take up residency in the stream for a year or more before migrating to sea in spring as smolts (Sandercock 1991). However, large numbers of fry (age 0, 1st year of life), typically move downstream following emergence. Chapman (1962) first coined the term 'nomads' referring to those coho fry moving downstream between emergence and October (Koski 2009)."

Excerpts from Jones et al. (2014) article, *The contribution of estuary-resident life histories to the return of adult Oncorhynchus kisutch,* in the Journal of Fish Biology:

> "Conventional understanding of the life history of juvenile coho salmon *Oncorhynchus kisutch* (Walbaum 1792) in the U.S. Pacific Northwest has presumed a relatively fixed pattern of rearing and migration. This model presupposes that successful *O. kisutch* rear in natal streams and migrate to the ocean as age 1 year (i.e. yearling) smolts, returning as 3 year-old adults (Gilbert 1913; Sandercock 1991). Recent studies have found much greater variation in juvenile life history and habitat-use patterns than previously expected, including evidence that estuaries may play a significant role in the life histories of some *O. kisutch* populations (McMahon & Holtby 1992; Miller & Sadro 2003; Koski 2009; Bennett et al. 2011)."
>
> "Life-history diversity in *Oncorhynchus* spp. has been described as an example of response diversity in which variations in phenotypic behavior confer resilience to populations under changing environmental conditions (Elmqvist et al. 2003; Bottom et al. 2009; Moore et al. 2010)... The Salmon River results demonstrate that, even within a small watershed, *O. kisutch* can express considerable variation in their migratory pathways and rearing environments. Such variations constitute a high level of response diversity, spreading mortality risks in time and space. The results further suggest that the productive capacity of the basin for *O. kisutch* is also a function of phenotypic diversity. Estuary restoration has re-established a variety of habitats capable of rearing juveniles that were not supported by stream habitats in the upper basin. Under the environmental conditions experienced during this survey, estuarine wetlands accounted for as much as 30 percent of the adult *O. kisutch* that now return to spawn in Salmon River. These results suggest that life-history diversity and the habitat opportunities that sustain it are fundamental to the productivity as well as the resilience of Salmon River *O. kisutch* (Jones et al. 2014)."

Ocean Life History

After rearing in 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. Ocean conditions, and marine survival, can vary considerably within and between years.

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 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 majority of coho salmon adults return to spawn as 3–year-old fish, having spent about 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 as adults from September to November. They primarily spawn from November through January and into February (Sandercock 1991; Sounhein et al. 2015; Oregon 2015).

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). The ocean survival rate necessary to achieve a 1:1 spawner to recruit ratio is also, in part, a function of freshwater conditions, since a comparatively higher ocean survival rate would be necessary to compensate for lower smolts/spawner when spawner abundance is high.

2.2.3 Population Structure of Oregon Coast Coho Salmon

The Oregon/Northern California Coasts Technical Recovery Team identified 56 historical populations that function collectively to form the Oregon Coast coho salmon ESU (Figure 1-1 and Table 2-2). The team categorized these populations as independent and dependent. Independent populations were historically self-sustaining and likely had relatively little demographic influence from neighboring 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).

[11] Weitkamp and Neely 2002

The 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. While dependent populations are important to the long-term health of the ESU, they are not the primary focus of the recovery effort (The Decision Support System described in Chapter 4 includes a criterion that dependent populations within the ESU are not permanently lost.)

The independent populations were grouped together to form five biogeographic strata: North Coast, Mid-Coast, Lakes, Umpqua, and Mid-South Coast (Table 2-2). 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 (Figure 2-3).

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
	Ecola	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		Vingie	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).

[12] ONCC TRT Table 1

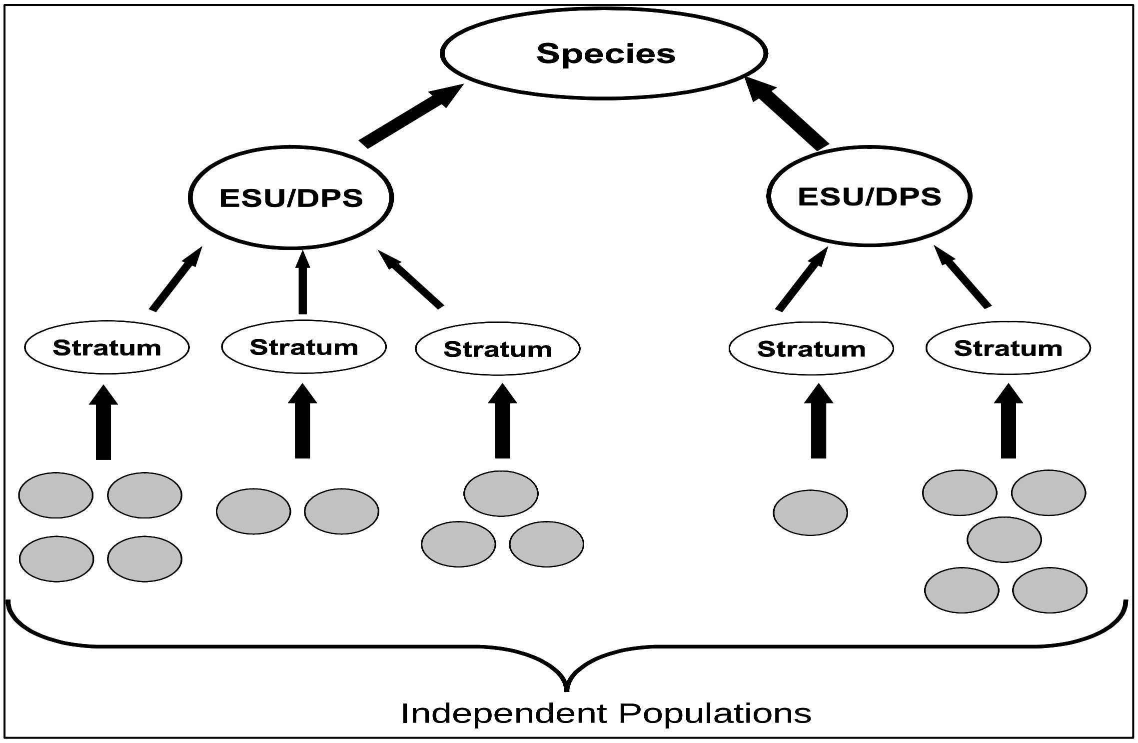

Figure 2-3. Hierarchical population structure within ESA-listed ESUs, as identified by the ONCC TRT.

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 (Buhle 2009). In the early 1990s, ODFW released hatchery coho salmon in 17 independent Oregon Coast coho salmon 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 mid1990s, generating a drop in production from a high of 35 million smolts in 1981 to approximately 260,000 smolts in 2010 (ODFW 2005a, 2009a, 2009b). Since 2010, hatchery coho salmon have been released in only three of the ESU populations (Nehalem, Trask, and South Umpqua) with three brood stocks still in propagation (ODFW 2009b). In 2016, the release of hatchery coho salmon remained at 260,000 smolts annually.

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 (70 FR 37204). The BRT determined that only the Cow Creek (South Umpqua) Hatchery Program, one 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. This information was updated in the 2016 5-Year Review and Jones 2015.

- The Cow Creek hatchery 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 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 time frames. On February 11, 2008, NMFS designated critical habitat for the Oregon Coast coho salmon ESU (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 features that support one or more life stages, and that NMFS considers essential to the conservation of the species, are described in detail in the final rule designating critical habitat for Oregon Coast coho salmon mentioned above (NMFS 2008). 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 summarizes the physical and biological features that we consider essential for coho salmon.

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

Site	Essential Physical and Biological Features	ESU Life Stage
Freshwater spawning	Water quality, water quantity, and substrate	Spawning, incubation, and larval development
Non-tidal freshwater rearing	Water quantity and floodplain connectivity	Juvenile growth and mobility
	Water quality and forage	Juvenile development
	Natural cover[a]	Juvenile mobility and survival
Tidal 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 ponds, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

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

NMFS recognizes that salmon habitat is dynamic and that the 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.

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3. Threats Assessment and Listing Factors

This chapter describes the fundamental causes of the decline in Oregon Coast coho salmon and what has changed since ESA listing. As discussed in Chapter 2, abundance of Oregon Coast coho salmon fell from between one and two million adult coho salmon historically, to as low as 20,000 from the 1970s into the 1990s. 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, NMFS defines 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. NMFS considers threats as those that exist in the present or are likely to occur in the near-term or medium-term 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.

The term 'threats' is often used as synonymous with the ESA 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; and
E. Other natural or human-made factors affecting the species' continued existence.

Limiting Factors

Limiting factors—or stresses—are biological, physical, or chemical conditions and associated ecological processes and interactions that limit a species' viability. Primary 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.

Text Box 3-1. 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.

Text Box 3-2. Relationship to Key Ecological Attributes and Stresses

In a common framework, an approach used to link actions at the population and watershed levels to those at the ESU level, the characteristics of an ecosystem that define habitats capable of supporting a viable salmonid population are typically called Key Ecological Attributes (KEAs). Stresses, similar to the term limiting factors used in this recovery plan, are KEAs that have been altered and now limit a species' viability.

3.2 Factors that Led to Listing of Oregon Coast Coho Salmon

Many human activities contributed to the original ESA listing of Oregon Coast 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)."[13] A subsequent status review in 2005 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). Subsequent status reviews conducted in 2011 and 2015 found continued uncertainty about ESU status because of persisting threats potentially driving its long-term status (habitat degradation and climate change) that were predicted to degrade in the future (Stout et al. 2012; NWFSC 2015).

Table 3-1 lists the human-made and natural factors that contributed to ESA listing, and to the reaffirmation of the listing. The table is organized by the Listing Factors in the ESA section 4(a).

[13] (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)
Listing Factor 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	There is 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 and floodplain habitat. Persistence of numerous primary threats to OC coho salmon, including legacy effects from past forest management, and rural activities and urban development in high intrinsic potential habitat, global climate change, etc. (76 FR 35755).
Protecting property and infrastructure by confining rivers and streams with levees, bulkheads, rip-rap and other armaments, dams, tidegates, culverts, etc.	Reduced quantity and quality of rearing habitat is the key limiting factor for OC coho salmon (floodplain area, number of pools, connected off-channel habitat, amount of wood etc.). Complexity contributes to slow moving water and sheltered conditions necessary for juvenile rearing. Construction, including roads, dams, tidegates 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 habitat conditions. Roads increase the amount of sediment and alter hydrology (increase peak flows), particularly when hydrologic connected to streams (Stout et al. 2012).
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 (Stout et al. 2012).
Rural activities including residential development and agricultural activities that impair stream habitat	Significant amounts of 'high intrinsic potential' rearing habitat are found on private lands and have been destroyed or degraded by land management including reduced or eliminated riparian buffers and reduced flood plain and stream complexity and rearing habitat.
Mining (gravel etc.) activities that impair stream habitat	Altered in-stream habitat and geomorphic function due to removal of gravel 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 and beaver habitat	Removing beaver and beaver habitat has caused loss of beaver pond habitat which is high value for rearing juvenile coho salmon (ODFW 2005c; Stout et al. 2012).
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.
Listing Factor 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	Very high harvest levels (as high as approximately 90%) greatly reduced the abundance of Oregon Coast coho salmon prior to the late 1990s.

Human Activities and Natural Factors	Summary of how activities and factors contributed to listing Oregon Coast coho salmon (limiting factors)
commercial and recreational fisheries, and as incidental catch in other fisheries.	
Listing Factor C. Disease and predation (Section 3.2.3)	
Introducing and protecting predators	Predation on coho salmon by non-native predators (bass and other non-native fish) is considered a primary threat to the lake populations.
Listing Factor 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,	Previous reports concluded “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 (76 FR 35755).
Listing Factor 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	Hatchery production contributed to increased risk to the naturally produced coho salmon.
Effects of Climate Change	“Global climate change is likely to result in further degradation of freshwater habitat conditions and poor marine survival” (76 FR 35755). Sea level rise is very likely to lead to loss of estuarine wetland habitats crucial to successful rearing and ocean transition.

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 2012) 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 built 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.”[14]

[14] Roni and Beechie 2012 p 4

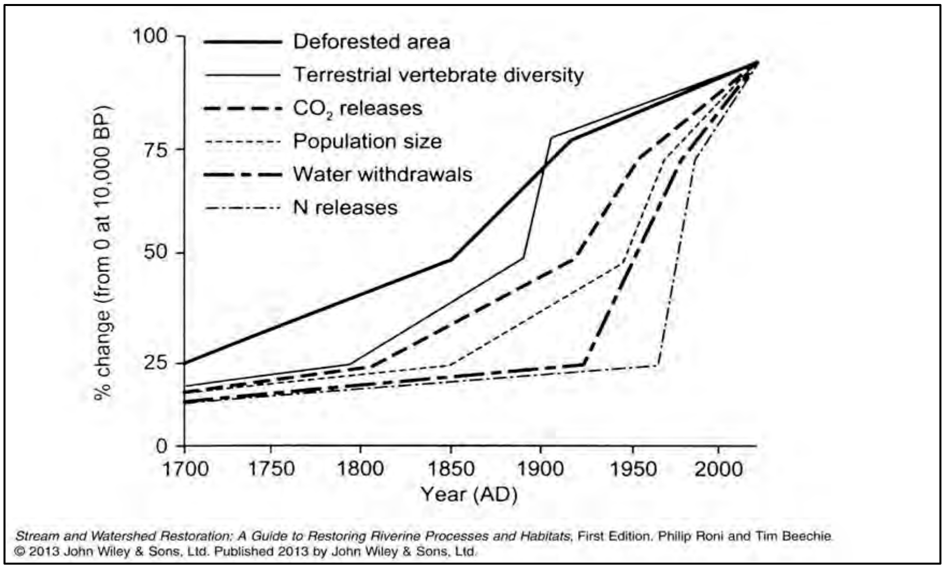

Figure 3-1. Increase in selected human impacts during the last 300 years (percent increase compared to 10,000 BP). From Roni and Beechie 2012. Reproduced by permission of John Wiley & Sons. (BP: before present day.)

3.3 How the ESA Listing Factors Currently Affect ESU Status

Since the original listing of the ESU, significant 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 reported that ongoing and 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).

Section 3.3 discusses the remaining threats for Oregon Coast coho salmon that continue to affect ESU viability today. The section 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.

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 Federal Register Notices, proposed rules, and previous BRT reports (Weitkamp et al. 1995; Good et al. 2005), as well as numerous other reports and assessments (ODFW 1995, 2005a, 2007; NWFSC 2015) that have reviewed in detail the effects of historical and ongoing land management practices that have altered Oregon coast coho salmon habitat. We draw on the BRT status review (Stout et al. 2012), the NWFSC Status Update (NWFSC 2015), and NMFS 5-Year Review (NMFS 2016c) that describe the factors that have led to the current degraded condition of Oregon Coast coho salmon habitat. We refer readers to these reports 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 Oregon Coast coho salmon.

Primary related limiting factors: Reduced quantity of coho salmon habitat (e.g., area of connected floodplain); within the remaining habitat, reduced quality (e.g., complexity and water quality).

Discussion of Current Concerns for Factor A

A recent review of the status of Oregon Coast coho salmon conducted by the Northwest Fisheries Science Center (2015) expressed concerns similar to those from the 2011 review by NMFS' biological review team. Both scientific reviews found 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 (NWFSC 2015; Stout et al. 2012). The 2011 BRT review identified several factors that have led to the current degraded condition of Oregon Coast coho salmon habitat. We briefly summarize this information here, along with updated information from the 2015 NWFSC review, and direct readers to the comprehensive analyses of factors affecting Oregon Coast coho salmon habitat in the BRT reports (Stout et al. 2012; NWFSC 2015) 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 Federal Register Notices, proposed rule and previous BRT reports (Weitkamp et al. 1995; Good et al. 2005), as well as numerous other reports and assessments (ODFW 1995; Christy 2004; Adamus et al. 2005; ODFW 2005b; ODFW 2007).

Many of the habitat changes resulting from land use practices over the last 150 years that contributed to the ESA-listing of Oregon Coast coho salmon continue to hinder recovery of the populations. Historically, habitat conditions in the coastal watersheds supported productive and sustainable coho salmon populations. Natural processes created seasonally inundated floodplains comprising complex feeding and refuge habitat that provided rich feeding and reliable refuge. Water stored on floodplains provided flood and drought resilience to the ecosystem. Channels across floodplains contained 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 shade sufficient to keep water temperatures cool. Extensive and abundant riparian vegetation stabilized streambanks, providing protection against erosion, while extensive floodplains provided sediment deposition zones, where ecosystem productivity peaks (Cluer and Thorne 2013; Cluer 2016).

Today, available habitat has been reduced and existing conditions are degraded in many of these once healthy watersheds. While restoration efforts continue, the scars of habitat degradation across the landscape continue to limit abundance, productivity, spatial structure, and diversity of Oregon Coast coho salmon.

This section describes the primary habitat-related limiting factors for Oregon Coast coho salmon: lost habitat (especially floodplain habitat and including blocked passage), reduced complexity, and degraded water quality. 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 (stream temperature regulation, wood recruitment, sediment and nutrient retention); and altered flow and sediment regimes.

Two of these concerns, stream complexity and water quality, were identified as primary and secondary limiting factors for the Oregon Coast coho salmon populations in a 2005 Oregon Coastal Coho Assessment (ODFW 2005b) (Table 3-2) and they continue to hinder recovery. Loss of floodplain habitat has emerged as a specific limiting factor and climate change has also emerged as an important potential limiting factor. This increases the importance of improving stream complexity, water quantity, and water quality as ways to safeguard against negative impacts on the coho populations from a changing climate (Oregon 2015).

Table 3-2. Primary and secondary limiting factors within remaining habitat 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[15]	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[16]	Stream complexity
South Umpqua	Water quantity	Stream complexity, water quality
Lakes Stratum		
Siltcoos	Non-native fish species	Stream complexity, water quality
Tahkenitch	Non-native fish species	Stream complexity, water quality
Tenmile	Non-native species	Stream complexity, water quality

[15] Hatchery Releases of coho were terminated by ODFW in these populations in the 1990s.
[16] Hatchery Releases of coho were terminated by ODFW in these populations in the 1990s.

Population	Primary limiting factor	Secondary limiting factor
Mid-South Coast Stratum		
Coos	Stream complexity	Water quality
Coquille	Stream complexity	Water quality
Floras	Stream complexity	Water quality
Sixes	Stream complexity	Water quality

Reduced amount and complexity of habitat

Loss of stream complexity, including connected floodplain habitat, within the remaining habitat 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 complex large wood debris structures, 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 reduced instream flows through water diversions, and 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). ODFW and other natural resource agencies also added to the loss of stream complexity through 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.

Beaver removal, combined with loss of large wood in streams, has also led to degraded stream habitat conditions for coho salmon (Stout et al. 2012). Beaver exploitation for the fur trade left them nearly extinct by 1900 (Naiman et al. 1988; Bouwes et al. 2016), though some researchers believe beaver populations in Oregon Coast streams were impacted more by early 1900s forestry and agricultural practices (ODFW 2005c). Their numbers have increased since the early 1900s, but remain at approximately 3-10 percent of historical levels (Pollock et al. 2003). While not all beaver on the Oregon Coast build dams (Maenhout 2013; Petro 2013), dam-building beaver occur within every stratum of the Oregon Coast coho salmon ESU (data from Anlauf et al. 2011, as cited in Stout et al. 2012). Removing dam-building beaver results in the eventual loss of their ponds as the dams fail without maintenance. Because beaver ponds provide high-value coho salmon habitat on the Oregon Coast (Leidholt-Bruner et al. 1992; Nickelson et al. 1992), their reduction constitutes degraded conditions for coho salmon.

Overall, the BRT found that stream habitat complexity and summer parr capacity are decreasing in the Umpqua Stratum but increasing in the other strata (Stout et al. 2012). 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. Table 3- 4 shows an updated analysis of stream habitat conditions and trends at the stratum level.

In addition to describing the loss of floodplain and other habitats and reduced stream complexity in the remaining habitat, 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 (Oregon Coast coho salmon)." The 2012 BRT report added loss of estuarine habitat as a threat to Oregon Coast coho salmon recovery (Stout et al. 2012). Trends in estuarine habitat are discussed in the section below on blocked/impaired fish passage. Most estuarine habitat loss occurred prior to 1970 (Good et al. 2005). However, many activities still occur (e.g., dredging and disposal, new and replacement overwater and in-water structures, shoreline hardening, gravel mining, outfalls, tidegates) that continue to impact and degrade sustainable and functional estuary coho salmon habitat.

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.[17] 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 Pacific Marine and Estuarine Fish Habitat Partnership, one of 19 nationally recognized partnerships, has been conducting a West Coast-wide assessment to protect, restore and enhance juvenile fish habitat, habitat connectivity, and water quality and quantity in estuaries and nearshore marine environments. A main project of this partnership is to conduct an assessment of the role estuaries play in the life of juvenile fish and to develop a prioritization scheme to guide conservation and restoration actions supporting fish habitat functions in West Coast estuaries. More recently, the Oregon Coastal Management Program produced an estuary and shorelands habitat map (http://coastalatlas.net/estuarymaps/) and GIS database using the Coastal and Marine Ecological Classification Standard (CMECS; v. 4.0) to modernize the informational foundation for Oregon's estuary management program (OCMP 2014), which has an inventory of Oregon's coastal and estuary habitats.

There has been considerable research on estuaries in recent years (Jones et al. 2014; Jones et al. 2011; Craig et al. 2014; Bennett et al. 2015) as summarized in Section 2.2.2. The important

[17] See for instance Jones et al. 2014.

addition to conventional thinking has been the evidence that large numbers of coho salmon in their first year of life exhibit considerable variation in their migratory movements and the habitats they use, including wetlands and estuaries. It will be important to continue to gain new information about the role of estuaries in Oregon Coast coho salmon recovery in the adaptive management of the ongoing efforts to sustain the coastal ecosystem.

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 is limiting the number of juveniles that survive to reach the ocean, underscoring the importance of protecting and restoring rearing habitat.

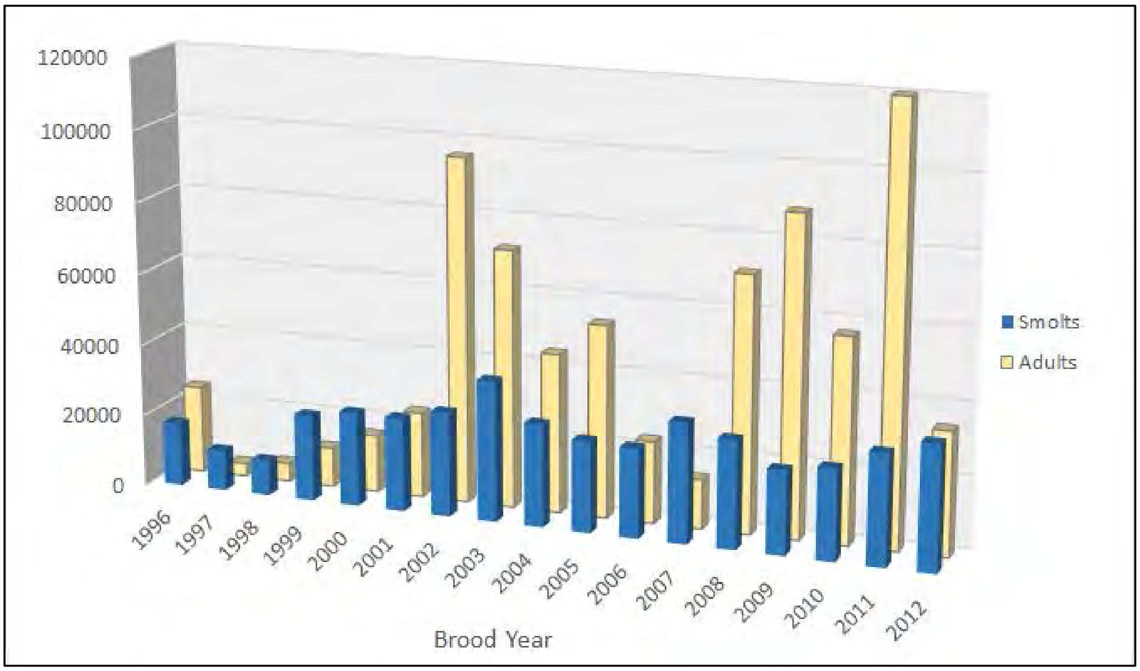

Figure 3-2. Comparison of the total spawner abundance for the mid-coast stratum to the number of smolts reported for the Mill Creek (Yaquina), Mill Creek (Siletz) and Cascade Creeks, 1995-2012 (Anthony 2016).

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, ODFW and the BRT both identified water quality as the primary or secondary limiting factor for 13 of the 21 Oregon Coast coho salmon populations (Table 3-2). Primary water quality concerns include high water temperatures and increased fine sediment levels, and, potentially, pollutants including arsenic, pesticides, and flame retardants (ODEQ 2015).

The Oregon Department of Environmental Quality (ODEQ) has routinely monitored water quality at a number of river sites across the state. The data from this monitoring has been used for developing the Oregon Integrated Report on the condition of Oregon's waters (Clean Water Act Section 305(b)) and waters that do not meet water quality standards and a TMDL is needed (Clean Water Act Section 303(d)). There are many streams within the Oregon Coast coho salmon area that have limiting water quality conditions for aquatic life and are listed on Oregon's

303(d) list. Figures 3-3 and 3-4 show water quality limited waters for temperature, dissolved oxygen, and pH (DEQ 2012).

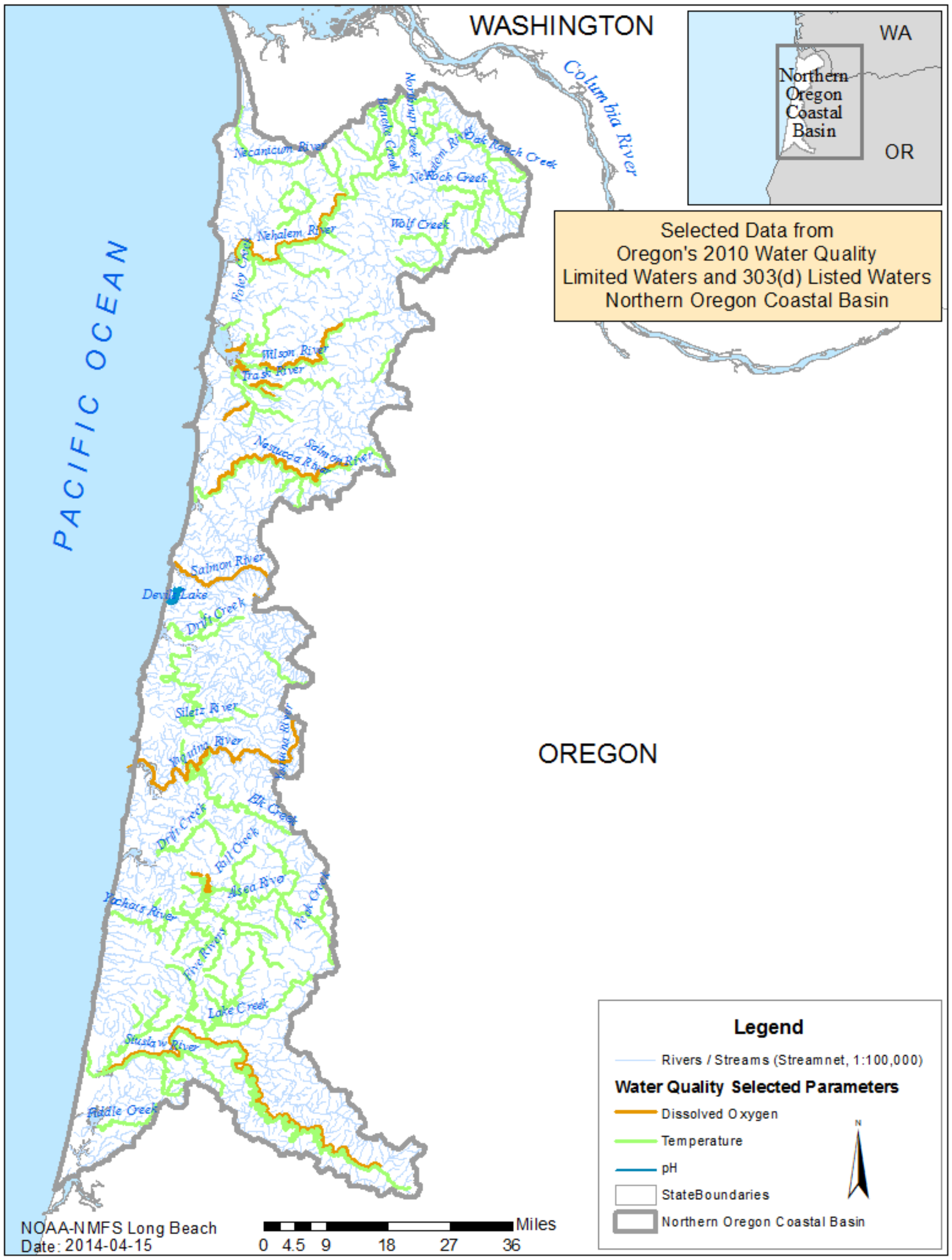

Figure 3-3. Water quality limited waters and 303(d) listed waters in Northern Oregon Coastal Basin.

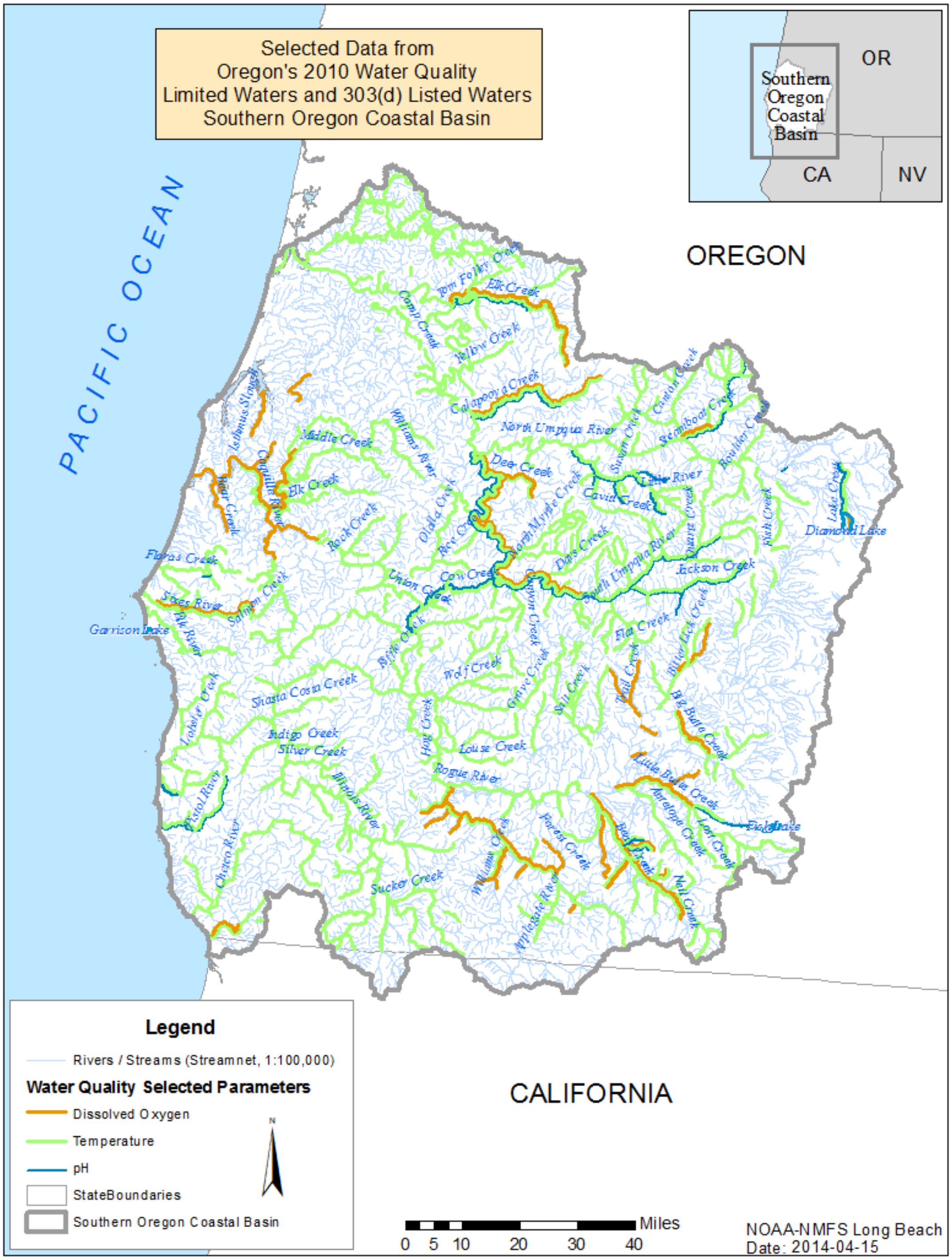

Figure 3-4. Water quality limited waters in Southern Oregon Coastal Basins.

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.

Water temperature has been negatively correlated with salmon survival and abundance in freshwater (Lawson et al. 2004; Crozier et al. 2008). 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. 2008). 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 Oregon Coast coho salmon ESU (Stout et al. 2012). Approximately 40 percent of the Oregon Coast coho salmon ESU is already considered temperature impaired (ODEQ 2007), and rising water temperatures due to climate change could cause further habitat degradation, even in the absence of threats from other human activities like forestry and agriculture. Thus, the effects of climate change pose a significant risk to coho salmon populations in those systems that are already impaired, and increase the likelihood of temperature impairment in the rest of the aquatic systems in the Oregon Coast coho salmon ESU.

Several land use activities have contributed to increased water temperatures in coastal streams. Historical and ongoing timber harvest and road building have reduced the function of riparian zones and shade on streams (Stout et al. 2012). Agricultural activities have also affected water temperatures by removing riparian vegetation, reducing streamflow through water diversion, filling 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. In addition to current practices, there are legacy conditions that impact water quality such as invasive plant species in riparian areas (Oregon 2015).

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, streams can be contaminated by hydrocarbons, fertilizers, pesticides, and other contaminants via stormwater and agricultural runoff and aerial spraying.

Waterbodies that are identified as impaired by ODEQ through its Integrated Report 303(d) process are addressed through the development and implementation of a Total Maximum Daily Load (TMDL). A TMDL is a determination of the total amount of a pollutant the waterbody can assimilate and still meet water quality standards. Water quality standards and TMDLs allocations are used to guide TMDL implementation efforts to restore water quality. Table 3-3 shows the TMDLs issued or being developed in the Oregon Coast coho salmon area.

Table 3-3. TMDLs Issued or Being Developed in the Oregon Coast Coho Salmon Area (ODEQ 2016).

TMDLs Issued or Being Developed in the Oregon Coast Coho Salmon Area and Approval Dates		
Waterbody and Approval Date	**Impairments Addressed**	**Allocations**
Clear Lake, Collard Lake TMDLs (1992)	- Clarity, Drinking water, protection of high quality water	Phosphorus reduction
Coquille River TMDLs (1996)	- Dissolved Oxygen - Aquatic Weeds and Algae	CBOD5 and TKN reduction
Garrison Lake TMDL (1992)	- Aesthetics - Algal Growth	Phosphorus reduction
Little River Watershed TMDLs (2002)	- Temperature - pH - Sedimentation	- Heat load reduction - Effective shade, increase in streamside vegetation - Sediment load reduction
Nestucca Bay Watershed TMDLs (2002 w/ 2006 Addendum)	- Temperature - Bacteria(E Coli, Fecal Coliform) - Sedimentation	- Heat load reduction - Effective shade, increase in streamside vegetation - Channel morphology improvements - Pathogen reductions - 20% stream bed areas fines in riffles and glide reaches
North Coast Subbasins TMDLs (2003 w/ 2006 Addendum)	- Temperature - Bacteria (E Coli, Fecal Coliform) - Biological Criteria (Temperature)	- Heat load reduction - Effective shade, increase in streamside vegetation - Pathogen reductions
Tenmile Lakes Watershed TMDLs (2007)	- Aquatic Weeds and Algae (Sediment, Total Phosphorus) - pH - Chlorophyll a	- Sediment and TSS reductions - Total Phosphorus reductions - Weed management
Tillamook Bay Watershed TMDLs (2001 w/ 2006 Addendum)	- Temperature - Bacteria (E Coli, Fecal Coliform)	- Heat load reduction - Effective shade, increase in streamside vegetation - Pathogen reductions
Umpqua Basin TMDLs (2007)	- Temperature - Bacteria (E Coli, Fecal Coliform) - Aquatic Weeds and Algae - pH - Dissolved Oxygen - Chlorophyll a - Biological Criteria	- Heat load reduction - Effective shade, increase in streamside vegetation - Minimum Stream Flow - Pathogen reductions - Phosphorus and Nitrogen reductions - Tui Chub management - BOD and SOD reductions
Upper South Fork Coquille TMDLs (2001)	- Temperature	- Heat load reduction - Effective shade, increase in streamside vegetation
Mid-Coast TMDLs (under development)	- Temperature - Bacteria (E Coli, Fecal Coliform, Enterococcus) - Sedimentation - Biological Criteria (Sediment) - Dissolved Oxygen	- Not applicable at this time
Coquille Subbasin TMDLs (under development)	- Temperature - Bacteria (E Coli, Fecal Coliform) - Dissolved Oxygen - Chlorophyll a	- Not applicable at this time

Blocked/ impaired fish passage

There has been extensive reduction in connectivity and access to historical estuarine and freshwater coho salmon habitats, resulting from two primary sources: fish passage blocked or partially blocked by culverts, tidegates, bridges, dams, dikes, and levees and the loss of estuarine and tidal habitats. Although considerable work has been done to eliminate or improve barriers in the Oregon Coast recovery domain, approximately 30 percent of habitat had an unknown passage status in 2005 (Dent et al. 2005). Therefore, in 2005, the BRT concluded that passage could not be eliminated as a risk to coho salmon at that time. Since then, additional data sets have been published (e.g., ODFW 2015; Mattison 2011) and there are a considerable number of fish passage barriers in the Oregon Coast recovery domain, although key attributes for each are not always known (Figure 3-5). Many restoration opportunities remain especially in estuarine habitats where tidegates continue to be a fish passage barrier.

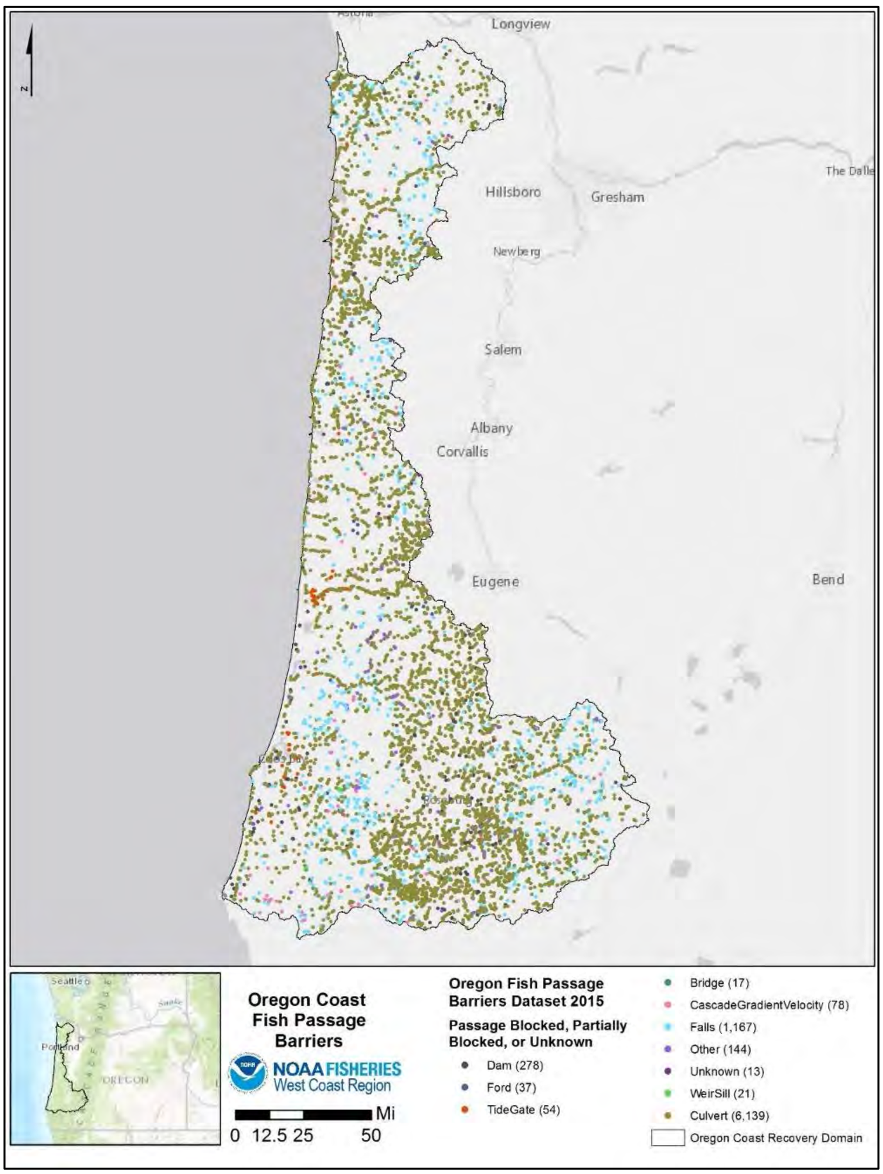

Figure 3-5. Oregon fish passage barriers for Oregon Coast coho salmon (ODFW 2015); does not include dikes, levees, or berms. (https://nrimp.dfw.state.or.us/DataClearinghouse/default.aspx?p=202&XMLname=44.xml)

Of particular importance is the restriction or prevention of fish passage in portions of most estuaries by tidegates, dikes, and levees. For example, Mattison et al. (2011) documented approximately 350 tidegates which were previously unaccounted for as restricting access, and even this is unlikely to be a non-comprehensive and incomplete database (Stout et al. 2012). Tidegates can also have direct effects on coho salmon movements through abrupt changes in salinity, elevated water velocities and turbulence, and degraded summer water quality, in addition to physically restricting fish passage (Giannico and Souder 2005; Bass 2010; Nordholm 2014).

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.

The historical ratio of estuarine and tidally influenced wetlands to total drainage area for the Coos, Coquille, Tillamook, and Umpqua Rivers were relatively high in comparison with other Oregon coastal drainages (Good 2000; Adamus et al. 2005). There are summaries of historical estuarine wetland losses along the Oregon Coast (Good 2000; Christy 2004; Adamus et al. 2005) and the amount of tidal wetland habitat available to support coho salmon migration, foraging, and rearing has declined substantially across all of the biogeographic strata (Figure 3-6) tidal habitat. In addition to the direct losses, restriction of access to sections of tidal habitat and stream/estuary ecotones through the installation of tidegates has severely changed habitats available to rearing and outmigrating smolts relative to historical conditions. Beyond the potential effects on the smolt rearing capacity of coastal basins, widespread estuarine and tidal freshwater wetland losses may have also diminished the expression of sub-yearling migrant life histories within and among populations (Stout et al. 2012). Although there have been modest gains in estuary habitat through recent restoration efforts (Good 2000; Cogan Owens Cogan, LLC 2014), the current biological status of Oregon coastal coho populations reflects the effects of estuarine tidal habitat loss, including the potential impacts of the associated diminished life history diversities (Stout et al. 2012). This loss in access and connectivity reduces available habitat types and conditions that support species abundance, productivity, and spatial structure. It may also be an important factor in reducing population diversity.

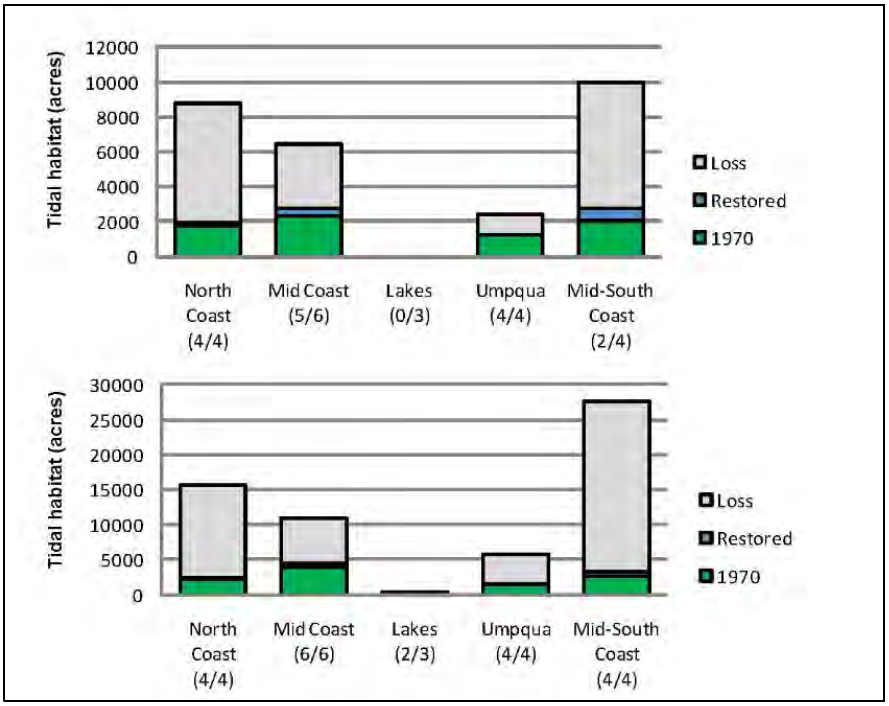

Figure 3-6. Tidal habitat gains and losses in the Oregon Coast Recovery domain. The top plot reflects the Good (2000) analysis and the bottom plot reflects the Adamus et al. (2005) analysis (Figure from Stout et al. 2012).

In Oregon, local governments regulate estuary and shoreland uses (Good et al. 2005). State law (Oregon Land Use Act ORS Chapter 197) requires each city and county to adopt a comprehensive land use plan that aligns with state planning goals, along with zoning and ordinances; each local plan is reviewed for approval by the Oregon Land Conservation and Development Commission. The local comprehensive plan guides a community's land use, conservation of natural resources, economic development, and public facilities. However, due to insufficient resources, local governments are frequently challenged in their abilities to administer and maintain estuary plans and the integration of estuary management plans with state and federal regulatory processes has not been fully realized (OLDCD 2014). The Oregon Department of Land Conservation and Development is currently involved in updating the estuary portion of the statewide planning program.

Analysis of habitat trends

In addition to identifying primary and secondary limiting factors for Oregon Coast coho salmon (Good et al. 2005), 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[18] to measure changes in habitat status for Oregon Coast coho salmon. The results of their analysis of these trends are summarized in Table 3-4. 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. In Section 4.3, we present an updated version of these trends as part of the delisting criteria.

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

Habitat conditions in many stream reaches have improved 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), U.S. Forest Service, other state and federal agencies, and many landowners and stakeholders. Together, these different projects are contributing to the restoration of habitat conditions in estuarine, tidal, and freshwater areas and are also adding 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). More recent work (Lanier et al. 2014) using updated estuary habitat mapping information suggests a smaller percentage of tidal habitat has been targeted and that restored marshes are often at a lower elevation than natural marshes and therefore more susceptible to sea-level rise.

However, while these habitat restoration projects remain a key element in the recovery process, it remains to be seen if 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 (in spite of restoration efforts) 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 3-4. Stream habitat conditions in Oregon Coast Coho Salmon ESU over time (Anthony 2016).

⇧	High probability of a positive trend
⬆	> 90 % probability of positive trend
⇩	High probability of a negative trend
⬇	> 90 % probability of negative trend
⬌	No trend detected; Low probability
N/A	Not modeled

	NC	MC	MS	UMP
	Bayesian Probabilities	Bayesian Probabilities	Bayesian Probabilities	Bayesian Probabilities
Winter Parr	⬇	⇩	⬇	⬌
Summer Parr	⬆	⬆	⬌	⬌
Wood Volume	⬇	⬌	⬌	⬆
% Fine Sediment in Riffles	⬌	⇩	⬌	⬌
% Fine Sediment in Reach	⇩	⬇	⬌	⬌
Percent Channel Shade	⬌	⬌	⬇	⬆
Channel Score (USFS)	N/A	N/A	N/A	N/A

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.

Primary related limiting factors: Reduced spawning escapement 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, several decades ago ODFW dramatically reduced the harvest of coho salmon. Consequently, the BRT (2012) and NWFSC (2015) 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 (NMFS and ODFW are key contributors). Amendment 13 is intended to ensure 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 on an annual basis. Amendment 13 sets harvest impact rates using a two dimensional matrix with parental status and a marine survival index as axes. In Chapter 6, we acknowledge the need for continued adaptive management of the criteria for parental status ('full seeding') and the use of the marine survival index. This approach is intended to ensure that impacts will be minimized when populations are at low abundance or when ocean conditions are poor. Harvest impacts (up to 35%) at higher abundance slow progress toward recovery goals, but do not represent a threat to the viability of the ESU.

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." Current harvest regulations can be found at the ODFW website: http://www.dfw.state.or.us/resources/fishing/docs/2016_Coastal_Coho_Seasons.pdf

Currently, Amendment 13 provides increased protections for Oregon Coast coho salmon from overutilization in commercial and recreational fisheries compared to previous management approaches. 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.

NMFS recognizes the importance of nutrients contributed to ecosystems by salmon carcasses and Chapter 6 of this Plan provides a recovery strategy and recommends actions to continue to increase the protection of the species from overutilization.

3.3.3 Factor C: Disease or predation

Threats: Disease and increase in parasites.

Primary related limiting factors: Reduced Oregon Coast coho productivity due to increases in infection of juvenile coho salmon by parasites and disease.

Threats: Predation from birds, marine mammals and non-native fish.

Primary related limiting factors: Predation on Oregon Coast coho salmon by non-native fish in the Lakes stratum may reduce coho salmon abundance and productivity.

Discussion of Current Concerns for Factor C

Disease

ODFW (2005b), in its assessment of Oregon Coast coho salmon, did not identify disease and parasitism as an important consideration in the recovery of this ESU. More recently, however, the BRT determined that 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). The level of impact that disease may be having on Oregon Coast coho salmon at the ESU, stratum, and/or population level is currently unknown. Disease infection and mortality rates for some diseases have been shown to increase with increases in water temperatures (Holt et al. 1975; Udey et al. 1975; Cairns et al. 2005). Cairns et al. (2005) have shown that "the direct effects of temperature associated with increased metabolic demand can be exacerbated by other factors, including decreased resistance to disease and increased susceptibility to parasites." In addition, disease and infection of juvenile coho salmon in the first few months of ocean residence is also a key concern (Jacobson et al. 2003, 2008).

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 (Stout et al. 2012). Nonetheless, the abundance of birds and marine mammals that prey on Oregon Coast coho salmon along the Oregon Coast has increased in recent decades due to federal protections of those species. More recent work showing predation by birds and marine mammals has raised concerns for some coho salmon populations in the ESU, including the Nehalem, Tillamook, Nestucca, Alsea, and Coquille River populations (Wright et al. 2007; Adrean 2013). It is currently unknown what level of impact bird and marine mammal predation is having on the ESU, strata, or populations of Oregon Coast coho salmon.

Predation by non-native fish

The BRT voiced concern about predation on Oregon Coast coho salmon from introduced non-native fish such as smallmouth bass (*Micropterus dolomieu*) and largemouth bass (*Micropterus salmoides*). These predatory fish are more abundant in the lakes; the lower, middle, and south Umpqua River populations; and the Coquille River population. The BRT concluded that predation and competition from non-native 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 OCCCP recognizes that coho salmon populations in the Lakes basins ((Tahkenitch, Siltcoos, and Tenmile Lakes) are primarily limited by interactions (including predation) with non-native 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 non-native fish predation on Coastal salmonids and coho in particular (ODFW 2007)." The rate at which non-native fish are preying on Oregon Coast coho salmon in the Lakes populations and the Umpqua and Coquille Rivers populations, and the level of impact non-native fish predation is having on these populations is unknown.

In the 2012 BRT review of the status of the Oregon Coast coho salmon ESU (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 (Oregon Coast 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 (Oregon Coast 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 to reduce predation on Oregon Coast coho and other salmonids. 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.

NMFS recognizes that the lake stratum has been the strongest in terms of sustainability and persistence in spite of the presence of non-indigenous species of fish.

3.3.4 Factor D: The inadequacy of existing regulatory mechanisms

Threat: Ongoing activities that contribute to the loss and degradation of coho salmon habitat

Primary related limiting factors: Uncertainty that the combination of voluntary and regulatory mechanisms are in place and effective (including enforcement capabilities) in order 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 will 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 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 2014). These rules require the establishment of riparian management areas (RMA) on certain streams that are within or adjacent to forestry operations. The RMA widths are 50 feet, 70 feet, and 100 feet on small, medium, and large fish-bearing streams, respectively. The rules prohibit tree removal in the RMAs within 20 feet of fish-bearing streams, but harvest can occur within the outer reaches of the RMA as long as the minimum leave tree and basal area requirements are met. Typically, for operational ease, forest managers designate trees closest to the stream for the leave tree and basal area requirements. This effectively makes a no-cut buffer of 20 feet, with harvest occurring in the outer zone of the RMA width. There are no tree retention requirements for non-fish-bearing streams, although often foresters will retain their wildlife trees along intermittent streams.

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 and salmon habitat, (EPA and NOAA 2015; Everest and Reeves 2007; ODF 2005; IMST 1999). On July 28, 2015, EPA and NMFS found the State's forestry management program was insufficient for approval under the coastal nonpoint program of the Coastal Zone Act Reauthorization Amendments (CZARA). In this letter, NOAA and EPA "found there were several gaps in Oregon's program related to forestry… Closing the gaps in forestry is a critical step to achieve a fully approvable coastal nonpoint program under CZARA (NOAA OCM 2015)."

NMFS continues to have several concerns, including:

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) 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 Oregon Department of Environmental Quality's protecting cold water standard. The RMA widths also do not ensure full recruitment of woody material to streams (McDade 1990; Meleason et al. 2002), and in some cases likely are inadequate for sediment filtration (Rashin et al. 2006).

2. The 2014 Oregon Department Forestry rules lack requirements concerning road density and maintenance/ reconstruction of existing roads. 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." This concern about unstable old roads and railroad grades is still true under the current rules (ODF 2014). 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. There are no limitations on cumulative watershed effects, therefore road density on private forest lands is unlikely to decrease.

3. The rules are not adequate to ensure water quality standards are met during forest management activities on high-risk landslide areas (EPA and NOAA 2015). Under the rules, shallow, rapidly moving landslide hazards directly related to forest practices are addressed only as they relate to risks for loss of human life and property (ODF 2014). Harvest is allowed on high-risk landslide hazard areas as long as the Oregon Department of Forestry does not believe it poses a risk to public safety or property.

In November 2015, the Oregon Board of Forestry voted to change the Forest Practices Rules to increase streamside protections for small and medium-sized streams where coho and other salmon and steelhead are present. The change counters the effect of increasing stream temperatures following certain types of forest harvest. It will also result in increased natural recruitment of large wood to streams. The change increases RMA width by 10 feet and increases basal area retention requirements on these stream types. The Oregon Department of Forestry is currently developing final rule language based on the Board’s decision. Since the rulemaking process has not be completed, NMFS cannot reasonably predict the outcome. If the proposal is not significantly strengthened, NMFS will still be concerned that it doesn’t provide adequate protections especially for shade and wood recruitment parameters. Oregon Department of Forestry’s RipStream data (see Groom et al. 2011a; Groom et al. 2011b) found that no-cut buffers of 90 feet meet ODEQ’s protecting cold-water standard approximately 50 percent of the time (Board of Forestry 2015). Because the November 2015 proposed buffers are less than 90 feet and allow harvest within the RMA, the proposal is not likely to meet the water quality standard.

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. Approximately 100,000 acres of these lands are ‘Common School Trust Lands’ with the goal to maximize revenue to the Common School Fund over the long term, consistent with sound techniques of land management. The majority of these lands are managed under the Elliott Forest Management Plan (ODSL and ODF 2011) and the remaining state forests are managed under the Northwest Oregon State Forests Management Plan (ODF 2010). Both of these management plans provide higher levels of protection than on private forestlands. Furthermore, the state of Oregon has completed watershed assessments and physical habitat surveys and implemented significant stream and road restoration actions on the State forestlands. The management plans for state forests also require retention of riparian management areas.

The state of Oregon is currently in the process of attempting to transfer ownership of the Elliott State Forest out of the Common School Fund. The final outcome of this process remains unclear, but the State Land Board is requiring that any proposal to buy the Elliott State Forest must include "conserving high quality watersheds by providing riparian management areas of 120 feet or more on both sides of all stream segments containing salmon or steelhead." It is also unclear what actions could occur within the 120-foot RMAs or on non-fish-bearing streams, and whether the Elliott State Forest Management Plan and the Northwest Oregon State Forests Management Plan will continue to provide Oregon Coast coho salmon habitat that is capable of supporting populations sustainable during both good and poor marine conditions.

Consequently, while the management plans for state forests are more restrictive than those for private forestlands, NMFS continues to be concerned over whether protective measures on state forestlands are, and will continue to be, sufficient to conserve Oregon Coast coho salmon and their habitat for the long term. We are particularly concerned about the strength of the streamside management measures to provide stream shade, woody debris recruitment (a key element in stream complexity), and other aspects of stream habitat complexity.

Northwest Forest Plan

Since 1994, land management on U.S. 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 forestlands 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 the BLM's Resource Management Plan for Western Oregon provides relatively protective, activity- specific management standards (USDA and USDI 1994; NMFS 2016a). We consider the Northwest Forest Plan and BLM's RMP, 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).

The BLM completed a revision to their resource management plans for BLM districts within western Oregon by signing their Records of Decision on August 5, 2016. These new resource management plans replace the Northwest Forest Plan. BLM consulted with NMFS for this revised Resource Management Plan for Western Oregon with a biological opinion dated July 15, 2016 (NMFS 2016a). The revised resource management plans have sub-watershed classification protections for riparian zones. The U.S. 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 and rural development activities

Across all populations of Oregon Coast coho salmon, rural development and land use activities (residential, agricultural, etc.) occupy lands adjacent to Oregon Coast coho salmon habitat (Burnett et al. 2007). Much of this development is in habitat considered to have had the largest amount of rearing habitat for Oregon Coast coho salmon, related to assessments of high intrinsic potential (floodplain areas, low gradient stream reaches with historically high habitat complexity) but has been degraded by past management activities (Burnett et al. 2007).

The regulatory mechanisms that provide a 'regulatory backstop' to voluntary efforts include:

- Oregon's land use program and management practices, including the Oregon Coastal Management Program and coordinated efforts with the Federal Emergency Management Agency (FEMA) to implement the National Flood Insurance Program in ways that maintain natural floodplain functions; and

- state and federal programs intended to achieve water quality standards. These include the Oregon Administrative Rules associated with the Agricultural Water Quality Management Program (implemented though locally adopted rules), state pesticide programs, noxious weed control programs, the state nonpoint source program, the federal pesticide labeling program, and irrigation and water availability regulations.

NMFS has concerns, however, that existing regulatory mechanisms may not be adequate to achieve water quality criteria that are related to coho salmon conservation. For example, we are concerned that the existing regulatory mechanisms have yet to demonstrate significant progress in meeting water quality standards. Regarding restoration of past habitat losses, there is no requirement or robust program to restore habitat degraded by ‘legacy actions’ which account for a considerable amount of loss and degradation of Oregon Coast coho salmon habitat in rural areas. Regarding ongoing agricultural actions, continuing and newly initiated regulatory mechanisms and voluntary actions have potential, but it is not yet clear that such actions are effective at achieving the goals of Agriculture Water Quality Management Area plans.

The water quality management program is ‘outcome based’ related to achieving water quality standards, not prescriptive or practice-based, and at this point does not have an effective means to measure progress towards meeting state water temperature standards. For riparian conditions related to water quality, this will continue to make the requirements of this program difficult to enforce. Under existing regulations, riparian areas, levees and dikes devoid of riparian vegetation due to agricultural activities are subject to regulation by the state but past riparian loss is not.

Regarding future water quantity, water withdrawals to meet demands for irrigation and population growth continue to reduce instream flows and affect aquatic species in some stream systems, including in the Umpqua River stratum. A water leasing program is available through contracts with the Oregon Water Resources Department and there is some uncertainty about how this program will assure adequate instream flow for Oregon coast coho salmon. The available information leads us to conclude that it will take significant increases in funding and other resources to ensure that water quality criteria are met and coho salmon habitat is restored to a significant extent.

Regulatory mechanisms for instream activities

Federal Clean Water Act Fill and Removal Permitting

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) and state removal fill permitting 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 (see Table 3-2). It is unlikely that programs carried out under the Clean Water Act alone are sufficient to protect coho salmon habitat in a condition that would provide for sustainable populations during good and poor marine conditions.

A recent development that could improve water quality is an effort by the Oregon Department of State Lands to develop a streamlined 'General Authorization' under the Removal-Fill Law that will allow installation of beaver dam analogues. Once final, beaver dam analogues meeting conditions of the rule would be a pre-authorized use, not requiring individual permits. This will encourage the use of beaver dam analogues and beaver for waterway restoration projects benefiting coho salmon (Oregon 2016).

Gravel Mining

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.

Gravel mining has occurred in various areas throughout the freshwater range of Oregon Coast coho salmon, but is currently only in the Nehalem, Trask, Kilchis, 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. Although gravel mining activities using similar methods occur throughout Oregon, application of Corps of Engineers jurisdiction has been inconsistent with gravel mining permits required on some rivers (Umpqua River) but not on others (Tillamook area rivers). At the state level, gravel mining requires a permit from Oregon Department of State Lands under the Removal-Fill Law (ORS 196.795-990). Application of the state's jurisdiction and permitting process has been more consistent throughout the domain. Under this regulatory environment, gravel mining has ceased in some areas (South Fork Coquille and Umpqua Rivers), but it remains a concern in the Tillamook area rivers.

In 1992, after ODFW expressed concerns about negative impacts on chum salmon habitat, the state of Oregon negotiated a mediated gravel agreement for Tillamook County gravel mining. Originally, the agreement included cessation of all mining after 1997. In 1999, the agreement was amended to allow mining at three sites in the Wilson, Kilchis, and Trask Rivers. This agreement was amended again in 2009 to allow mining at nine sites in the Wilson, Kilchis, Trask, Miami, and Nehalem Rivers. The volume of gravel harvested from these rivers currently is greatly reduced compared to historical levels. However, site visits by NMFS in 2015 found the mining sites on the Wilson, Kilchis, and Trask Rivers all suffer from incision, bank erosion, and flat cross-section topographies. These are all signs that gravel removal is occurring in excess and degrading stream morphology (NMFS 2005b, Federal Interagency Working Group 2006). NMFS is concerned by the current condition of the Wilson, Kilchis, and Trask River sites, the lack of implementing site-level best management practices (see bar form retention in Federal Interagency Working Group 2006) at these sites, and the increasing number of sites permitted by the state since the 1992 cessation.

Regulatory mechanisms for floodplain development

Development in floodplains can disconnect this important area from river channels and destroy natural riparian and wetland vegetation. Altering the natural processes that allow habitat to form and recover from disturbances, such as floods, can affect multiple stages of the salmon life cycle and impede their survival and long-term recovery. In Chapter 6, we include recommendations on to modify statutes, regulations, or codes to avoid floodplain development in areas where floodplain function is most critical for salmon.

The Federal Emergency Management Agency (FEMA) consulted with NMFS under Section 7 of the ESA to determine whether implementation of its National Flood Insurance Program (NFIP) in Oregon impacts the survival of listed species including Oregon Coast coho salmon, which depend on healthy, functioning floodplain habitat (NMFS 2016b). Through the consultation process, NMFS determined that the NFIP in Oregon reduces the quantity and quality of floodplain and in-channel habitat, which will jeopardize the continued existence of 17 marine and anadromous species (including Oregon Coast coho salmon) and also adversely modify critical habitat. NMFS provided a reasonable and prudent alternative (RPA) to ensure FEMA's implementation of the NFIP avoids harming these species.

Regulatory mechanisms affecting beaver pond availability

In Oregon Coast streams, beaver dams create valuable summer and winter habitat for coho salmon (Leidholt-Bruner et al. 1992; ODFW 2005c). Much of this habitat has been lost post-European settlement to forestry and agricultural practices (ODFW 2005c). Lack of the type of habitat provided by beaver ponds has been identified as limiting the production of Oregon Coast coho salmon repeatedly (Nickelson et al. 1992; ODFW 2005c; ODFW 2007; Stout et al. 2012). Restoring beaver and beaver dams has proven effective at increasing juvenile coho salmon populations (Kemp et al. 2012) including on the Oregon Coast (Pollock et al. 2015).

On private land in Oregon, beaver are classified as a predatory species (ORS 610.002); landowners may lethally remove beaver without a permit from ODFW or requirement to report. On public land, beaver are classified as a protected furbearer (ORS 496.004 and OAR 635-050-0050). ODFW requires a permit to take protected furbearers. For beaver, this permit includes a designated trapping season, but does not limit the numbers of beaver taken. ODFW requires a permit to hold and relocate beaver (ORS 497.308) and has published beaver relocation guidelines. An Oregon Department of State Lands permit for beaver dam removal recently became required under their 'large woody debris' definition to remove any volume within essential salmonid habitat or more than 50 cubic yards outside of essential salmonid habitat (OAR 141-085).

The Oregon Department of State Lands is currently engaged in a rulemaking process to develop a streamlined 'General Authorization' under the Removal-Fill Law allowing installation of beaver dam analogues. Once final, beaver dam analogues meeting conditions of the rule would be a pre-authorized use, not requiring individual permits. This will encourage the use of beaver dam analogues and beaver for waterway restoration projects benefiting coho salmon. The rulemaking is anticipated to be complete in December 2016.

The mission of the USDA Animal and Plant Health Inspection Service (APHIS) Wildlife Services is to provide federal leadership and expertise to resolve wildlife conflicts to allow people and wildlife to coexist. Wildlife Services is not a regulatory agency and, therefore, works within the regulatory bounds of Oregon State law. For the five-year period of 2008-2012, Wildlife Services trapped over 2,800 beaver throughout Oregon, killing all but 10 of them. The number of beaver killed within the Oregon Coast domain is not available, nor do we have more recent numbers at this time.

Are Existing Regulatory Mechanisms Adequate?

In summary, positive changes in the regulation and management of fisheries and hatchery production have manifested increases in Oregon Coast coho salmon abundance. 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."

We are concerned with current regulations protecting habitat is some cases. For example, there is continuing concern that "current forest practices could also be causing or contributing to degradation of water quality (Oregon 2015)." In addition, there is a proposal for the state to transfer ownership of the Elliott State Forest to another entity, which could result in a change in the applicable regulatory mechanisms and 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.

Regarding spawning and rearing habitat (including estuaries), however, the state of Oregon and numerous stakeholders prefer reliance on voluntary actions, not regulatory mechanisms, to protect the environment and achieve coho salmon recovery goals. These volunteer efforts are vital to habitat restoration efforts, but may not be enough to achieve long-term coho salmon recovery without additional regulatory protection. The question NMFS must consider, therefore, is if the combination of voluntary measures and regulatory mechanisms is adequate to ensure the long-term health of Oregon Coast coho salmon habitat.

While NMFS is encouraged by the multiple voluntary and regulatory revisions by state, federal, and non-governmental organizations, as our 2016 5-Year Review (NMFS 2016c) states "at this time we do not have information that would reveal improvements in (ESU-wide) habitat quality, quantity, and function." Consequently, we remain concerned about the adequacy of existing voluntary and regulatory mechanisms to stop habitat conditions from further decline in the future. We recognize the challenges associated with monitoring habitat conditions and will continue to work with partners to obtain the best information available and assess it in the context of the other listing factors.

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

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

Threat: Changes in ocean conditions

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

Threat: Climate change

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

Threat*:* Major Cascadian Subduction Zone Earthquake

Primary related limiting factors: A major earthquake could quickly degrade freshwater and estuarine habitats along the Oregon coast, thus affecting coho salmon abundance, productivity, and spatial structure.

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 (Stout et al. 2012) and NWFSC (2015) found that hatchery practices that were detrimental to the long-term viability of this ESU have been eliminated. Changes in ODFW hatchery management, including the most recent termination of coho salmon releases from hatcheries in the Salmon North Umpqua River, 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 salmon has been reduced to very low levels for the individual strata and the ESU as a whole.

The hatchery programs that remain are managed to limit the proportion of hatchery fish on natural spawning grounds. ODFW hatchery programs are managed consistent with the state's Native Fish Conservation Policy (OAR 635.007.0502 -- 0509) and the Fish Hatchery Management Policy (OAR 635.007.0542 -- 0548). ODFW also coordinates with NMFS for approval of all hatcheries programs that may affect Oregon Coast coho salmon through the submission of federal Hatchery Genetic Management Plans. Given program changes and management oversight, hatchery fish do not currently limit, and are not expected to limit, Oregon Coast coho salmon natural production.

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

Changes in ocean conditions

Ocean conditions in the Pacific Northwest have exhibited patterns of recurring, decadal-scale variability (including the Pacific Decadal Oscillation and the El Ninõ Southern Oscillation), and correlations exist between these oceanic changes and salmon abundance in the Pacific Northwest (Burke et al. 2013; Mantua et al. 1997; Rupp et al. 2012; Malick et al. 2015; Stout et al. 2012). The marine survival of Oregon Coast coho salmon has been quite variable depending on whether marine conditions were good or poor.

Today, with harvest less of a constraint than in the past, marine survival is the principle driver of interannual and interdecadal variation in Oregon Coast coho salmon abundance (NWFSC 2015). 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 recent years, good ocean productivity and survival rates have contributed to the rebound of the Oregon Coast coho salmon ESU.

Concerns remain regarding 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 (Stout et al. 2012; NWFSC 2015; NMFS 2016c). 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 discussed in the following section, the effects of climate change will likely pose additional concerns for the productivity of marine habitats (Weitkamp 2016). The International Panel on Climate Change (IPCC) recently determined that by the end of the century global sea level is expected to rise by 0.3 m (low emissions) to 0.9 m (high emissions) and the oceans are expected to become more acidic (IPCC 2014). These and other effects of climate change (e.g., increased temperature, hypoxia, and acidification) will have direct impacts on the food webs that salmon rely on in marine habitats to grow and survive.

Effects of climate change

The potential effects of global climate change have emerged as a critical concern for this species. Climate change continues to actively alter environments around the globe as temperature and precipitation patterns change and become more variable. The year 2015 broke numerous global records, including highest greenhouse gas concentration, highest land and sea surface temperatures, highest upper ocean heat content and sea level, and smallest maximum ice extent in the Arctic (Bluden and Arndt 2016). The year 2016 is on track to surpass global temperature records set in 2015; global temperatures recorded between January and June 2016 (1.05 °C above the 20th century average) are 0.85 °C above those set in 2015 (0.20 °C above the 20th century average). (NOAA website: www.ncdc.noaa.gov/sotc/global/2016/6/supplemental/page-2).

Likely changes across the Pacific Northwest in temperature, precipitation, wind patterns, ocean acidification, and sea-level height due to climate change could affect survival and productivity of Oregon Coast coho salmon in their freshwater, estuarine, and marine habitats. Recent descriptions on expected impacts to Pacific salmon and their ecosystems include Mote et al. 2003, Crozier et al. 2008, Martins et al. 2012, Beechie et al. 2012, Wainwright and Weitkamp 2013, and Weitkamp 2016.

This section summarizes the findings from a recent climate change study by Weitkamp (2016). The full report by Weitkamp and other information are available on the NMFS website: www.westcoast.fisheries.noaa.gov.

The Oregon Coast coho salmon life cycle relies on three main habitat types for growth and survival —freshwater rivers and lakes, estuaries, and marine environments—making them particularly vulnerable to environmental variation (Morrison et al. 2016). While all habitats used by coho salmon will be affected by climate change, the impacts and certainty of the change vary by the habitat type. Some effects (e.g., increasing temperature) affect salmon at all life stages, while others are habitat specific, such as flow variation in freshwater, sea-level rise in estuaries, and upwelling in the ocean. 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).

Throughout the life cycle of Oregon Coast coho salmon, there are a numerous potential effects of climate change (Figure 3-7) (Stout et al. 2012; Wainwright and Weitkamp 2013; Weitkamp 2016). The main predicted effects in terrestrial and freshwater habitats include warmer, drier summers, and reduced snowpack (only the Umpqua is snow driven for Oregon Coast coho salmon). Since most streams occupied by Oregon Coast coho salmon are much less reliant on snowpack for water delivery than elsewhere in the Pacific Northwest (Wainwright and Weitkamp 2013; Scalzitti and Kochanski 2016), expected increases in maximum stream temperatures and decreases in minimum flows are expected to be modest compared to in other snow-driven basins in the Northwest (Beechie et al. 2012; Dalton et al. 2013). However, more intense precipitation during storms is also predicted (IPCC 2014), which could increase high flow events and be detrimental for salmon habitats (Crozier et al. 2008). For example, Ward et al. (2015) documented increasing variation in flow for Puget Sound rivers over the last 60 years and determined it had the most negative effect on Chinook salmon survival of any climate signal considered (Weitkamp 2016).

The impacts of climate change on the productivity of Oregon Coast coho salmon populations will vary by watershed condition and habitat type. In freshwater habitats, lower summer flows, higher summer stream temperatures, and increased winter floods, 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. Increasing temperatures will have physiological effects on salmon, with increased stress to neuroendocrine, cardiorespiratory, immune, osmoregulatory, and reproductive systems, potentially reducing survival and reproductive success (Whitney et al. 2016). In addition, changes in stream temperature regimes will likely lead to shifts in the distributions of native species and provide ‘invasion opportunities’ for exotic species, resulting in increased predator-prey interactions for juvenile coho salmon.

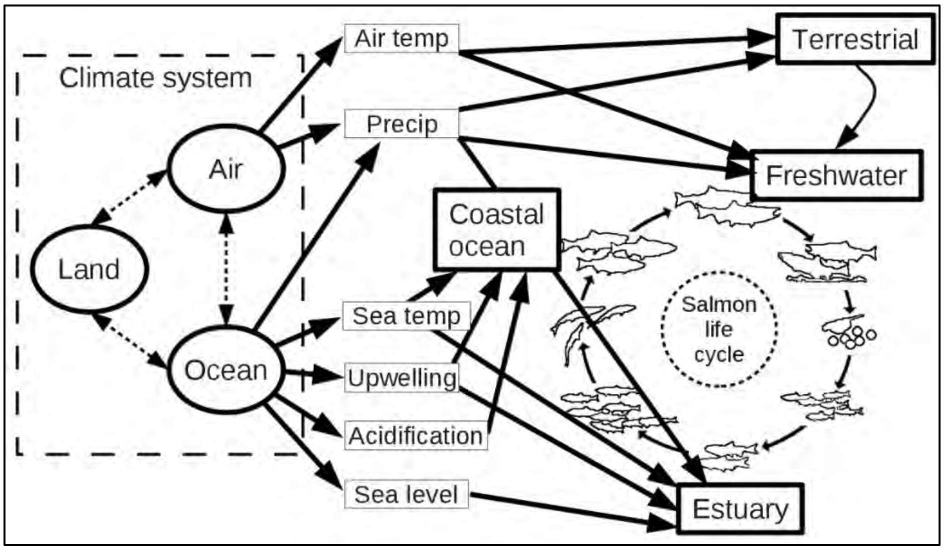

Figure 3-7. The BRT’s conceptual diagram showing pathways by which climate influences the salmon life cycle (Stout et al. 2012).

In estuarine habitats, the main physical effects are predicted to be rising sea level and increasing water temperatures. As sea levels rise, terrestrial habitats will be flooded and tidal wetlands will be submerged (Kirwan et al. 2010). For Oregon coast estuaries, the widespread presence of dikes would restrict estuary expansion, likely resulting in a near-term loss of wetland habitats for coho salmon (Wainwright and Weitkamp 2013). Sea-level rise will also result in greater intrusion of marine water into estuaries, resulting in an overall increase in salinity, which will also contribute to changes in estuarine floral and faunal communities (Kennedy 1990). In addition to reducing intertidal wetland habitats, these changes could increase thermal stress, increase predation risk, and result in unpredictable changes in biological community composition, thus influencing coho salmon growth and survival. For example, increased temperature upstream of or in estuaries may provide behavioral cues that cause young salmon to enter marine waters earlier than normal, resulting in a mismatch between the timing of ocean entry and the timing of seasonal productivity of marine food webs (Weitkamp et al. 2014). Similarly, early strong freshets may flush juvenile salmon to estuary or ocean environments before they are physiologically ready, which might increase predation risks (Limburg et al. 2016).

In marine habitats, the temperature of marine waters is increasing globally at a rate of 0.06 °C/decade (NOAA website, http://www.ncdc.noaa.gov/cag/). The timing of peak abundances of many larval fishes in the California Current, including those commonly consumed by juvenile coho and other salmon (Daly et al. 2009), are becoming earlier as surface temperatures increase (Asch 2015). These rising ocean temperatures are predicted to cause a poleward shift in fish distributions at a rate of 30 kilometers/decade and to deeper waters at 3.5 m/decade (Cheung et al. 2014). Oregon Coast coho salmon rely on conditions in the California Current marine ecosystem for growth and survival. This ecosystem, like other eastern boundary currents, is dependent on wind-driven upwelling for its extremely high productivity (Bakun 1990; Checkley and Barth 2009; Chavez and Messié 2009). Minor changes to the timing, intensity, or duration of upwelling can have huge effects on the productivity of the ecosystem (Black et al. 2014; Peterson et al. 2014), and, thus, the productivity of Oregon Coast coho salmon. There are a number of physical changes in marine habitats 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.

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 exists about the magnitude that most of the specific effects of climate change will have on the coho salmon habitat, NMFS and the NWFSC (2015) remain concerned that most changes associated with climate change could result in poorer and more variable habitat conditions for Oregon Coast coho salmon in freshwater, estuarine, and marine environments (Table 3-5). Given this uncertainty, NMFS and the NWFSC stress that it is critical that the species is resilient enough to survive catastrophic changes in the environment, including events such as climate change and decreases in ocean productivity (NWFSC 2015).

Table 3-5. 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.

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

This chapter describes the recovery goals and delisting criteria for Oregon Coast coho salmon. In the simplest terms, NMFS will remove the Oregon Coast coho salmon from federal protection under the ESA when we determine that:

- The species has achieved a biological status consistent with recovery—the best available information indicates it has sufficient abundance, population growth rate, population spatial structure, and diversity to indicate it has met the biological recovery goals (see Section 4.2).
- Factors that led to ESA listing (described in Chapter 3) have been reduced or eliminated to the point where federal protection under the ESA is no longer needed, and there is reasonable certainty that the relevant regulatory mechanisms are adequate to protect Oregon Coast coho salmon sustainability.

Section 4.1 describes the statutory requirements for recovery and removing Oregon Coast coho salmon from the list of threatened and endangered species; Section 4.2 describes the biological recovery criteria for Oregon Coast coho salmon based on the work of the ONCC TRT; Section 4.3 describes goals and criteria for each of the five listing factors; and Section 4.4 describes how we intend to make a listing determination considering the biological status and five listing factors. Section 4.4 also introduces a delisting framework to assess progress towards recovery.

In accordance with our responsibilities under section 4(c)(2) of the ESA, NMFS will conduct reviews of Oregon Coast coho salmon ESU status at least once every five years to evaluate the status of the ESU and gauge progress toward recovery.

4.1 Endangered Species Act Requirements

Under the ESA, 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.[19] 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 based on a review of the five listing factors in ESA section 4(a). The recovery criteria inform the determination in ESA section 4(c) to reclassify or remove a species from the list.

[19] 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.

This section of the Plan presents a set of ‘objective, measureable criteria’ for Oregon Coast coho salmon, that we consider practicable, as called for in the ESA, that include the most accurate, practicable and up-to-date information available. These criteria are at the ESU and stratum scales, since it is, at this time, not practicable to create scientifically based goals, strategies and actions at the population scale, given the data gaps and scientific uncertainties that remain.

The purposes of the ESA include providing a means to conserve the ecosystems on which endangered species and threatened species depend. While NMFS’ ESA goal is to achieve recovery and the delisting criteria, we suggest that aiming for Oregon’s ‘broad sense recovery goals’ is the best way to ensure that we meet and surpass ESA requirements for recovery and delisting. Broad sense recovery recognizes the social and economic value of the ESU, and the potential for wild fish to once again support robust commercial and recreational fisheries that fuel economic development on the Oregon coast. In addition, broad sense recovery recognizes the essential role of salmon as a keystone species that delivers vital marine-derived nutrients into our coastal watersheds. Salmon are a lynchpin to the ecological, economic, and cultural health of the coast—when we restore our salmon runs and habitats, we also improve the health of our rivers, lands, communities, and economies. Aiming for more than simply returning the Oregon Coast coho salmon ESU to viability is consistent with the 2014-2018 Strategies Goals and Objectives of the U.S. Department of Commerce (U.S. Department of Commerce 2014).

NMFS applies two kinds of ESA recovery, or delisting, criteria. The first, biological recovery criteria, examines the biological health (viability, or sustainability and persistence) of the species (§4.2). The second is based on ESA section 4(a)(1) and describes the status of the five listing factors and the human activities (threats) that contributed to the decline in the status of the species. The five listing factors are discussed in Chapter 3 and constitute a major part of the framework for evaluating the status of the species. The listing factor 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 listing factor 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.

When making a listing determination, NMFS considers the status of the species (viability assessment), the five ESA listing factors, limiting factors and threats, and actions that have been taken to help recovery the species. Figure 4-1 shows the recovery actions and research, monitoring, and evaluation (on the left) inform the analyses and assessments. The analysis of the five listing factors is shown across the top. The viability assessments of the populations are shown to be aggregated to the stratum level and the strata are aggregated to the species level. Finally, the scroll on the right shows that we will consider both the listing factor analysis and species viability assessment when we make a decision to list or delist a species.

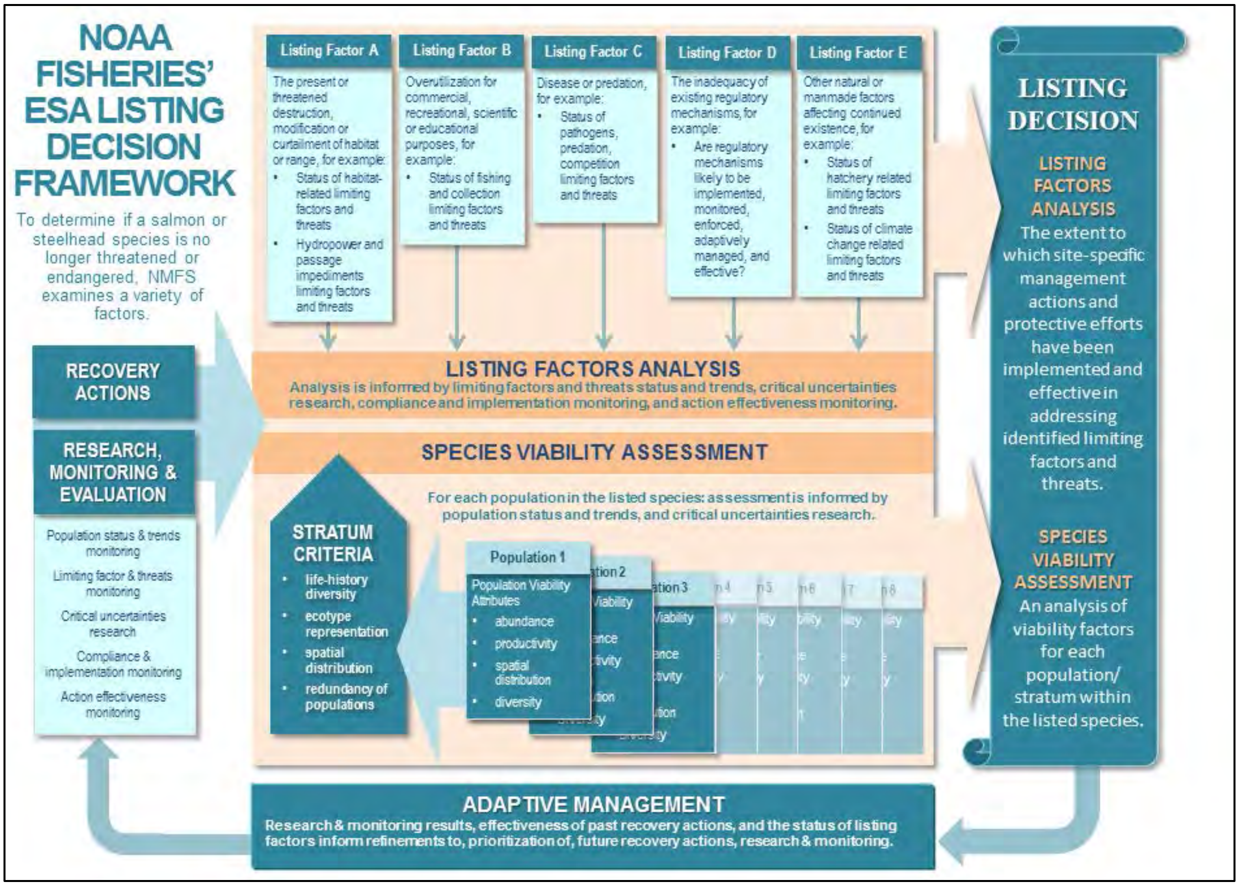

Figure 4-1. Components of a listing determination.

Text Box 4-1 contrasts the listing status of bald eagles and Oregon Coast coho salmon as an example of the importance of examining the five listing factors in making a delisting determination in addition to the biological status of a species.

Text Box 4-1
Comparing Bald Eagles and Oregon Coast Coho Salmon:
The Importance of Regulatory Protections in ESA Listing Determinations.

Similar to Oregon Coast coho salmon, bald eagles in the lower 48 U.S. states were once abundant, but human activities led to drastic declines in their numbers. 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 Oregon Coast coho salmon as threatened.

Why are Oregon Coast 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 Oregon Coast 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. A combination of voluntary efforts and regulatory protections for Oregon Coast coho salmon are needed to reduce or eliminate remaining threats and support the sustainability and persistence of the Oregon Coast coho salmon ESU, before and after delisting.

4.2 Biological Recovery Criteria

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

Viability is a key concept within the context of the Endangered Species Act. A Viable Salmonid Population is an independent population of any Pacific salmon or steelhead that has a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic changes over a 100-year time frame (McElhany et al. 2000). NMFS introduced four attributes to evaluate the viability[20] of a salmon population in its technical memorandum "Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units" (McElhany et al. 2000). These four attributes—abundance, population growth rate, population spatial structure, and diversity—make up the viable salmonid population (VSP) parameters, which NMFS scientists use to measure biological status as part of salmon recovery.

The VSP parameters form the basis for our evaluations of individual salmon populations, which taken together comprise species under the ESA. The parameters are closely associated, such that improvements in one parameter typically cause, or are related to, improvements in another parameter. For example, improvements in population growth rate might depend on increased diversity or habitat quality, and be accompanied by increased abundance and spatial structure. We describe these parameters below. Section 4.2.2 describes how the ONCC TRT applied them to define biological criteria for evaluating the status of Oregon Coast coho salmon populations and measuring progress towards ESU recovery (Wainwright et al. 2008).

[20] See the definitions of viable, sustainable, and persistent populations in the glossary.

Abundance

Abundance refers to the number of adult fish returning to spawn, as measured over a specific number of years. Abundance is recognized as an important measure because, small populations are at greater risk of extinction than large populations. This is primarily because several processes that affect population health operate differently in small populations than they do in large populations. The ONCC TRT described[21] two abundance levels that NMFS thinks are particularly important: 'viable' (meaning having a negligible risk of extinction over a 100 year time frame) 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 (i.e. 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. 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. 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.

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. Spatial structure is important 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 processes 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.

[21] Wainwright et al. 2008

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

4.2.2 Biological Recovery Criteria for Oregon Coast Coho Salmon

In developing its technical memorandum "Biological Recovery Criteria for the Oregon Coast Coho Salmon Evolutionarily Significant Unit" (Wainwright et al. 2008), the ONCC TRT used 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 framework described in Section 4.2.1 was intentionally general, and NMFS expected each technical recovery team (as described in Chapter 1) to 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 Northwest Regional Office, the ONCC TRT[22] developed and published a means to evaluate the current and future biological status of the Oregon Coast coho salmon ESU and to assess progress towards meeting the biological recovery based on the general framework described in Section 4.2.1 (Wainwright et al, 2008).

The ONCC TRT's approach focuses first on the biological status of Oregon Coast coho salmon at the population level, primarily the 21 independent populations. The combined status of the populations is then used to determine the status of the Oregon Coast coho salmon ESU as a whole. Among other information, the ONCC 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 ONCC 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 ONCC TRT created 'objective and measurable' criteria that could be applied to each population to determine its status. The ONCC TRT also developed a way to 'roll up' the scores for each population into scores for the whole ESU. Because populations from rivers that are close together tend to be similar, the ONCC TRT identified five groupings of similar populations, termed 'strata.' These strata represent the genetic and geographic similarities among populations such that preservation of sustainable populations within each stratum will conserve major genetic diversity within the ESU, and spread risks of losing genetic and geographic diversity due to

[22] Specifically, the Oregon Coast Workgroup of the Oregon and Northern California Coasts Technical Recovery Team (ONCC TRT).

catastrophes (Wainwright et al. 2008). The ONCC 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 Oregon Coast coho salmon ESU.

The ONCC TRT developed two principle elements within the biological criteria that describe a sustainable stratum and ESU:

- Most (more than half) of the independent populations in a stratum would have to be considered sustainable (see the glossary for a definition) for the stratum to be considered sustainable.
- All five strata should be sustainable for the whole ESU to be considered sustainable.

In addition to these population-based criteria, the ONCC TRT considered risks to viability that operate at the 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 are 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. Instead, the ONCC 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 ESU persistence and sustainability value (the ESU sustainability score) for Oregon Coast coho salmon.

Decision Support System for Oregon Coast Coho Salmon

The ONCC TRT developed a knowledge-based Decision Support System (DSS) for the Oregon Coast coho salmon ESU (Wainwright et al. 2008). The DSS was designed to evaluate the biological sustainability of the entire ESU, where ‘biological sustainability’ implies that “a population is able to survive prolonged periods of adverse environmental conditions, while maintaining its genetic legacy and long-term adaptive potential” (Wainwright et al. 2014). The DSS consists of a suite of biological recovery criteria that contribute to ESU sustainability. The biological recovery criteria evaluate two general conditions that imply different levels of risk:

- Persistence. The persistence analysis evaluates the ability of the ESU to persist over a 100-year period without artificial support, including the ability to survive prolonged periods of adverse environmental conditions. It is based on population productivity, probability of persistence, and abundance relative to critically low thresholds (Stout et al. 2012).
- Sustainability. The sustainability analysis evaluates the ability of the ESU to maintain its genetic legacy and long-term adaptive potential for the foreseeable future. The ONCC TRT explained that sustainability 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. Criteria used to evaluate population sustainability are objective measures of spawner abundance, artificial influence, spawner and juvenile distribution, and habitat capacity. They also include ESU-level measures of genetic diversity, phenotypic and habitat diversity, and small populations (NWFSC 2015).

The ONCC TRT integrated the concept of uncertainty into the DSS (see Wainwright et al. 2008 for a full explanation). For example, if more than half the populations in every stratum meet the criteria that would suggest 'certainty' that the biological recovery criteria are met.

The 2008 ONCC TRT document provides a detailed discussion that includes 29 separate biological criteria as components of the Decision Support System. In brief, these criteria look at watershed- and population-level spawner and juvenile occupancy and distributions, population-specific productivity, probability of persistence (from population viability models), spawner abundance, artificial influence, and ESU-wide genetic and phenotypic diversity (Wainwright et al. 2008). NMFS considers this ONCC TRT report describing the DSS, and the NOAA Fisheries BRT and NWFSC status updates, as the 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 ONCC TRT and BRT documents provide full technical discussions on the biological recovery criteria and DSS approach (Wainwright et al. 2008; Stout et al. 2012; NWFSC 2015; NMFS 2016c). Currently, ongoing maintenance and implementation of the DSS is done by ODFW staff. NMFS may update details of the biological recovery criteria over time as new information becomes available; however, a formal revision to the recovery plan will be required if substantial changes are warranted.

Under the DSS approach, the information collected for the biological criteria is used to evaluate six measures of biological status for Oregon Coast coho salmon viability that form the basis of our assessment of population, stratum, and ESU health. The six measures are:

1. Spawner abundance,
2. Spawner distribution,
3. Juvenile distribution,
4. Critical abundance,
5. Population productivity, and
6. Artificial influence.

The results of the assessment of these six measures are then used to develop a series of 'scores,' expressed in terms of certainty, that indicate how well the populations, strata, and ESU are doing (their biological status) for the abundance, productivity, spatial structure, and diversity attributes. The biological recovery criteria used to evaluate the status of Oregon Coast coho salmon are summarized below.

Biological Recovery Criterion for Oregon Coast Coho Salmon and Most Recent Status Update

The biological recovery criterion for Oregon Coast coho salmon is that there is at least a moderate certainty that the Oregon Coast coho salmon ESU is sustainable. As discussed previously, the biological status of the ESU must meet two criteria: (1) most (more than half) of the independent populations have to be sustainable in each stratum, and (2) all five strata have to be sustainable for the Oregon Coast coho salmon ESU to be considered sustainable (NWFSC 2015). In future listing decisions, NMFS will determine if this criterion has been met using the best available scientific information, including the biological recovery criteria described earlier in this section. This information is used to assess the following six key indicators using the Decision Support System to determine population, stratum, and ESU health and sustainability.

The questions presented below for each indicator help explain what the DSS analyzes:

1. Spawner abundance — *Are there enough coho salmon in this population/stratum/ESU to maintain genetic diversity?*
2. Spawner distribution — *How much of the spawning habitat*[23] *is actually used by the coho salmon in the population/stratum/ESU—on average, are there spawning coho salmon in most of the available spawning habitat?*
3. Juvenile distribution — *After coho salmon spawn, in what portion of the available habitat do we find their offspring in this watershed—are there juvenile coho salmon in most of the available rearing habitat?*
4. Critical abundance — *Are there enough salmon spawning in this population/stratum/ESU when the ocean survival has been low—*was *spawning density sufficient to avoid small population risks?*
5. Population productivity — *Do generations of salmon in this population produce enough offspring—is recruitment sustainable—when the ocean survival has been low?*
6. Artificial influence — *What is the proportion of hatchery produced fish spawning in this population—are the vast majority of naturally spawning coho salmon of natural (versus hatchery-origin coho salmon)?*

4.3 ESA Listing Factors Criteria

4.3.1 Background: The ESA Listing Factor Criteria

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

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; and
E. Other natural or human-made factors affecting the species' continued existence.

When NMFS makes determinations to list or delist a species, we evaluate the current status as well as the current and future threats for each of these listing factors. Threats, in the context of salmon recovery, are understood as the activities or processes that cause the biological and physical conditions that limit salmon survival (the limiting factors).

[23] We received a number of comments on the proposed Plan about the importance of assessing all spawning and rearing habitat, not just wadable streams. ODFW is currently working to develop habitat monitoring approaches for non-wadable streams.

The specific criteria listed below for each of the factors help to ensure that underlying causes of decline have been addressed and mitigated and the Oregon Coast coho salmon ESU is ready for delisting. As part of a future listing determination, NMFS will consider the implementation of the proposed actions described in the Plan and the extent to which each of the section 4(a)(1) listing factors has been addressed. To assist in this examination, NMFS will use criteria described below, in addition to the evaluation of biological recovery criteria and other relevant data to see if the underlying causes of decline have been addressed and mitigated and are not likely to re-emerge in the foreseeable future.

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 in Chapter 3, some threats perceived as significant effects on Oregon Coast coho salmon at the time of listing, such as harvest mortality and hatchery production, have since been addressed through management adjustments and now pose little danger to species viability. Other threats, such as the destruction or modification of habitat, continue to affect survival and productivity. In its recent 5-Year Review (NMFS 2016c), NMFS determined that Listing Factors A and D were the most important threats to Oregon Coast coho salmon. It also recognized that new threats, such as those posed by global climate change, are emerging. Considering potential climate change scenarios and expected continued development, NMFS is concerned that the cumulative effect of all threats will have a continuing impact on the status of the Oregon Coast coho salmon ESU and the habitat upon which it depends.

4.3.2 Criteria for Assessing the Listing Factors and ESU Status

This section describes goals and criteria for assessing each of the five listing factors. NMFS will consider these goals and criteria in determining whether the ESU has recovered to the point that it no longer requires the protections of the ESA.

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

Goal for Listing Factor A: Protect and restore the "physical or biological features that are essential for the conservation of the species"[24] 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 Chapter 3 describe, Oregon Coast coho salmon have suffered from widespread loss and degradation of freshwater habitat. Recognizing that the ESU rebounded from record low viability in the 1990s, NMFS will need to determine that the habitat condition is, and will likely continue to be, adequate to support a viable ESU before it can remove Oregon Coast coho salmon from the list of threatened species. Healthy habitat conditions will be particularly important given the recent ocean anomalies and the uncertainty of future ocean and freshwater conditions due to global climate change that could lead to periods of unprecedented 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

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

mid-1990s, and evidence of negative trends in some strata." The most recent assessment of the ESU (NWFSC 2015) indicates that this has not changed.

Figure 4-2 illustrates the relationships between ocean survival, freshwater habitat status, and ESU viability and recovery. The figure is adapted from a scientific journal article, written in 1993.[25] by Dr. Peter Lawson, then with ODFW and now with NOAA's NWFSC. Lawson's article provides an important message about the need to maintain healthy freshwater habitat conditions to safeguard Oregon Coast coho salmon long-term sustainability during periods of unfavorable ocean conditions. The need for this caution has not diminished in light of more recent scientific findings and information.

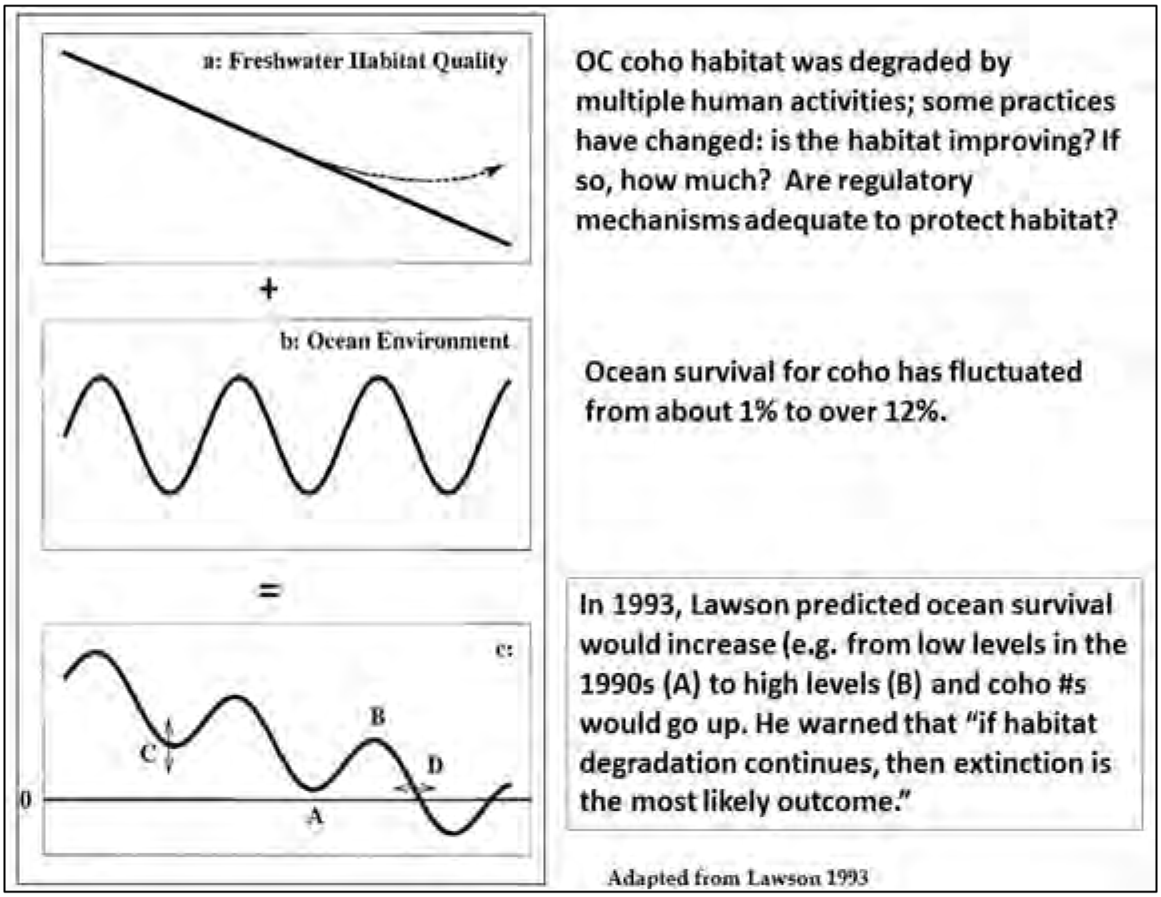

Figure 4-2. Relationship between ocean survival, freshwater habitat status, and Oregon Coast coho salmon ESU viability and recovery. Adapted From Lawson 1993.

NMFS recognizes the need to "balance the Plan's significant reliance on regulatory mechanisms with the flexibility to implement a combination of regulatory, programmatic, and voluntary approaches to achieve desired recovery outcomes…" (Oregon, 2015). The 2007 OCCCP explains "The state has determined that the best way to increase the quantity and quality of coho habitat throughout the ESU, and achieve desired status, is through the voluntary participation of landowners and local groups."

[25] Lawson 1993

NMFS supports an overarching recovery strategy that emphasizes certain, effective voluntary approaches to habitat protection and restoration and Oregon Coast coho salmon recovery. To be effective, these need to be consistent with the best available scientific (geomorphic) information relating to high quality coho salmon habitat and avoid projects that are not likely to be effective. NMFS also recognizes that recovered habitats need to be protected from future degradation. Consequently, both voluntary and regulatory approaches are needed to meet the criteria in Listing Factors A and D. For purposes of ESA recovery and delisting (in particular, compatibility with Listing Factor D), NMFS will assess the adequacy of the combination of voluntary measures and 'regulatory backstops' that are in place to ensure that the desired outcomes will be achieved, as described below.

Listing Factor A Criteria:
The criteria for Listing Factor A are that the past and present habitat loss and degradation have been addressed so as to not limit attainment of the desired status of the ESU, and that there is evidence that key watershed processes and habitat features (as described in Section 3.3.1) and water quality will be stable or improving.

Section 3.3.1 describes how natural processes created high quality rearing habitat for coho and how monitoring programs have shown that human activities have reduced the quantity and quality of that habitat. Chapter 9 includes recommendations to continue and expand the monitoring programs.

NMFS will consider the best available and measurable information to determine if the criteria for Listing Factor A has been met.

1. NMFS will assess the condition of Oregon Coast coho salmon habitat.

    a. <u>Results of habitat monitoring</u>

       NMFS will use the best available quantitative information about Oregon Coast coho salmon habitat condition, including limiting factors and trends, to determine progress toward ESU recovery. This will include information from ODFW, such as the Oregon Aquatic Inventories Project and other sources. NMFS will also support the development and application of information from emerging methods and technologies. For example, we are encouraged by the promising developments in the use of remote sensing and other approaches that could provide a cost-effective way to inventory key habitat features and track the net change of these features over time. Chapter 9 includes additional information about how NMFS places a very high priority on development and application of this capability in terms of assessing progress towards recovery of Oregon Coast coho salmon.

       Salmon rely on adequate quantities of cold water for their continued existence, and increasing stream complexity in coastal rivers would contribute to both Oregon Coast coho salmon habitat and to achieving Oregon's water quality standards under the Federal Clean Water Act. NMFS will work with EPA, ODEQ, ODFW, ODF, Oregon Department of Agriculture (ODA), and others to assess the effect of water conditions on salmon recovery, including progress towards assuring adequate water quality and quantity on the coast, with particular attention to protecting cold water.

NMFS recognizes that considerable work has been done and is ongoing by state, local, and federal agencies and the private sector towards meeting water quality goals. We also recognize that this work will evolve over time as new information is obtained and the entire effort is 'adaptively managed.' NMFS will consider the best available information about water quality and quantity conditions and related voluntary efforts and regulatory mechanisms, relying on the indicators (metrics) that can provide the most useful assessment.

NMFS could, for example, consider the following:

- Oregon Water Resources Department (and local jurisdiction) regulation of water extraction from surface and groundwater sources that may influence habitat quantity and quality.
- The Clean Water Act Section 303(d) listings of water bodies within the range of Oregon Coast coho salmon.
- Progress in moving waterbodies from category (waterbody is water quality limited and a TMDL is needed,) to 4a (TMDL issued but waterbody not yet attaining water quality standard(s)) to 2 (specific water quality standards are met).[26]
- Progress in meeting requirements of the Coastal Zone Act Reauthorization Amendments (CZARA).
- Progress towards meeting specific allocations or targets in TMDLs or other water pollution control plans (numeric if available) including those for effective shade, instream flow, channel morphology, cold-water refugia, and other relevant indicators that address impairments affecting aquatic life.
- The adequacy of state, county, and city land use and development regulations that protect coho salmon habitat, especially riparian areas and floodplain connectivity.

b. Information about the resilience of Oregon Coast coho salmon in response to low ocean survival

As one indication of the adequacy of freshwater and estuarine habitat, NMFS will consider available evidence relating to the resilience of the Oregon Coast coho salmon ESU. For example, we will carefully assess the scores for population productivity critical abundance within the DSS (Wainwright et al. 2008).

2. NMFS will evaluate evidence of the abatement of habitat-related threats.

[26] (category 3 is when there is insufficient data)

In Chapter 3, we described the threats that led to listing Oregon Coast coho salmon as threatened under the ESA. As stated above, the criteria for Listing Factor A include the reduction or removal of threats such that they do not limit attainment of the desired status of the ESU.

In future listing determinations, NMFS will examine available evidence that the combination of voluntary and regulatory measures has reduced or eliminated threats to the extent that there is adequate quantity and quality of key habitat features in key portions of the watersheds for independent populations.

Our analyses of the abatement of threats from voluntary and regulatory measures will be informed by the extent to which management actions and protective (conservation) efforts have been implemented and are effective. We expect to use the 'Policy for Evaluation of Conservation Efforts When Making Listing Decisions' (PECE) criteria as a tool in assessing the extent to which habitat-related limiting factors and threats have been reduced or eliminated. The PECE criteria will serve as a check list to examine (1) the certainty that the conservation efforts will be implemented and (2) the certainty that the efforts will be effective in achieving the criteria for Listing Factor A and the habitat portion of Listing Factor D.

Listing Factor B: Overutilization for commercial, recreational, scientific, 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). The NWFSC 2015 status review update also found that harvest rates on Oregon Coast coho salmon have remained low (below 20%) since 1993.

ODFW reported that for the 2015 return, the harvest rate on Oregon Coast coho salmon was 20 percent and the total number of native spawners was 57,106 (ODFW 2016). These statistics warrant a caution about the implementation of Amendment 13, since the harvest rate in 2015 was the highest rate since 1993 in a year when the total number of native spawners was the lowest since 1999. Chapters 6 and 9 offer recommendations relating to harvest management in the future.

Listing Factor B Criterion:
To meet the goal for Listing Factor B, harvest practices will need to ensure they are consistent with the recovery of Oregon Coast coho salmon, meaning the fishery impact rates in the future should not be higher than specified in the Amendment 13 harvest matrix (as updated).

Listing 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[27] and NMFS (Wainwright et al. 2008 and Stout et al. 2012) identified predation by birds, marine mammals, and non-native species of fish as concerns. In particular, warm-water fish species introduced to the lakes were identified as primary limiting factors for the Siltcoos, Tahkenitch, and Tenmile lake populations. NMFS recognizes that there is some disagreement among fisheries scientists as to the degree of risk posed to coho salmon populations by warm-water fish species.

Listing Factor C Criteria:
NMFS will 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):

- Predation by birds, non-native fish species, and marine mammals is managed in a way that allows for recovery of the Oregon Coast coho salmon ESU. NMFS recognizes the challenges associated with managing the predation of one federally protected species (Oregon Coast coho salmon) by other federally protected species (migratory birds and marine mammals).
- Disease and pathogens do not impede recovery of the Oregon Coast coho salmon ESU.

Listing Factor D: The inadequacy of existing regulatory mechanisms

Goal for Listing Factor D: Regulatory mechanisms have been established, maintained, and implemented in ways that supports the recovery of the Oregon Coast coho salmon ESU.

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

NMFS' general approach recognizes that the state of Oregon and many stakeholders find that including voluntary approaches to achieving ESA recovery is more cost-effective than relying on a regulatory approach. A combination of voluntary and regulatory approaches is key to achieving recovery goals. However, in order to address ESA Listing Factor D, NMFS needs assurance that voluntary programs are 'backed up' by regulatory mechanisms that ensure that the Oregon Coast coho salmon ESU is not threatened or endangered, nor will it become so, because of the present or threatened destruction, modification, or curtailment of its habitat or range. NMFS therefore accepts the concept of a 'regulatory backstop.' This means we support the goal of achieving recovery with a strong voluntary effort, but we will look for evidence that regulatory mechanisms are in place to protect Oregon Coast coho salmon now and in the future.

[27] OCCCP: Predation as a Limiting Factor, page 26

Goal for Factor D related to Listing Factor A (destruction of habitat): The goal is that voluntary programs will be effective in achieving goals, but regulatory mechanisms are in place that complement voluntary actions and contribute to protecting and restoring Oregon Coast coho salmon such that the ESU is not threatened or endangered, nor will it become so, because of the present or threatened destruction, modification, or curtailment of its habitat or range.

<u>Criteria</u>*:*
To meet the goal for Listing Factor D related to Listing Factor A, a combination of voluntary and regulatory mechanisms should be in place that:

- are effective in ensuring that voluntary and regulatory conservation efforts will be implemented and that the efforts will be effective in attaining habitat-related goals. The criteria included in the Policy for Evaluation of Conservation Efforts (PECE) provides a useful checklist for NMFS to evaluate the overall effectiveness of the voluntary and regulatory programs;[28]
- improve protections for floodplain and other rearing habitats, such as implementing the NMFS Biological Opinion on the National Flood Insurance Program, to limit future loss of floodplain habitat in jurisdictions enrolled in that program, and other mechanisms for areas not enrolled;
- change beaver management to allow beavers to build more dams in Oregon Coast coho rearing habitat;
- change agricultural and rural land management and practices to encourage restoration of riparian vegetation and floodplain and habitat complexity (e.g., connected side channels and wetlands) that will improve water quality as well as coho salmon habitat;
- change forest management (especially in privately owned forests but also in state-owned forests) to increase the natural recruitment of large wood into streams, provide more shade to counter increasing temperatures, and reduce transport of fine sediment into waterbodies during storms;
- protect riparian areas and floodplains in rural residential areas through effective state, county, and city land use and development regulations; and
- improve protection of surface and ground water sources through water regulation (by state and local agencies) of water extractions that may influence habitat quantity and quality.

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

[28] 60FR15100 March 28, 2003

Criterion:
In order to meet the goal for Listing Factor D related to Listing Factor B, harvest management (through the Pacific Fishery Management Council or other regulatory mechanism) should 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 Oregon Coast coho salmon will not be a threatened or endangered species because of disease and predation.

Criterion:
In order to meet the goal for Listing Factor D related to Listing Factor B, monitoring and regulatory mechanisms should be 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 Oregon Coast coho salmon will not be a threatened or endangered species because of conditions described in Listing Factor E.

Criterion:
In order to meet the goal for Listing Factor D related to Listing Factor E, hatchery management (through ODFW and NMFS section 7 regulatory mechanism) should ensure that the goals for Listing Factor E relating to hatcheries are reached.

Listing 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 ONCC TRT, BRT, and NWFSC have concluded that ODFW has implemented reductions and reforms in hatchery operations that effectively reduced hatcheries as a threat to recovery. ODFW has submitted Hatchery Genetic Management Plans (HGMP) to NMFS for every hatchery program in the Oregon Coast coho salmon ESU for approval under the ESA limit 5 of the 4(d) rule.

Criterion*:*
To meet this goal, hatchery practices will need to remain consistent with the recovery of Oregon Coast coho salmon. Implementation of the hatchery program according to a NMFS approved HGMP will achieve this criterion. NMFS will continue to work with ODFW to adaptively manage hatchery production to ensure hatchery risks are appropriate for the conservation and recovery of the ESU.

Goal 2 for Listing Factor E: Evaluate Threats Due To Other Causes.

As resources allow, NMFS will work with partners to support a continuation of monitoring programs in an effort to detect significant changes in Oregon Coast coho salmon habitat due to multiple factors, including climate change (by monitoring changes in stream flow, temperature, and their effects upon freshwater survival at all life stages). This is consistent with the ESA section 4 (g) which states in part:

> "(1) The Secretary shall implement a system in cooperation with the States to monitor effectively for not less than five years the status of all species which have recovered to the point at which the measures provided pursuant to this Act are no longer necessary and which, in accordance with the provisions of this section, have been removed from either of the lists published under subsection (c).
>
> (2) The Secretary shall make prompt use of the authority under paragraph 7 of subsection (b) of this section to prevent a significant risk to the well-being of any such recovered species."

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 each of 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.

4.4.1 Biological Status and Threats Review

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 Chapter 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.

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 chapter and portrayed in Figure 4-1, the delisting framework for Oregon Coast coho salmon combines our assessment of biological status, the five listing factors, recovery actions, and research, monitoring and evaluation. The combined results from these assessments provide NMFS with the information needed to fully assess the overall risk to the species in future listing determinations.

4.4.2 Applying the Delisting Framework for Oregon Coast Coho Salmon

NMFS plans to apply the delisting framework approach portrayed in Figure 4-1 in making future decisions regarding the overall risk of extinction of Oregon Coast coho salmon. The challenges of applying this framework are underscored by the fact that we need to take into account the factors that have contributed to the threatened status and:

- the concept of trade-offs[29] between the various objectives and criteria and efforts;
- the ONCC 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 Oregon Coast coho salmon ESU;
- the threatened destruction, modification, or curtailment of its habitat;[30]
- the uncertainties described in our listing determinations and ONCC TRT and BRT reports; and
- the reality is that there are multiple combinations of strategies and actions that could meet the biological criteria and listing factors, and protective efforts, and there is no single, pre-established, approach to progress from threatened to recovered status for Oregon Coast coho salmon.

The following tables show that we will consider the status of the biological health of the ESU and the status of the five listing factors, and assess the certainty that the goals and criteria have been met.

- Table 4-1 presents the components of the listing determination framework in a manner that allows us to indicate the certainty we have that the biological and listing factor criteria have been met.
- Table 4-2 shows how the factors contributed to our threatened status determination in 2011.
- Table 4-3 describes the strongest case for delisting—if we had 'complete certainty' that the biological and all the listing factors met their respective objectives and criteria.
- Table 4-4 shows a hypothetical characterization of how we might delist even if one criterion was not met, because the ESA and NMFS guidance do not require the highest level of certainty that all criteria have been met, nor do they specify exactly what the status of the species and the listing factors must be in order to delist.
- Table 4-5 illustrates the concept of trade-offs—how we could delist with different combinations of certainty that biological and listing factor criteria had been met.

[29] NMFS Recovery Guidance 2007.
[30] ESA Section 4(a)(1)(A)

Table 4-1. Framework for considering the biological and listing factors for Oregon Coast coho salmon.

Degree of certainty that criterion has been met	Biological Status (Is the ESU sustainable?)[31]	Listing Factor (LF) A Is the habitat adequate for recovery?	LF B[32]	LF C[33]	Listing Factor D The regulatory mechanisms for each listing factor (A,B,C, and E) are adequate to achieve and sustain recovery				LF E Other factors[34]
					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									

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

Table 4-2. 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[35]	Listing Factor (LF) A[36]	LF B[37]	LF C[38]	Listing Factor D Habitat regulatory mechanisms were inadequate to achieve and sustain recovery[39]				LF E Other factors[40]	
					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					Regulatory mechanisms for habitat					
High certainty it is not met										

[35] 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.
[36] NMFS was uncertain about the adequacy of the habitat based on ONCC TRT, BRT, Habitat Consultation Division and 5 year status review analyses.
[37] NMFS did not consider overutilization to be a threat to recovery (BRT).
[38] NMFS did not consider disease & predation to be a threat to recovery except predation in the Lakes Stratum.
[39] NMFS considered the inadequacy of regulatory mechanisms to be an impediment to recovery - see the Listing FRN June, 2011; BRT, ONCC TRT and other sources.
[40] Other factors: Green indicates NMFS did not consider hatcheries to be a threat to recovery; yellow indicates we are concerned but uncertain about climate change (BRT).

Table 4-3. The strongest case for delisting would be if we had 'complete certainty' that the biological status 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
					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									

Table 4-4. Hypothetical characterization of how NMFS might delist. In this hypothetical scenario, NMFS 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 4-5. Hypothetical characterization of combinations of how NMFS could delist. 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										

5. Current Status Relative to Recovery Goals

This chapter discusses the current status of the Oregon Coast coho salmon ESU relative to the recovery goals, including the difference, or gap, between the current status of the ESU relative to achieving the recovery goals and meeting the delisting criteria. This reflects recent findings by the Northwest Fisheries Science Center in its *2015 Status Review Update for Pacific Salmon and Steelhead Listed under the Endangered Species Act: Pacific Northwest* (NWFSC 2015), the findings from NMFS's Biological Review Team 2012 status review (Stout et al. 2012), and NMFS' *5-Year Review: Summary & Evaluation of Oregon Coast Coho* Salmon (NMFS 2016c).

The good and bad news:

- In 2014, the total number of native spawners reached a 60-year high, with nearly 360,000 native coho salmon spawners returning to the Oregon coast (ODFW 2016). However, the total number of native spawners dropped from nearly 360,000 to about 57,000 in 2015. (The primary reason was probably poor ocean survival and possibly freshwater conditions - e.g., floods). This underscores the BRT's concerns about the potential for the ESU to decline quickly when poor conditions return.
- Restoration efforts have continued to restore habitat condition for Oregon Coast coho salmon; NMFS continues to support these local and statewide efforts (see the Chapter 3).
- Harvest managers continue to manage Oregon Coast coho salmon harvest in a manner that is greatly improved over previous approaches.
- ODFW hatchery policies and practices continue to be consistent with recovery.
- ODFW continues to implement one of the best salmon habitat monitoring efforts on the West Coast that provides valuable information relative to delisting (at the stratum level), and new emerging approaches for tracking the net change in habitat feature show promise. In spite of this excellent habitat monitoring program, there are important data gaps and uncertainties regarding details of habitat status, especially at the population scale. Additional information is needed about the net change in key habitat features (e.g., elements of habitat complexity), where and how to most effectively protect and restore coho salmon habitat, and in what sequence. Continued funding is a major concern and ongoing research, monitoring and evaluation, with adaptively managed strategies, will be important for long-term conservation of Oregon Coast coho salmon.
- ODFW supports delisting of Oregon Coast coho salmon, but acknowledges that continued efforts through restoration and management are vital to achieving a desired status that provides substantial ecological and societal benefits.
- ODA has initiated a strategic initiative of focus areas and Strategic Implementation Areas (SIAs) to document landscape conditions and improvements on agricultural lands necessary to achieve state water quality standards; if these few, small pilots can be expanded and supported, they have the potential to contribute significantly to recovery.

- In November 2015, the Oregon Board of Forestry voted to increase stream buffer protections on small and medium-sized streams where coho and other salmon are present to counter the effect of increasing stream temperatures, specifically the Protecting Cold Water criterion, following certain types of forest harvest (Oregon 2016). However, it remains to be seen if the voluntary measures and changes in regulatory mechanisms (including the Board of Forestry rulemaking) will result in progress towards meeting Oregon Coast coho salmon habitat and water quality goals, particularly temperature and sediment. These include forest practices (the Oregon Department of Forestry has not yet implemented the Board of Forestry's rule changes and indications are that this will only be successful in meeting water quality standards 50% of the time), agricultural practices (ODA's Strategic Implementation Area and Focus Area initiatives are as of yet limited in number and area covered and have not yet been tested for effectiveness, beaver removal, and floodplain protections. NMFS recognizes that it will take time for changes to be implemented and show habitat improvement. We described in Chapter 4 that we will assess the effectiveness of measures in the context of all recovery criteria.

5.1 Current Status of Oregon Coast Coho Salmon ESU

This section describes the current status of the Oregon Coast coho salmon ESU based on status reviews conducted by NMFS' biological review teams in 2015 (NWFSC 2015) and 2012 (Stout et al. 2012). It also discusses findings from NMFS' 2016 *5-Year Review: Summary and Evaluation of Oregon Coast Coho Salmon*.

5.1.1 Northwest Fisheries Science Center Findings from 2015 Status Review

In 2015, the Northwest Fisheries Science Center reviewed the biological status of the Oregon Coast coho salmon ESU as part of its larger status review for Pacific Northwest salmon and steelhead listed under the ESA. The results of this NWFSC 2015 review are based in part on the most recent DSS evaluation conducted by ODFW (Lewis 2015) using data through the species' 2014 return year. The NWFSC 2015 findings are summarized here and described in detail in the full report: *Status Review Update for Pacific Salmon and Steelhead Listed under the Endangered Species Action: Pacific Northwest* (NWFSC 2015).

Abundance and Productivity

Findings by the NWFSC (2015) and ODFW (2016) show many positive improvements to Oregon Coast coho salmon in recent years, including positive long-term abundance trends and escapement. Results from the NWFSC recent review show that while Oregon Coast coho salmon spawner abundance varies by time and population, the total abundance of spawners within the ESU has been generally increasing since 1999, with total abundance exceeding 280,000 spawners in three of the last five years (NWFSC 2015).

Most independent populations in the ESU showed an overall increasing trend in abundance with synchronously high abundances in 2002-2003, 2009-2011, and 2014, and low abundances in 2007, 2009, and 2015 (Figure 5-1). This synchrony suggests the overriding importance of marine survival to recruitment and escapement of Oregon Coast coho salmon (NWFSC 2015).

The most recent information (ODFW 2016) indicates that the 'estimated total population' in 2014 of approximately 420,000 spawners was the highest since at least the 1950s (2011 was the 2nd highest with 378,000 spawners. However, the 2015 return apparently suffered from severe, unprecedented ocean conditions (see Section 3.3.5) and the total population was only 71,000, with the number of native spawners down to approximately 57,000, the lowest number since 1999. This underscores the considerable uncertainty in predicting the effects of climate change on the globe as a whole, and on Oregon Coast coho salmon and their freshwater, marine, and estuarine habitat in particular. This underscores the importance to recovery of the key factor that we have the most control over at this point—rearing habitat.

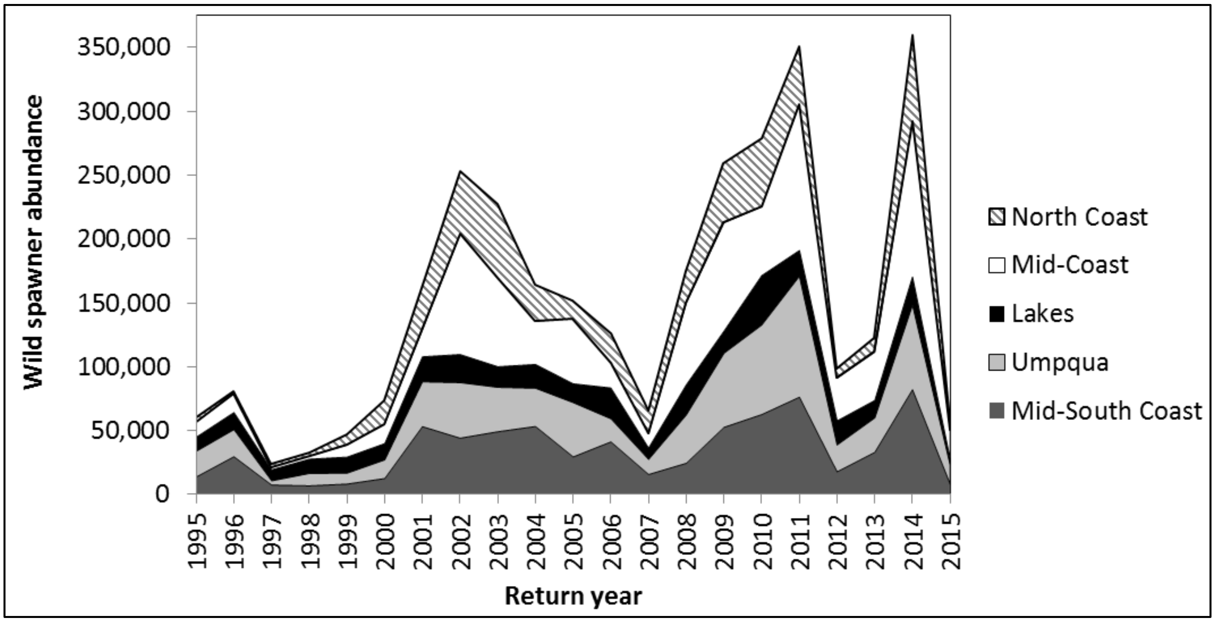

Figure 5-1. Estimated abundance of native spawners by strata for Oregon Coast coho salmon, 1995-2015 (NWFSC 2015).

Spatial Structure and Diversity

The NWFSC inferred the spatial structure of coho salmon populations within the Oregon Coast ESU using population-specific spawner abundance and productivity. The review indicates that there is no geographic area or stratum within the ESU that appears to have considerably lower abundance or be less productive than other areas (NWFSC 2015).

The NWFSC determined that wild coho salmon diversity within the ESU is not likely a hindrance to ESU sustainability. While the 2008 biological review team status review concluded that there was low certainty that ESU-level genetic diversity was sufficient for long-term sustainability in the ESU (Wainwright et al. 2008), the recent NWFSC review suggests this is an unlikely outcome. This change reflects a move by the state of Oregon in the 1990s to greatly reduce the production of hatchery coho salmon along the coast, thus reducing hatchery influence in wild Oregon Coast coho salmon populations. As a result, all but one independent population in the Oregon Coast coho salmon ESU currently have a five-year average of more than 98 percent wild spawners (NWFSC 2015). The observed upward trends in abundance and productivity and downward trends in hatchery influence make decreases in genetic or life history diversity or loss of dependent populations in recent years unlikely (NWFSC 2015).

Decision Support System Evaluation Summary of Current Biological Status

The Decision Support System for Oregon Coast coho salmon was specifically developed to evaluate biological recovery criteria for the entire ESU at two levels, persistence (EP) and sustainability (ES), which imply different levels of risk (Wainwright et al. 2008). As discussed in Chapter 4, the persistence analysis evaluates the ability of the ESU to persist over a 100-year period without artificial support, including the ability to survive prolonged periods of adverse environmental conditions. The sustainability analysis evaluates the ability of the ESU to maintain its genetic legacy and long- term adaptive potential for the foreseeable future based on habitat availability and other conditions necessary for the full expression of the population's (or ESU's) life history diversity. Criteria used to evaluate population sustainability are objective measures of spawner abundance, artificial influence, spawner and juvenile distributions, and habitat capacity. The DSS also includes ESU-level measures of genetic diversity, phenotypic and habitat diversity, and small populations.

The most recent overall scores from the DSS (using data through return year 2014) show improvement over previous iterations for both ESU persistence and sustainability. The most recent EP value is 0.73 (high certainty the ESU is likely to persist), compared to values of 0.44 for the 2012 assessment (moderate to high certainty the ESU is likely to persist). For ESU sustainability, the current value is 0.29 (moderate certainty the ESU is sustainable), which is also higher than values resulting from previous assessments (0.23, or low to moderate certainty the ESU is sustainable). The scores for the five strata reflected moderate or high levels of certainty that the strata were sustainable. The only populations that did not pass the sustainability criteria were the Necanicum, Salmon, Sixes, and North Umpqua (NWFSC 2015 based on Lewis 2015). These low scores could be one consideration for prioritizing recovery efforts, but the recovery criteria described in Chapter 4 are at the strata scale, so it is not a requirement that the scores for these populations be raised in order to meet the biological recovery criteria.

Based on this review, the NWFSC determined that while the current DSS scores show that there is moderate certainty the ESU is sustainable, there remain concerns for listing factors related to habitat and regulatory mechanisms (NWFSC 2015).

5.1.2 Summary of Current Status

Overall, the NWFSC (2015) found that increases in Oregon Coast coho salmon ESU scores for persistence and sustainability clearly indicate that the biological status of the ESU is improving, due in large part to management decisions (reduced harvest and hatchery releases). It determined, however, that Oregon Coast coho salmon abundance remains strongly correlated with marine survival rates. The NWFSC determined that the following statement from the biological review team's 2012 status review (Stout et al. 2012) of Oregon Coast coho salmon was worth repeating:

> "The BRT was particularly concerned that the long-term loss of high value rearing habitat has increased the vulnerability of the ESU to near-term and long-term climate effects. 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."

The NWFSC (2015) warned that, as Lawson (1993) stated over two decades ago, “The true measure of success for such [stream restoration] projects is the continued survival of the population through subsequent episodes of low abundance” (Lawson 1993, p. 6), when discussing cycles in ocean productivity, habitat restoration, and the productivity of Oregon Coast coho salmon. Lawson (1993) cautioned that variation in ocean productivity can mask the true benefits of stream restoration projects; increased abundances are incorrectly attributed to stream restoration when the increases resulted from high marine survival. Consequently, it is only when marine survival is low that it becomes apparent whether habitat quality and quantity are sufficient to support self-sustaining populations. The NWFSC determined that with marine survival rates expected to decrease for Oregon Coast coho salmon entering the ocean in 2014 (Peterson et al. 2014), 2015 and 2016, it would be advisable to wait to observe how the populations fare during this potential downturn before deciding to change their status. It concluded that the updated information did not indicate a change in the biological risk category for the Oregon Coast coho salmon ESU since the time of the previous biological review team (Stout et al. 2012) review (NWFSC 2015).

Figures 5-2 and 5-3 illustrate the approximate status and trends (if known) of the four VSP parameters and the five listing factors at two times: the first shows what led to listing Oregon Coast coho salmon as threatened, the second shows the status as reported by NMFS in the 2016 5-Year Review (NMFS 2016c). These figures are not intended to be quantitative estimates but indications of the improvements in viability criteria and several listing factors since listing.

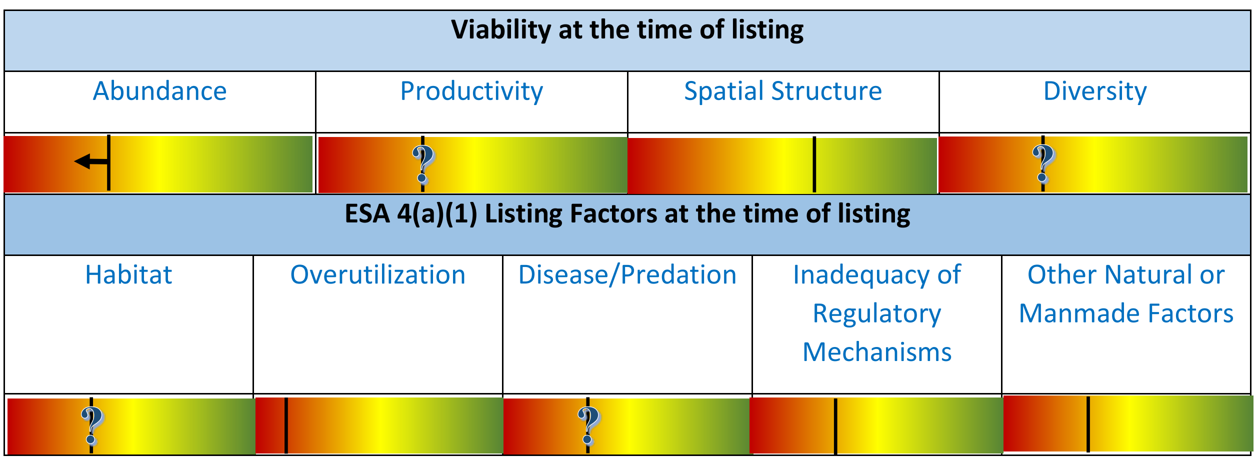

Figure 5-2. Status and trends of Viable Salmonid Population parameters and listing factors for Oregon Coast coho salmon at the time of listing (NMFS 2016c).

Status and Recent Trends

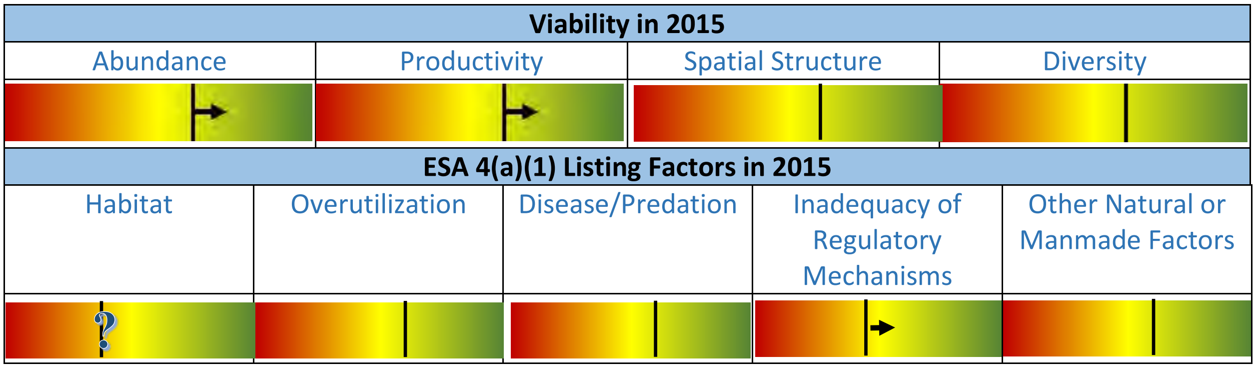

Figure 5-3. Status and trends of Viable Salmonid Population parameters and listing factors for Oregon Coast coho salmon at the time of 2016 five-year status review (NMFS 2016c).

Table 5-1 provides a characterization of our current assessment of the biological status and listing factors, and the gap between current and desired conditions. The table shows that we are not yet reasonably certain that the habitat and habitat-related regulatory mechanisms are adequate to meet the criteria and goals described in Chapter 4.

Table 5-1. Characterization of the current assessment of the biological status and elements of the delisting criteria incorporating the 2016 5-Year Status Review (NWFSC 2015 and NMFS 2016c).

Degree of certainty that criterion has been met	Biological Status	Listing Factor (LF) A	LF B	LF C[41]	Listing Factor D				LF E Other factors[42]	
					A	B	C	E		
High certainty it is met										
Moderate certainty it is met	**Moderate Certainty that the ESU is sustainable**									
Low Certainty it is met										
Uncertain										
Low Certainty it is not met		**Concern about net change of habitat status**								
Moderate certainty it is not met					**Concern that regulatory mechanisms for land use are not adequate**					
High certainty it is not met										

[41] Concern about predation in some areas of the ESU.
[42] Green reflects hatchery status; yellow reflects concern about the potential effects of climate change on both freshwater and marine survival.

5.2 Closing the Gap between ESU Current Status and Recovery

As discussed in Section 5.1, the updated status review completed by NMFS' Northwest Fisheries Science Center indicates that the biological status of the Oregon Coast coho salmon ESU has improved to a moderate certainty that the ESU is sustainable (NWFSC 2015; NMFS 2016c). This finding reflects positive long-term abundance trends and escapement, and increases in DSS scores for ESU persistence and sustainability (NWFSC 2015; Lewis 2015). The improvements in biological status are likely due primarily to previous management decisions (reduced harvest and hatchery releases). They, however, are also tied largely to favorable marine survival, which can change quickly. The NWFSC concluded that with marine survival rates expected to decrease for Oregon Coast coho salmon entering the ocean in 2014 (Peterson et al. 2014, 2015, and 2016), it may be advisable to wait to observe how populations fare during this potential downturn before deciding to change their status (NWFSC 2015). The key to improving the overall status of Oregon Coast coho salmon is improving freshwater habitat productivity as the best (if not the only) hedge against marine survival cycles that are likely to persist forever.

NMFS has determined, based on the NWFSC (2015) review and our own analysis of the ESA section 4(a)(1) factors, that the collective risk to the Oregon Coast coho salmon ESU persistence has not changed significantly since the 2012 status review (Stout et al. 2012). Thus, the implementation of sound management actions in each H—habitat, hydropower, hatcheries, and harvest—is essential to the recovery of the Oregon Coast coho salmon and must continue (NMFS 2016c).

Since the quantitative assessments of trends in habitat conditions described in Section 4.3.2 for ESA recovery have been set at the stratum 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 ODFW and other partners to develop and implement enhanced abilities to track changes in key habitat features with a goal of ensuring that there are adequate quantity and quality of rearing habitat over time.

We will also work with all our partners to set population-specific habitat targets and action plans. Our intent is to post these targets and plans on the NMFS regional website.[43]

Text Box 5-1. Closing the Gap

To close the gap between the current situation and recovery, the strategies and actions in Chapter 6 focus on improving (and documenting) the status of Limiting Factors A and D by ensuring long-term protection and improvement in the quantity and quality of rearing habitat. To do this, NMFS has determined that key strategies are to:

- Guide enhanced voluntary programs to restore key habitat areas and features,
- keep track of the implementation and effectiveness of these programs,
- ensure the protection of habitat that is currently functioning (not just restoring degraded habitat) with effective regulatory backstops, and
- employ the best available monitoring methods to assess the net change in key habitat features.

[43]http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/oregon_coast/oregon_coast_salmon_recovery_domain.html

6. Recovery Strategies and Actions

The ESA requires that recovery plans; "…to the maximum extent practicable …, incorporate … a description of such site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the species…" This chapter describes multiple recovery strategies and site-specific management actions for Oregon Coast coho salmon which are based on the best scientific data available and designed to help meet the goals described in Chapter 4 and fill the gaps described in Chapter 5. As explained in the Disclaimer at the beginning of this Plan, this is a guidance and planning document, not a regulatory document. Instead, as explained in Chapter 1, the Plan provides a suggested roadmap to recovery. The strategies and actions in this chapter are therefore suggestions, not requirements, and not delisting criteria (which are in Chapter 4). We emphasize that there are multiple scenarios that could constitute recovery under the ESA, and a variety of strategies and actions that would lead to those scenarios.

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 will be presented in the Recovery Implementation Schedule.[44]

NMFS recognizes that there are many important species and natural resources in Oregon that are in need of assistance. Implementing recovery actions for Oregon Coast coho salmon will benefit many of those species and resources in western Oregon. In particular, we support a cooperative, collaborative effort among agencies and stakeholders to achieve water quality standards as an effective approach to protecting and restoring salmon habitat.

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.

NMFS' overall recovery direction for Oregon Coast coho salmon centers on restoring degraded habitats and the ecosystem processes and functions that affect those habitats, and protecting habitats that are currently functioning through effective regulatory backstops. The primary focus is to protect and restore freshwater and estuarine rearing habitats upon which egg-to-smolt survival, and overall productivity, depends, so the highest priorities are for the strategies and actions related to rearing habitats.

Oregon Coast coho salmon populations responded to favorable marine conditions and changes in fisheries management since listing. In the most recent status review update (NWFSC 2016), we

[44] 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.

determined that we have a moderate certainty that the ESU is sustainable. While coho salmon sustainability 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 to extinction, particularly if global climate change leads to a long-term downward trend in freshwater and marine coho salmon habitat compared to current conditions. In response to this concern, we recommend continued, and enhanced, monitoring to quantify the net change in key habitat features. 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 NMFS' opinion that the current strengthened status of the Oregon Coast coho salmon populations is primarily due to a combination of reduced harvest and hatchery production and high marine survival, and that 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 conservation efforts, especially habitat protection and restoration, need 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 systematically to the well-being of the species. The integration of recovery actions for the populations and strata, along with broader conservation and 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 salmon hatchery production.*

  Because the hatchery production of coho salmon was curtailed since the early 1990's, the natural productivity of coho salmon has improved. Buhle et al. (2009) estimated an increase in natural coho salmon productivity of 27 percent from the hatchery reforms in the early 1990's to the 1997-2000 brood cycles. This increase in productivity from hatchery reforms likely still persists, but it is unknown to what extent.

- *Current harvest management regimes that allow harvest of a portion of native Oregon Coast coho salmon run have greatly reduced threats to ESU recovery.*

While overharvest of Oregon Coast coho salmon was one of the factors leading to the species decline, fishery impacts have been dramatically curtailed since ESA listing. Fishery impacts are now managed under Amendment 13 of the Pacific Fishery Management Council's Pacific Coast Salmon Fishery Management Plan, which reduced risks from fishery-related impacts. Continued adaptive management of harvest will ensure that it does not impede the recovery of any population of coho salmon in the ESU.

- *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. Activities contributing to degraded habitat, including impaired water quality, 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 and are consistent with actions needed to achieve the state's water quality standards in the range of Oregon Coast coho salmon. The strategy also recognizes that there are unknowns regarding our understanding of the specific issues that affect the fish now, or might influence their recovery in the future. As a result, the strategy 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 threats 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 to 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. 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.

- *Voluntary efforts to protect and restore natural watershed processes and functions, and the habitat upon which native species depend are critical and necessary for species recovery, but effective regulatory backstops are necessary to ensure sufficient reduction of indirect and direct threats and achieve the long-term goals of the ESA.*

  In the long run, the many people who live, work, and recreate within the range of Oregon Coast coho salmon will bear a large responsibility for the ongoing protection and restoration of salmon habitat. NMFS appreciates and applauds the many voluntary contributions to protect and restore salmon habitat within the ESU, and will continue to work with the state of Oregon and others to support these voluntary efforts. However, we are on record about the inadequacies of regulatory mechanisms in the past relating to forest, agricultural, and floodplain practices. For the long-term persistence of Oregon Coast coho salmon, we prefer that effective regulatory mechanisms provide stronger 'backstops' to the voluntary programs than they do now. Without stronger regulatory backstops in place, the burden of achieving recovery goal and delisting falls heavily on the effectiveness of the voluntary programs and the documentation of what they have accomplished. Thus, we recommend that the state enhance its protective regulatory mechanisms as well as its voluntary efforts. This will promote the use of best management practices that support the long-term restoration and conservation of healthy habitats, including water quality, for Oregon Coast coho salmon.

- *Long-term persistence of the Oregon Coast coho salmon ESU will be enhanced by 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, it will be helpful to develop and implement a common framework, including consistent use of terminology, which will provide consistency among local plans and help to ensure that recovery efforts are strategic, comprehensive and proactive. This requires a multi-faceted effort with coordination between federal, state, and local agencies and the private sector, and linkage between 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 the threats that are the causes of ecosystem impairment. We also need to define a common vocabulary, tools, and framework that allow us to measure our accomplishments consistently and effectively. 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, stratum, 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: ensuring protection of high quality habitat and restoring degraded habitat. Related state and federal scientific reports and findings identify diminished floodplain, reduced stream complexity, degraded water quality (especially increased temperature), reduced water quantity, and, for the Lakes Stratum populations, non-native fish 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 protecting and 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.

An important element in our Plan is to identify strategies that could, if implemented, address the root causes of ecosystem impairment, such as re-establishing natural sediment deposition zones in floodplain areas, thus improving water quality and providing access to valuable rearing habitat. 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.

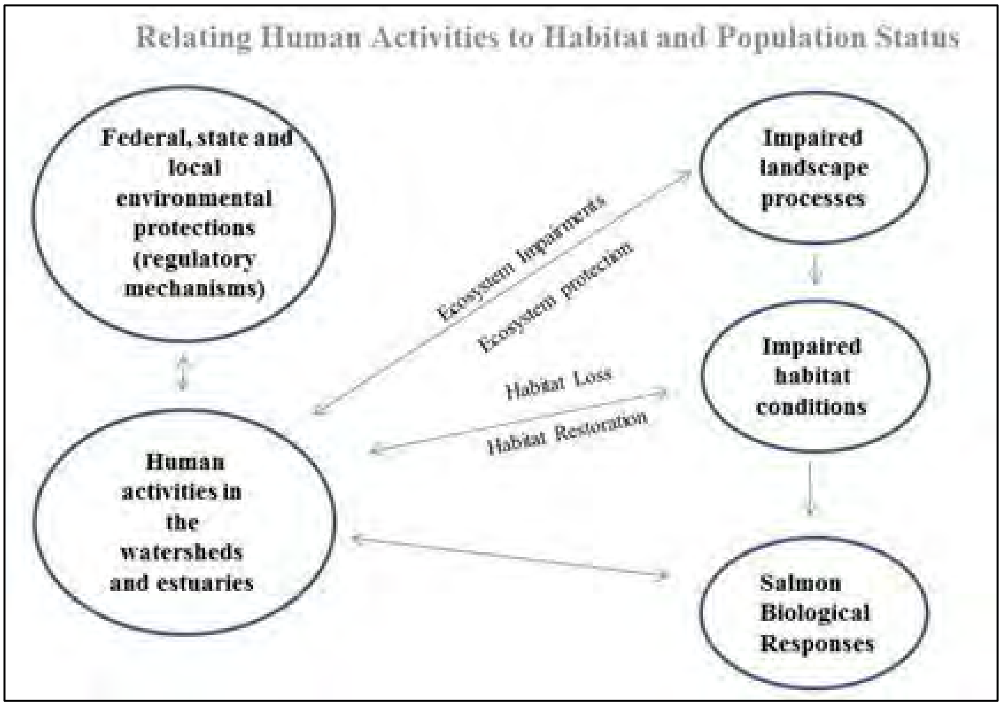

Figure 6-1. Relationships between human activities, watershed processes and fish response.

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

Research indicates that increasing rearing habitat (including quality, quantity, and diversity of 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 overwinter 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 (e.g., Koski 2009; Jones et al. 2014) 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 overwintering habitat for juvenile fish provides refuge from high velocity flows and usually contains one or more of the following features: connected floodplains and wetlands with attached off-channel alcoves, beaver dams and ponds, lakes, and channels with large wood and debris and deep pools (ODFW 2007 and Cluer 2016). In addition, while more than one set of habitat conditions is capable of providing overwinter habitat for juvenile survival, high quality and quantity overwintering habitat is found *only* in areas where the stream is low gradient and connected with areas alongside the stream (ODFW 2007); in other words, floodplains (Cluer 2016). High quality summer- rearing habitat contains many of the same features as winter rearing habitat, but foremost provides refuge from high summer water temperatures.

Natural watershed-level and reach-level physical and biological processes form the habitat features that salmon need. A long-term goal of salmon recovery is the restoration and protection of these natural processes to the extent that they can continue to create salmon habitat. Key watershed-scale processes include the following features (Roni and Beechie 2013, Table 2.1):

- Watershed-scale processes:
  - Runoff and stream flow,
  - Erosion and sediment supply, and
  - Nutrient delivery.
- Reach-scale processes:
  - Riparian processes (shading, root reinforcement of banks, wood supply, sediment retention, litter fall etc.);
  - Stream flow and flood storage;
  - Sediment transport and storage;
  - Channel, floodplain, and habitat dynamics;
  - Organic matter transport and storage; and
  - Instream biological processes.

Protecting and restoring these freshwater and estuarine processes is a general recovery strategy applicable to all listed salmonid species, including Oregon Coast coho salmon.

2. Ensure long-term ecosystem functions and high quality habitat by reducing habitat- related threats and encouraging formation of beaver dams and beaver dam analogues.

Specific physical and biological features are essential to the conservation of the ESU. For example, connected and periodically inundated floodplains, channel complexity, spawning gravels, water quality and quantity, side channels, estuary habitat, and healthy food webs support one or more life stages of the Oregon Coast coho salmon ESU as 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 in summer and winter; water quality and forage supporting juvenile development; and natural cover

such as summer shade and some turbidity (Cluer 2016), submerged and overhanging large wood, log jams, beaver dams and ponds, aquatic vegetation, large rocks and boulders, side channels, and undercut banks (this is the top priority for Oregon Coast coho salmon recovery);

- Freshwater migration areas 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 mobility and growth during outmigration, and adult mobility and survival as return spawners;
- Diverse estuarine habitats (including floodplains) free of artificial obstructions with water quality 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.

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

Improving ecosystem function by increasing the number of beaver dams and beaver dam analogues (human-made, channel-spanning structures that mimic or reinforce beaver dams) is an important tool in the overall strategy to restore habitat. These dam structures support creation of coho salmon rearing habitat by impounding water and retaining sediment, and generally facilitating fluvial geomorphic changes that can result in increased stream sinuosity, pool formation, and reconnected and expanded floodplains. Besides increasing stream complexity, beaver dams and beaver dam analogues act to raise water tables in alluvial aquifers, thus helping to increase summer stream flows, reduce stream temperatures, and expand riparian areas and wetlands. Tools for increasing beaver activity, and their associated benefits, are described in *The Beaver Restoration Guidebook: Working with Beaver to Restore Streams, Wetlands, and Floodplains* (Pollock et al. 2015). The handbook is available online at: http://www.fws.gov/oregonfwo/ToolsForLandowners/RiverScience/Beaver.asp.

3. 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 increasing effectiveness of voluntary actions and regulatory mechanisms (including enforcement of existing laws and regulations and revisions as warranted).

As part of our strategy, NMFS aims to strengthen partnerships with governmental and nongovernmental organizations and others to encourage collaboration toward recovery and conservation of Oregon Coast coho salmon populations. NMFS will encourage 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 tribes, 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. One example was begun in 2014, when NMFS joined a small team from public and private organizations 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 of 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, which includes ODFW, NMFS, the NOAA Restoration Center, National Fish and Wildlife Foundation (NFWF), Wild Salmon Center (WSC), and Oregon Watershed Enhancement Board (OWEB), launched the Oregon Coast Coho 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[45] (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 a 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 through a collaborative process that engages local communities and landowners, while promoting regional economic development. Local outreach efforts by the Team to date indicate that there is considerable interest in supporting implementation of the Business Plan and its constituent SAPS.

Another key part of the recovery strategy is to support ongoing efforts associated with the Oregon Coast Coho Conservation Plan, as enhanced by recent state initiatives described in Chapters 3 and 8. Consistent with sections 4 and 6 of the ESA, NMFS is 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, and/or other initiatives that replace or supplement the ongoing efforts 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.

[45] 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. 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.
4. Provide guidance to support policy decisions regarding prioritization of conservation investments to achieve the desired status goal for the Coast coho ESU.
5. Implement ESU-wide evaluation of Coho Winter High Intrinsic Potential Habitat (CWHIP) models and mapping methodologies (see Research, Monitoring, and Evaluation section).
6. Support development – in consultation with community-based watershed entities – of long-term conservation strategies that address limiting factors at scales within populations.
7. 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.).

4. 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. Chapter 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.

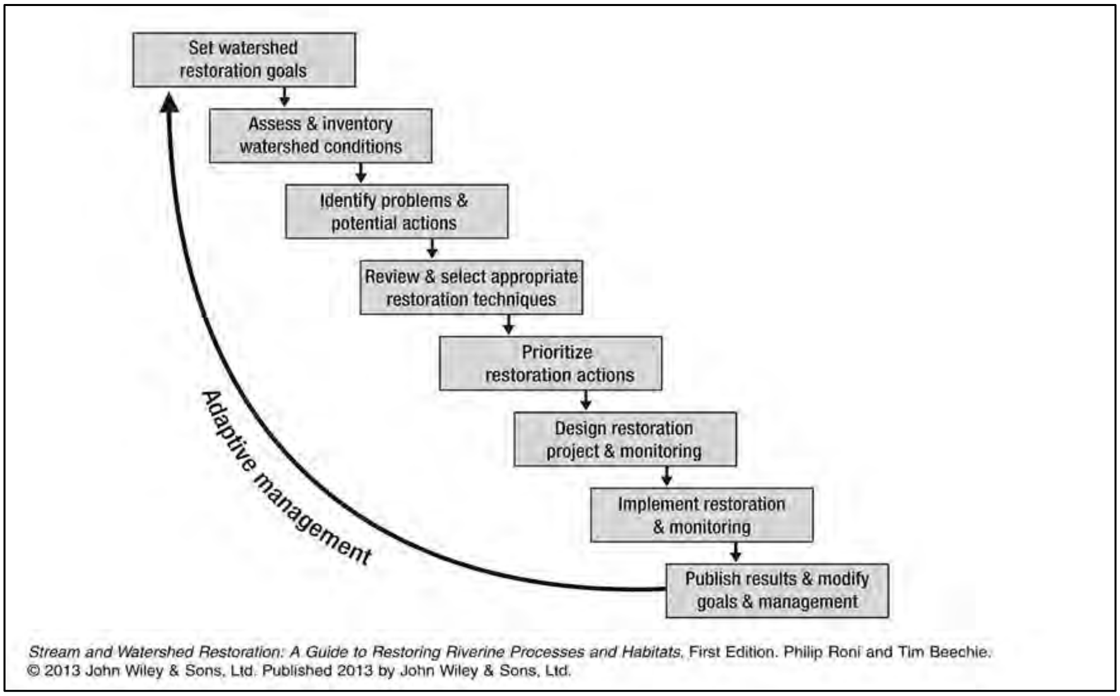

Figure 6-2. Step-by-step approach to restoring riverine processes and habitats through an adaptive management process.

ODFW has designed and implemented a scientifically designed habitat monitoring program, but usable results to date are available only at the stratum, not population, scale and show mostly a flat trend for key indicators at the stratum level (see Figure 3-3). 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 historical 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 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 increase the amount of coho salmon habitat and, within the habitat, restore the key processes and features described earlier. Together they reduce soil erosion, regain instream habitat complexity, restore riparian and floodplain connectivity, and 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 scheduled in coordination with other agencies. The list of actions includes those for implementation at the ESU level, and at the stratum or population level. In Chapter 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: <u>Habitat actions at the ESU Level</u>

Design actions including multiple tools that contribute to the restoration and protection of natural watershed-scale and reach-scale physical and biological processes including the re-establishment of connected floodplain habitats.

A1-1 Enhance the effectiveness of voluntary programs and ensure that regulatory backstop mechanisms and other approaches are in place to provide increased protection for Oregon Coast coho salmon habitat. Considerations for voluntary programs include increasing the capability and financial and technical support coast-wide and for local organizations (watershed councils, soil and water conservation districts, etc.). In this context, we recommend strategies and actions that take climate change into account:

> "Restoring floodplain connectivity, restoring stream flow regimes, and re-aggrading incised channels are most likely to ameliorate stream flow and temperature changes and increase habitat diversity and population resilience. By contrast, most restoration actions focused on in-stream rehabilitation are unlikely to ameliorate climate change

effects Beechie et al. 2012).”

NMFS supports multi-agency collaboration to prioritize opportunities to restore floodplain connectivity to increase inundation using voluntary approaches with regulatory backstops.

A1-1.1 Implement the Beaver Restoration Guidebook (Pollock et al. 2015). Increase number of beaver dams and beaver dam analogues (to modify sediment and fluvial processes in ways that contribute significantly to coho salmon habitat). To support a voluntary approach, create and fund a beaver support network of groups that can respond to reports of nuisance beavers. The goal of this group would be to offer choices to landowners including tree protection, flow devices to lower pond levels, translocation and other non-lethal alternatives. The group would also provide outreach and education about the role of beavers in healthy ecosystems and tools that landowners can use, such as the building of beaver dam analogues, to work with beaver to improve coho salmon rearing habitat.

A1-1.2 Seek agreements with APHIS, ODFW, ODOT and other agencies, along with timber companies and others, to (1) refer all beaver nuisance reports to the beaver support network proposed above, (2) avoid lethal removal of beavers pending use of non-lethal methods by the beaver support network, and (3) keep a record of these referrals.

A1-1.3 Increase incentives, such as creating a Beaver Pond Compensation Fund,[46] to encourage beaver conservation.

A1-1.4 If necessary, revise regulations and statute(s) relating to beaver management to increase the number and size of beaver ponds (which can create prime coho salmon rearing habitat).

A1-1.5 Improve implementation, effectiveness and accountability of Oregon’s Agricultural Water Quality Management Act in order to achieve water quality goals, including quantitative, narrative, and beneficial use criteria. Consistent with the state’s emphasis on voluntary efforts, NMFS supports a greatly expanded implementation of (voluntary) agricultural Focus Areas, with associated mechanisms to track progress, to contribute to achieving water quality standards. Progress towards achieving water quality standards (particularly temperature and sediment) and coho salmon habitat goals can be accelerated by aligning Focus Area work with efforts to increase salmon habitat complexity.

A1-1.6 Improve the effectiveness of ecosystem protections in forests, including implementation of the Oregon Forest Practices Act. In order to reduce the negative impacts of forestry management (reduced recruitment of wood into streams, increased water temperature and fine sediment), including modifying the OFPA and/or Forest Practice Rules for fish-bearing and non-fish bearing stream reaches and developing and updating measures for landslide prone areas.

A1-1.7 Modify statutes, regulations, or codes to avoid floodplain development in areas where floodplain function is most critical for salmon. Also, achieve a no-net loss approach to floodplain function by requiring mitigation for development in

[46] As recommended by Oregon Department of Agriculture (Oregon 2015)

floodplains. Options to achieve these goals include modification of implementation of the FEMA National Flood Insurance Program, including implementing measures identified in the Reasonable and Prudent Action. Or, modification of state or local requirements or codes.

A1-1.8 Develop and implement new regulatory, voluntary, and incentivized approaches, as necessary, to protect rearing habitats in estuaries from continued degradation and to restore habitat and processes (e.g., connectivity) lost to legacy land use practices.

A1-1.9 Support a multi-agency and landowner collaborative effort to inventory and prioritize the repair, replacement, and removal of water control structures (tidegates) in the range of Oregon Coast coho salmon.

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 an effort.

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

A1-3.1 Develop and use a common framework for population-level plans to facilitate 'rolling up' the strategies and actions, combining these elements with consistent terminology and approach into an internally consistent ESU-level plan. As resources permit, 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 and a comprehensive analysis of nontidal wetland and estuarine habitat losses. This information is important for understanding the causes behind coho salmon decline and the potential paths forward to re-establishment of resilience.

A1-3.2 Develop and make available updated summaries of climate change information relevant to Oregon Coast coho salmon recovery. Support analyses of this climate change information that quantify likely impacts to salmon habitat, during their full life history, including temperature and flow impacts, and impacts to rearing habitat.

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 Oregon Coast coho salmon—how to most effectively use available resources to improve freshwater and estuarine 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 Oregon Coast 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. In particular, NMFS supports a significant increase in the number of, and financial and technical support for, agricultural Focus Areas in collaboration with salmon recovery efforts. Because the Focus Area concept is locally driven, it has the potential to significantly accelerate achievement of water quality and salmon recovery goals with voluntary efforts if it is greatly expanded, provided with technical support and well-funded.
- **A1-**5.2 Provide adequate funding to provide assistance and incentives to landowners and others to implement priority 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: <u>Potential site-specific management actions that contribute to protecting and restoring watershed processes</u>

A2-1 For each independent population, develop and approve scientifically credible Strategic Action Plans (SAPs) where practicable using a common framework developed for this Plan.[47] 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, when possible, quantitative population-specific escapement and habitat protection and restoration goals.

- **A2-**1.1 Prioritize restoration of the stream reaches with high intrinsic potential and good habitat condition,[48] 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 high priority coho salmon habitat, evaluating each of the following threat categories and implementing local activities consistent with the recovery strategies in this

[47] 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

[48] 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.

section.

A2-2.1 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).

A2-2.2 Hydrology: protect stream hydrology by protecting and restoring patterns of sediment and water runoff.

A2-2.3 Agricultural practices (including livestock): NMFS recommends that agencies collaborate with each other, SWCDs, WSCs, and others to continue to increase the effectiveness of current agricultural water quality area plans, focus areas, and rules in order to meet water quality goals. This should provide for pursuing voluntary means with increased outreach efforts and incentives (e.g., layered or stacked funding to increase the attractiveness of projects to landowners) to achieve quantitatively defined goals as well as regulatory approaches.

A2-2.4 Beaver management: provide support to landowners who experience beaver-related challenges in order to protect both property and beaver and their ponds. (See actions identified under Listing Factor A1, habitat actions at the ESU level.)

A2-2.5 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 salmon habitat, barriers, and limiting factors.[49]

A2-2.6 Estuarine habitat: Protect and restore tidally influenced habitats (prioritized in SAPs) by 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.

A2-2.7 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).

A2-2.8 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, including establishment of larger, riparian buffers where possible and other methods to restore and protect habitat-forming ecosystem processes.

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

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

A2-2.11 Mining: work with state agencies to protect ecosystem processes by limiting

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

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 share data and 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 Oregon Coast 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 salmon 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 (coordinated and collaborative effort of local, state, and Federal organizations).

A2-4.1 Provide education on the root causes, lost functions, and historical events/actions that led to degraded ecosystem functions and salmon habitat. It is important that landowners and the public understand what caused coho salmon habitat degradation. This understanding will help build support for restoration and recovery efforts.

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

A2-4.3 Assemble, 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.[50]

A2-4.4 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.

A2-4.5 Develop and implement outreach programs 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: <u>Habitat Research, Monitoring, and Evaluation actions at the ESU level</u>

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 stratum level; NMFS supports expanding the program if resources are available to include non-wadable streams, wetlands, and estuaries and population-level trends.

A3-3 Continue to provide funding for current habitat monitoring programs, as well as the development and use of remote sensing methods that track the net gain and loss of key habitat features, and estimate net changes in coho salmon habitat at the population/watershed level.

A3-4 Support a multi-agency effort to enhance the temperature monitoring system in the basins that support Oregon Coast coho salmon to better track warm-water and cold-water refugia.

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

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

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[50] Considerable information is already developed and available. See:
· Needham, M.D. and A. T. Morzillo. 2011. Landowner incentives and tolerances for managing beaver impacts in Oregon. Final project report for ODFW and OWEB, Corvallis, OR. (http://www.dfw.state.or.us/wildlife/living_with/docs/ODFW%20and%20OWEB%20-%20Landowner%20Beaver%20Project%20-%20Final%20Report%20-%20Needham%20and%20Morzillo.pdf)
· Guidelines for Relocation of Beaver in Oregon (2012), Oregon Department of Fish and Wildlife (http://www.dfw.state.or.us/wildlife/living_with/docs/Guidelines_for_Relocation_of_Beaver_in_Oregon.pdf)
· Living with Wildlife: American Beaver, ODFW (http://www.dfw.state.or.us/wildlife/living_with/docs/beaver.pdf)
· Pollock, M.M., G. Lewallen, K. Woodruff, C.E. Jordan and J.M. Castro (Eds). The Beaver Restoration Guidebook: Working with Beaver to Restore Streams, Wetlands, and Floodplains, Ver. 1.02. USFWS, Portland, Oregon. (http://www.fws.gov/oregonfwo/ToolsForLandowners/RiverScience/Documents/BRG%20v.1.02.pdf)

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. Collaborate with governmental and nongovernmental organizations and others to protect watershed and estuarine processes and functions and coho salmon habitats (rearing and spawning) that are currently functioning well, especially winter and summer rearing habitat.
2. Collaborate with governmental and non-governmental organizations and others to identify and implement actions that will restore watershed and estuarine processes (including access); provide stream complexity for juvenile rearing; increase shading to reduce stream temperature; connect side channels, wetlands and off-channel habitats; and reduce sediment levels. 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 during warm summer months.

   When necessary, implement restoration actions to improve overwintering 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), and access to estuarine rearing habitats (tidegates, dikes, and levees).
3. Implement the best available scientific methods (including remote sensing) to track the net change in Oregon Coast coho salmon habitat over time and progress toward recovery at the population level (resources permitting).
4. Implement instream and estuarine work, including wood or boulder placement—after or in conjunction with reconnections and other efforts to restore natural ecological processes.
5. Provide and support public outreach, education, and volunteer actions to protect and restore ecosystem process and functions and improve juvenile coho salmon rearing habitats.

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 that are causing ecosystem impairment. Applying a systematic approach like this will also help ensure internal consistency for the recovery plan. All this is dependent on adequate funding and other resources.

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 ones 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 Oregon Coast 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 (including water quality) 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, floodplain, riparian, channel, biological, and estuarine. The most important changes include reduced quantity and quality of riparian habitat (complexity), instream wood, and beaver ponds; loss of floodplain connectivity & wetlands; increased water temps.	
4. What human activities (indirect and direct threats) and natural processes caused the important changes in OC coho salmon habitat?	Identify direct threats	Rural development and agriculture, stream cleaning, logging, development, levees, dikes, tidegates, mining, roads, reduction of beaver ponds, 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 from 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	
6. What are the basic and component strategies?	Develop basic habitat strategy	Two-pronged strategy: improve effectiveness of voluntary actions and regulatory backstops	Support agency and stakeholder participants with technical and financial support.
	Develop strategies for indirect threats	Improve habitat protections in voluntary and regulatory mechanisms	Engage local support for more effective voluntary protections.
	Develop strategies for direct threats	Support OCCCP voluntary actions	
	Develop strategies for natural processes	Federal (NMFS) 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 and new landscape-scale monitoring capabilities	Implement monitoring that can track efforts and measure net gain or loss of habitat in order to achieve adequately functioning habitat. Maintain or increase funding for monitoring programs.	Adequate quantity and quality of key habitat features related to juvenile coho salmon rearing.
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 key habitat features (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.	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 potentially subject to harvest in ocean and in-river fisheries. Before ESA listing of the ESU, coho salmon were subjected to overharvest. Since the mid-1990's fishery impacts have been curtailed dramatically and 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 any population of coho salmon in the ESU.

6.2.2.1 Strategy to Address Overutilization through Harvest

In order to meet the criteria in Section 4.3, the recovery strategy for fishery harvest will be to continue to implement the Amendment 13 harvest matrix, as updated in the future. ODFW, NMFS and the Pacific Fishery Management Council will ensure ocean and freshwater fisheries are implemented in accordance with the prescribed criteria in Amendment and ESA approved Fisheries Management and Evaluation Plans (FMEPs). This includes the following:

- Fisheries managers provide the monitoring necessary to ensure that harvest limits as specified in Amendment 13 are not exceeded on an annual basis. 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 forecast skill relating to the challenging aspects of run predictions for purposes of harvest management.
- ODFW continues to implement the ESA-approved FMEPs for freshwater fisheries, including annual reporting and submitting proposed fisheries for the coming season to NMFS.

6.2.2.2 Harvest Management Actions

Listing Factor B1: Harvest Actions

B1-1 Continue abundance-based harvest management, adaptively managing to ensure harvest levels are according to the Amendment 13 harvest matrix, as amended in the future.

B1-2 Review, and amend as necessary, existing 'full seeding' criteria in the Amendment 13 harvest matrix to better estimate whether habitat quality is sufficient for spawners to replace themselves when marine survival is low.

B1-3 Continue to refine and develop marine survival indices for Oregon Coast natural-origin coho salmon stocks for use in Amendment 13 harvest matrix criteria.

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

Predation from introduced non-native fish (i.e., large and smallmouth bass, yellow perch, etc.) continues to present a threat to Oregon Coast coho salmon. The ONCC TRT and BRT identified these species as the primary limiting factor in the Lakes Stratum. As water temperatures increase due to climate change, non-native fish predation is also emerging as a limiting factor in the warmer river reaches of the Umpqua basin and Coquille River.

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 reducing the impact of predation by non-native fish, birds, and marine mammals. In order to meet the criteria in Sections 4.2 and 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, birds, and marine mammals 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 on Oregon Coast coho salmon by non-native fish, birds, and marine mammals, we recommend ODFW consider options, including but not limited to increasing the sport fisheries on non-native species. Examples may include, Tenmile, Tahkenitch, and Siltcoos populations and bird and/or marine mammal hazing programs to reduce the threat to recovery (as has been done in the lower Umpqua River).

The strategy also addresses potential threats. We recommend monitoring disease and parasitism in Oregon Coast coho salmon during the marine residence and summer-rearing portion of their life cycle to assess the impact of disease on population abundance and productivity. Monitoring should investigate the relationship between water temperature and infection rates to help inform future recovery actions as temperatures increase due to climate change.

6.2.3.2 Predation and Disease Management Actions

Listing Factor C1: Predation and Disease Actions

C1-1 As resources allow, monitor to determine the rates of predation on Oregon Coast coho salmon by non-native fish (especially in the Tenmile, Tahkenitch, and Siltcoos populations; Umpqua basin, and Coquille River), birds, and marine mammals.

C1-2 Develop actions to reduce the impact of predation on Oregon Coast coho salmon by non-native fish, birds, and marine mammals. 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 and take other steps as necessary to decrease the distribution of non-native fish that occur within the range of Oregon Coast coho salmon habitat.

C1-3 As resources allow, monitor for disease and parasitism in all populations to determine the impact to Oregon Coast coho salmon abundance and productivity.

C1-4 If necessary, develop actions to reduce the occurrence of disease and parasitism in Oregon Coast coho salmon populations.

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 will work with state and federal agencies to consider what research is need and practicable regarding 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.

Climate change and changes in ocean conditions have emerged as critical concerns for Oregon Coast coho salmon. Climate changes in the Pacific Northwest are influencing water temperature, precipitation, wind patterns, ocean acidification, and sea-level height. The potential threat of a major earthquake on the Oregon Coast in the next 100 years is also a concern, particularly since such an earthquake could greatly affect the estuarine and lower elevation habitats where coho salmon rear. Steps taken to protect and restore freshwater and estuarine habitat conditions, as identified below and in Section 6.2.1, will help guard against the effects of these changes on Oregon Coast coho salmon survival and productivity.

6.2.4.1 Strategy to Address Other Issues: Hatcheries; Climate Change and Other Natural Factors

As part of our recovery strategy, and to achieve the goal for hatcheries in Section 4.2, 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 Oregon Coast 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.

  Beechie et al. (2012) recommends that increasing floodplain connectivity, restoring stream flow regimes, and restoring incised channels to provide stream complexity (including through beaver reintroduction and installation of beaver dam analogues) are the actions most likely to ameliorate stream flow and temperature changes and increase habitat diversity and population resilience (Table 6-2).

- 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 will coordinate and collaborate with ODEQ, ODFW, USGS, U.S. Forest Service, 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 coho salmon production, as specified in HGMPs, and increase use of native-origin broodstock to minimize genetic and ecological risks of hatchery coho on natural-origin coho salmon.

E1-2 Manage production levels of hatchery Chinook salmon and steelhead, as specified in HGMPs, so that competition and predation risks do not increase on natural-origin coho salmon.

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. Summary of habitat restoration types and their ability to ameliorate climate change effects on peak flows, low flows, stream temperature, or to increase salmonid population resiliency (Beechie et al. 2012).

Category	Common techniques	Ameliorates temperature increase	Ameliorates base flow decrease	Ameliorates peak flow increase	Increases salmon resilience
Longitudinal connectivity (barrier removal)					
	Removal or breaching of dam	●	●	○	●
	Barrier or culvert replacement/removal	○	○	○	●
Lateral connectivity (floodplain reconnection)					
	Levee removal	●	○	●	●
	Reconnection of floodplain features (e.g. channels, ponds)	●	○	●	●
	Creation of new floodplain habitats	●	○	●	●
Vertical connectivity (incised channel restoration)					
	Reintroduce beaver (dams increase sediment storage)	●	●	●	●
	Remove cattle (restored vegetation stores sediment)	●	●	●	○
	Install grade controls	●	●	●	○
Stream flow regimes					
	Restoration of natural flood regime	●	●	○	◒
	Reduce water withdrawals, restore summer baseflow	●	●	○	○
	Reduce upland grazing	○	◒	◒	○
	Disconnect road drainage from streams	○	○	●	○
	Natural drainage systems, retention ponds, other urban stormwater techniques	○	◒	●	○
Erosion and sediment delivery					
	Road resurfacing	○	○	○	○
	Landslide hazard reduction (sidecast removal, fill removal)	○	○	○	○
	Reduced cropland erosion (e.g. no-till seeding)	○	○	○	○
	Reduced grazing (e.g. fencing livestock away from streams)	◒	○	○	○
Riparian functions					
	Grazing removal, fencing, controlled grazing	●	○	○	○
	Planting (trees, other vegetation)	●	○	○	○
	Thinning or removal of understory	○	○	○	○
	Remove non-native plants	◒	◒	○	○
Instream rehabilitation					
	Re-meandering of straightened stream, channel realignment	◒	○	○	◒
	Addition of log structures, log jams	◒	○	○	○
	Boulder weirs and boulders	◒			
	Brush bundles, cover structures	○	○	○	○
	Gravel addition	○	○	○	○
Nutrient enrichment					
	Addition of organic and inorganic nutrients	○	○	○	○

Actions are grouped by major processes or functions they attempt to restore: connectivity (longitudinal, lateral and vertical), watershed-scale processes (stream flow and erosion regimes), riparian processes, instream rehabilitation, and nutrient enrichment. Filled circles indicate positive effect, empty circles indicate no effect, and partially filled circles indicate context-dependent effects. See text for supporting citations.

Table 6-3 summarizes potential voluntary, regulatory, and enforcement strategies for recovery of Oregon Coast coho salmon under the five listing factors.

Table 6-3. Summary of Potential 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 this plan and the OCCCP led by ODFW, ODA, ODF, NRCS, 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.	Ensure 'regulatory backstop' protections for rural development, agricultural, forest and mining practices and other sources of water quality impairments. Address emerging threats including possible changes in managing federal and state forests.	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.
B (and D) Over-utilization for commercial, recreational, scientific, or educational purposes	Minimize fishery impacts by promoting safe handling and release of coho salmon caught incidentally in other fisheries. Employ fishing techniques to avoid/minimize catch of coho in fisheries closed to retention.	Ensure implementation of fisheries according to ESA approved Amendment 13 harvest matrix as updated. Review compliance annually in preseason fishery processes.	Ensure high compliance with fishing regulations in sport and commercial fisheries. Conduct increased enforcement patrols in fisheries where there are problems/violations.
C (and D) Disease or predation	Work with ODFW (e.g., invasive species 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 non-native fish predators.	Support state enforcement of invasive species laws.
E (and D) Other natural or human-made factors affecting the species' continued existence	Continue to use best available science to guide hatchery management. Participate in educational programs including climate change.	Evaluate and approve HGMPs. Ensure implementation of programs by ODFW according to the ESA-approved HGMPs	Review hatchery fish releases, collection of brood stock, and incidental handling of coho salmon at hatchery facilities for compliance with approved HGMPs.

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 stratum level, and will be complemented by the Recovery Implementation Strategy, containing more detailed activities at the population level, to be posted on the NOAA Fisheries West Coast Region website. Although the best available science supports the recovery actions as outlined here at the ESU and stratum levels, scientific uncertainty, ongoing uncertainties regarding developments in state and local regulations and land management, uncertainties in the relationships between voluntary and regulatory efforts, and continuous developments in the technology to support habitat monitoring, rendered it impracticable to recommend detailed activities at the population level in this document. 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.

The following actions illustrate the types of actions that could be implemented to improve North Coast Stratum coho salmon populations and habitats. Other approaches could also be implemented to achieve the desired results. The actions will be further refined, sequenced, and scheduled in coordination with other agencies and local stakeholders.

Key Strategies and Potential Actions for the North Coast Stratum

- Implement and, as necessary, revise local regulatory mechanisms, voluntary and incentivized efforts to protect and restore watershed processes that promote winter and summer rearing habitats (e.g., wood recruitment, habitat complexity, floodplain connectivity, beaver pond habitat, increasing native riparian vegetation etc.). Examples of regulatory programs include the Oregon Agricultural Water Quality Management Act, Oregon Forest Practices Act, FEMA National Flood Insurance Program, and state beaver statutes and administrative rules. While increased statutory protections could strengthen recovery efforts, they may not be necessary if voluntary programs are shown to be effective in achieving ecosystem health, including water quality and increased habitat complexity. (See actions identified in Section 6.2.1.2, under Listing Factor A1, habitat actions at the ESU level.)

- 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. Actions identified in SAPs will likely include activities such as restoring habitat capacity for rearing juvenile coho salmon by increasing large wood loading, beaver pond 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, encourage beaver conservation and beaver dam analogues, 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 pond abundance and reducing or limiting development of channel-confining structures, including roads and infrastructure.
- Continue to implement weak stock management approach for fisheries according to Amendment 13 harvest matrix. Typically the North Coast Stratum populations are the weakest stocks in need to most protection under Amendment 13.

Priority Watershed Actions

Rural (including residential and agricultural) Lands

1. Protect and restore riparian areas adjacent to stream channels using voluntary actions with regulatory backstops in place.
2. Plant and restore riparian vegetation adjacent to stream channels.
3. Increase habitat complexity by increasing large wood, boulders, or other instream structure, through improved ecosystem functions wherever possible.
4. Improve lateral connectivity between stream channels and adjacent wetlands and connectivity with floodplains.

Timber Lands

1. Increase protective management of riparian forests, including management that increases the sustainable natural recruitment of large wood into the rivers and streams through voluntary programs or increased regulatory mechanisms.
2. Eliminate the construction of permanent new roads, unless constructed to relocate another permanent road that has greater impacts on Oregon Coast coho salmon habitat, and replace culverts where needed to comply with current guidelines.
3. Decommission roads where practicable.
4. Increase habitat complexity by increasing large wood, boulders, or other instream structure.

Secondary Watershed Actions

Beaver Management

1. Include strategies to increase beaver, beaver ponds, and beaver dam analogues in strategic action plans.
2. Seek agreements with state and federal agencies and others to pursue non-lethal means of beaver removal (see Section 6.2.1.2, A1-1.2 above). If necessary, revise regulatory mechanisms to prohibit killing of beaver within the range of Oregon Coast coho salmon unless property or infrastructure damage is occurring and only when all other options are exhausted.
3. Create a program to educate landowners, managers, policymakers and the public in general about the benefits of beaver ponds to the health of our ecosystems, with a focus on benefits to salmonids. Include opportunities to conserve and manage beaver through cost effective, non-lethal management practices (Pollock et al. 2015).
4. Implement the Beaver Restoration Guidebook (Pollock et al. 2015) to incorporate beaver, beaver ponds, and beaver dam analogues into restoration actions.

Table 6-4. 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 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-3	Tributaries	Increase habitat complexity	Improve agricultural practices (reduce or disallow stream channel dredging in ESA-listed streams flowing through or adjacent to rural lands)	All Populations	Medium
NCS-4	Tributaries	Increase habitat complexity	Increase large wood, boulders, or other instream structure	All streams where coho salmon would benefit immediately	High
NCS-5	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-6	Off-Channel	Increase habitat complexity and connectivity to side-channels	Increase large wood, boulders, or other instream structure	All Populations	Medium
NCS-7	Off-Channel and Wetlands	Increase habitat complexity and connectivity and access to alcoves, off-channel ponds, floodplains, and wetlands	Increase beaver pond abundance	All Populations	Medium
NCS-8	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-9	Mainstems	Improve wood recruitment to support long-term increases in habitat complexity	Support voluntary programs to increase stream complexity in rural areas.	All Populations	Medium
NCS-10	Mainstems	Improve water quality by improving water temperature	Improve water quality by improving stream shade	Tillamook and Nehalem Populations	High
NCS-11	Mainstems	Improve water quality by improving water temperature	Improve water quality by improving stream shade	All Populations	Medium

Action ID	Habitat component	Strategy	Action	Area	Priority
NCS-12	Mainstems	Improve water quality by improving water temperature	Improve water quality by improving instream flows	Tillamook Population	High
NCS-13	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-14	Mainstems	Improve marginal and streambank habitat complexity	Increase large wood and marginal and streambank habitat structure	All Populations	Medium
NCS-15	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-16	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-17	Mainstems	Increase habitat complexity	Improve gravel mining practices making them consistent with other streams in Oregon (Chetco River and Hunter Creek) by implementing standard best management practices to retain gravel bar form and function (per Federal Interagency Working Group 2006). Explore upland rock/gravel sources for similar quality rock for quarrying, rather that removing from river bottom.	Tillamook and Nehalem Populations	Medium
NCS-18	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-19	Estuary	Increase access to sloughs, side channels, and floodplains	Reduce fish passage barriers to floodplains by reducing or setting dikes back or completely removing tidegates and dikes where feasible.	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). It identifies priorities for restoration of ecological processes that will improve water quality, instream habitat complexity, and spawning conditions (Beaver population). Actions will 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 pond conservation plan that includes reducing lethal control, improving public education and acceptance of beaver, 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.

The following actions illustrate the types of actions that could be implemented to improve Mid-Coast Stratum coho salmon populations and habitats. Other approaches could also be implemented to achieve the desired results. The actions will be further refined, sequenced, and scheduled in coordination with other agencies and local stakeholders.

Key Strategies and Potential Actions for the Mid-Coast Stratum

- Implement and, as necessary, revise local regulatory mechanisms, voluntary and incentivized efforts to protect and restore watershed processes that promote winter and summer rearing habitats (e.g., wood recruitment, habitat complexity, floodplain connectivity). Examples of regulatory programs include the Oregon Agricultural Water Quality Management Act, Oregon Forest Practices Act, FEMA National Flood Insurance Program (recommendation A1-1.7), 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. (See actions identified in Section 6.2.1.2, under Listing Factor A1, habitat actions at the ESU level.)

- Implement the Strategic Action Plans to protect and restore ecosystem processes and functions and coho salmon habitats. Actions identified in SAPs will likely include activities such as restoring habitat capacity for rearing juvenile coho salmon by increasing large wood loading, beaver pond 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, ODA, 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, encourage beaver conservation and beaver dam analogues, 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 pond abundance and reducing or limiting development of channel-confining structures, including roads and infrastructure.

Priority Watershed Actions

State and Private Timber Lands

1. Increase protection of riparian forests with no-touch buffer widths with voluntary programs or increased regulatory mechanisms.
2. Eliminate the construction of permanent new roads, unless constructed to relocate another permanent road which has greater impacts on Oregon Coast coho salmon habitat.
3. Decommission roads where practicable.
4. Increase placement of large wood into stream channels.

Rural (including residential and agricultural) Lands

1. Plant, restore, and protect riparian areas adjacent to stream channels using voluntary actions with regulatory backstops in place.
2. Develop and implement recommended riparian buffer vegetation and widths (e.g., ODA's Streamside Vegetation Assessment Tool) (ODA 2015) for streams that flow through rural 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. Include strategies to increase beaver, beaver ponds, and beaver dam analogues in strategic action plans.
2. Seek agreements with state and federal agencies and others to pursue non-lethal means of beaver removal (see Section 6.2.1.2, A1-1.2 above). If necessary, revise regulatory mechanisms to prohibit killing of beaver within the range of Oregon Coast coho salmon unless property or infrastructure damage is occurring and only when all other options are exhausted.
3. Create a program to educate landowners, managers, policymakers and the public in general about the benefits of beaver ponds to the health of our ecosystems, with a focus on benefits to salmonids. Include opportunities to conserve and manage beaver through cost effective, non-lethal management practices (Pollock et al. 2015).
4. Implement the Beaver Restoration Guidebook (Pollock et al. 2015) to incorporate beaver, beaver ponds, and beaver dam analogues 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 historical floodplains through tidegate elimination, management, and operations; levee and dike removal; and overwater structure modifications in the Yaquina, Alsea, Siletz, 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 6-5. 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

Action ID	Habitat component	Strategy	Action	Area	Priority
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 water withdrawals to improve water quality that is sufficient for salmonid rearing and spawning	Beaver population	Medium
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 pond 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 pond 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	Improve timber harvest activities (increased harvest buffers on	All populations	High

Action ID	Habitat component	Strategy	Action	Area	Priority
		long-term increases in habitat complexity	private industrial timberlands, reduce road densities on private and federal timberlands)		
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 complexity	Improve state agricultural practices (disallow stream channel dredging in ESA-listed streams flowing through or adjacent to ag lands)	Siuslaw population	High
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	High

Action ID	Habitat component	Strategy	Action	Area	Priority
				and Siuslaw estuaries	
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

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

NMFS recognizes that the lakes stratum has consistently been the most sustainable within the ESU. The primary strategy to ensure the continued health of the populations in the Lakes Stratum is to 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. Consequently, the summer lake rearing life stage of Oregon Coast coho salmon in the Lakes populations has been eliminated. However, the lakes are continuing to function as important habitat for Oregon Coast 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. It identifies priorities for restoration of ecological processes that will improve water quantity, water quality, connectivity of stream adjacent wetlands, and instream habitat complexity. It improves 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. The actions can address these factors 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.

The following actions illustrate the types of actions that could be implemented to improve Lake Stratum coho salmon populations and habitats. Other approaches could also be implemented to achieve the desired results. The actions will be further refined, sequenced, and scheduled in coordination with other agencies and local stakeholders.

Key Strategies and Potential Actions for the Lakes Stratum

- Coordinate with the Oregon Department of Fish and Wildlife to reduce predation rates by reducing populations of non-indigenous fish in Siltcoos, Tahkenitch, Tenmile, and

Mercer Lakes. Exploitation rates of non-indigenous fish will need to be increased to such a level that summer rearing of juvenile Oregon Coast coho salmon is restored.

- Implement and, as necessary, revise local regulatory mechanisms, voluntary and incentivized efforts to protect and restore watershed processes that promote winter and summer rearing habitats (e.g., wood recruitment, habitat complexity, floodplain connectivity). Examples of regulatory programs include the Oregon Agricultural Water Quality Management Act, Oregon Forest Practices Act, FEMA National Flood 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. (See actions identified in Section 6.2.1.2, under Listing Factor A1, habitat actions at the ESU level.)
- Implement the Strategic Action Plans to protect and restore ecosystem processes and functions of coho salmon habitats. Actions identified in SAPs will likely include activities such as restoring the summer lake rearing life stage of the Oregon Coast coho salmon life history, habitat capacity for rearing juvenile coho salmon by increasing large wood loading, beaver pond 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, ODA, SWCDs, Lake Front Owners Association, Watershed Councils, and others to identify and implement actions that will 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, encourage beaver conservation and beaver dam analogues, 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 pond abundance and reducing or limiting development of channel-confining structures, including roads and infrastructure.

Estuaries

- 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.

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 all potential techniques for complete removal.
    b. Evaluate long-term electrofishing methods.
    c. Consider a bounty program to remove warm-water fish in the lake, commercial fisheries, volunteer tournaments with prizes, eliminating bag limits, or a 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 Oregon Coast coho salmon in the lakes.)
2. Monitor non-indigenous fish species in the lake for ongoing predation and competition with Oregon Coast coho salmon.
    a. Assess summer versus winter predation and survival rates of Oregon Coast coho salmon juveniles.
    b. Assess the role of over-water structures in the predator-prey interaction.

State and Private Timber Lands

1. Increase protection of riparian forests with no-touch buffer widths.
2. Increase placement of large wood into stream channels.
3. Eliminate the construction of permanent new roads, unless constructed to relocate another permanent road that has greater impacts on Oregon Coast coho salmon habitat.
4. Decommission roads where practicable with emphasis on roads adjacent to riparian areas.
5. Identify landslide prone areas and avoid road building or heavy timber harvest in these risk avoidance areas.
6. Develop conservation plans for state and private forest lands.

Rural (including residential and agricultural) Lands

1. Plant, restore and protect riparian areas adjacent to stream channels using voluntary actions with regulatory backstops in place. 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. Implement ODFW dock guidelines for all dock repairs, replacements, and new construction.

Secondary Watershed Actions

Beaver Management

1. Include strategies to increase beaver, beaver ponds, and beaver dam analogues in strategic action plans.
2. Seek agreements with state and federal agencies and others to pursue non-lethal means of beaver removal (see Section 6.2.1.2, A1-1.2 above). If necessary, revise regulatory mechanisms to prohibit killing beaver within the range of Oregon Coast coho salmon unless property or infrastructure damage is occurring and only when all other options are exhausted.
3. Create a program to educate landowners, managers, policymakers, and the public in general about the benefits of beaver ponds to the health of our ecosystems, with a focus on benefits to salmonids. Include opportunities to conserve and manage beaver through cost effective, non-lethal management practices (Pollock et al. 2015).
4. Implement the Beaver Restoration Guidebook (Pollock et al. 2015) to incorporate beaver, beaver ponds, and beaver dam analogues 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

- Protect the estuary from any recreational use encroachment.
- Manage recreational off-road vehicle for no entry into riparian areas.
- Seek fish passage into Clear Lake for Oregon Coast coho salmon (partnering with ODOT and the City of Reedsport).

Table 6-6. 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	Evaluate all potential techniques 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 grating 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 pond 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 strategies on the upslope agricultural areas with the intent of transferring conserved water to instream flows.	Population wide	Medium
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

Action ID	Habitat component	Strategy	Action	Area	Priority
LS-15	Wetlands	Increase habitat complexity and connectivity and access to alcoves, off-channel ponds, floodplains, and wetlands	Increase beaver pond 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 identifies priorities for restoration of ecological processes to improve water quantity, water quality, and instream and estuarine habitat complexity. Collaborative actions also aim to improve instream flow, water temperature, and channel complexity 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 pond conservation plan that includes reducing lethal control, improving public education and acceptance of beaver, 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.

The following actions illustrate the types of actions that could be implemented to improve Umpqua Stratum coho salmon populations and habitats. Other approaches could also be implemented to achieve the desired results. The actions will be further refined, sequenced, and scheduled in coordination with other agencies and local stakeholders.

Key Strategies and Potential 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.
- Implement and, as necessary, revise local regulatory mechanisms, voluntary and incentivized efforts to protect and restore watershed processes that promote winter and summer rearing habitats (e.g., wood recruitment, habitat complexity, floodplain connectivity). Examples of regulatory programs include the Oregon Agricultural Water Quality Management Act, Oregon Forest Practices Act, FEMA National Flood Insurance Program, and state beaver statutes and administrative rules. Encourage local organizations to work with state and federal agencies to develop and approve scientifically credible, thorough Strategic Action Plans for the Lower, Middle, North, and

South Umpqua populations, consistent with ESU-level common framework. (See action identified in Section 6.2.1.2 under Listing Factor A1, habitat actions at the ESU level.)

- Implement the Strategic Action Plans to protect and restore ecosystem processes and functions and coho salmon habitats. Actions identified in SAPs will likely include activities such as restoring habitat capacity for rearing juvenile coho salmon by increasing large wood loading, beaver pond 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, ODA, 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, encourage beaver conservation and beaver dam analogues, and improve juvenile coho salmon rearing habitats.
- Reduce predation rates by continuing to reduce populations of non-native 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 pond abundance and reducing or limiting development of channel-confining structures, including roads and infrastructure.

Estuaries

- 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.

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.

State and Private Timber Lands

1. Increase protection of riparian forests with no-touch buffer widths with voluntary programs or increased regulatory mechanisms.
2. Eliminate the construction of permanent new roads, unless constructed to relocate another permanent road which has greater impacts on Oregon Coast coho salmon habitat.
3. Decommission roads where practicable.
4. Increase placement of large wood into stream channels.

Rural (including residential and agricultural) Lands

1. Plant, restore, and protect riparian areas adjacent to stream channels using voluntary actions with regulatory backstops in place.
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. Include strategies to increase beaver, beaver ponds, and beaver dam analogues in strategic action plans.
2. Seek agreements with state and federal agencies and others to pursue non-lethal means of beaver removal (see Section 6.2.1.2, A1-12 above). If necessary, revise regulatory mechanisms to prohibit killing beaver within the range of Oregon Coast coho salmon unless property or infrastructure damage is occurring and only when all other options are exhausted.
3. Create a program to educate landowners, managers, policymakers and the public in general about the benefits of beaver ponds to the health of our ecosystems, with a focus on benefits to salmonids. Include opportunities to conserve and manage beaver through cost effective, non-lethal management practices (Pollock et al. 2015).
4. Implement the Beaver Restoration Guidebook (Pollock et al. 2015) to incorporate beaver, beaver ponds, and beaver dam analogues 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 historical 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 6-7. 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	Increase large wood, boulders, or other instream structure	All streams where coho would benefit immediately	High

Action ID	Habitat component	Strategy	Action	Area	Priority
		connectivity to side-channels			
US-11	Off-Channel and Wetlands	Increase habitat complexity and connectivity and access to alcoves, off-channel ponds, floodplains, and wetlands	Increase beaver pond 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 connectivity and access to alcoves, off-channel ponds, floodplains, and wetlands	Increase beaver pond abundance	All populations	Medium
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

Action ID	Habitat component	Strategy	Action	Area	Priority
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.

The following actions illustrate the types of actions that could be implemented to improve Mid-South Coast Stratum coho salmon populations and habitats. Other approaches could also be implemented to achieve the desired results. The actions will be further refined, sequenced, and scheduled in coordination with other agencies and local stakeholders.

Key Strategies and Potential Actions for the Mid-South Coast Stratum

- Implement and, as necessary, revise local regulatory mechanisms, voluntary and incentivized efforts to protect and restore watershed processes that promote winter and summer rearing habitats (e.g., wood recruitment, habitat complexity, floodplain connectivity). Examples of regulatory programs include the Oregon Agricultural Water Quality Management Act, Oregon Forest Practices Act, FEMA National Flood 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. (See actions identified in Section 6.2.1.2 under Listing Factor A1, habitat actions at the ESU level.)
- Implement the Strategic Action Plans to protect and restore ecosystem processes and functions and coho salmon habitats. Actions identified in SAPs will likely include activities such as restoring habitat capacity for rearing juvenile coho salmon by increasing large wood loading, beaver pond 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, 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, encourage beaver conservation and beaver dam analogues, 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.
- 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-native fish in the Coquille and Coos Rivers.
- Reduce predation rates by reducing populations of non-native fish in the Coquille River.

Priority Watershed Actions

State and Private Timber Lands

1. Increase protection of riparian forests with no-touch buffer widths.
2. Eliminate the construction of permanent new roads, unless constructed to relocate another permanent road which has greater impacts on Oregon Coast coho salmon habitat.
3. Limit placement of temporary roads and decommission roads where practicable.
4. Increase voluntary landowner placement of large wood into stream channels.

Rural (including residential and agricultural) Lands

1. Plant, restore, and protect riparian areas adjacent to stream channels using voluntary actions with regulatory backstops in place.
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. Include strategies to increase beaver, beaver ponds, and beaver dam analogues in strategic action plans.
2. Seek agreements with state and federal agencies and others to pursue non-lethal means of beaver removal (see Section 6.2.1.2, A1-1.2 above). If necessary, revise regulatory mechanisms to prohibit killing beaver within the range of Oregon Coast coho salmon unless property or infrastructure damage is occurring and only when all other options are exhausted.
3. Create a program to educate landowners, managers, policymakers and the public in general about the benefits of beaver ponds to the health of our ecosystems, with a focus on benefits to salmonids. Include opportunities to conserve and manage beaver through cost effective, non-lethal management practices (Pollock et al. 2015).
4. Implement the Beaver Restoration Guidebook (Pollock et al. 2015) to incorporate beaver, beaver ponds, and beaver dam analogues into restoration actions.

Estuary and Tidal Lands

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. Develop an estuary lowlands restoration strategy that considers improved access to historical 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 Oregon Coast coho salmon habitat.

Table 6-8. Habitat component specific actions to restore high quality coho salmon habitat in the Mid-South Coast Stratum.

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

Action ID	Habitat component	Strategy	Action	Area	Priority
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 enhancement of shade to reduce stream temperatures and improve water quality.	All Populations	High
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 pond abundance	All streams where coho salmon would benefit immediately	High

Action ID	Habitat component	Strategy	Action	Area	Priority
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 pond 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
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

Action ID	Habitat component	Strategy	Action	Area	Priority
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 gravel mining practices making them consistent with other streams in Oregon (Chetco River and Hunter Creek) by implementing standard best management practices to state and federal regulations and permitting of gravel mining (retain gravel bar form and function (per Federal Interagency Working Group 2006). Explore upland rock/gravel sources for similar quality rock for quarrying, rather that removing from river bottom.	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
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	Improve agricultural practices (grazing and hay production buffers	All Populations	High

Action ID	Habitat component	Strategy	Action	Area	Priority
		support long-term increases in habitat complexity	on agricultural land adjacent to ESA-listed streams)		
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.

Another important uncertainty for Oregon Coast coho salmon recovery relates to changes in hatchery production. 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 by the NWFSC) 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 development of life-cycle models, could 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 a whole.

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 chapter describes the best available estimates of time and costs necessary to recover Oregon Coast coho salmon. As we have described in earlier chapters, 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. Consequently, the following sections provide a range of estimates, using several basic assumptions and based on the information currently available.

7.1 Time Estimates

The Oregon Coast Coho Conservation Plan described the desired status goal for broad sense recovery 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. <u>Ecological processes.</u> 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. <u>Scientific uncertainty.</u> 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 ponds to increase productive capacity of coho salmon habitat; and the total amount of Coho Winter High Intrinsic Potential Habitat (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 NMFs has moderate certainty that the biological status is sustainable and the combination of voluntary and regulatory measures, can ensure that delisting criteria will be met, it is possible that we could delist Oregon Coast coho salmon more quickly – potentially following the 2021 or 2026 5-year reviews. On the other hand, without adequate documentation that voluntary and regulatory measures are effective, 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

While this recovery plan contains an extensive list of actions to recover Oregon Coast coho salmon, there are many uncertainties involved in predicting the course of recovery and in estimating total costs. Such uncertainties include biological and ecosystem responses to recovery actions, as well as long-term and future funding to implement recommended actions. Thus, it is impracticable to estimate all projected actions and costs to reach recovery. Instead, it is most appropriate to focus on a shorter time frame, with the understanding that before the end of each five-year implementation period, specific actions and costs will be estimated for subsequent years. Rather than speculate on conditions that may or may not exist that far into the future, this Plan relies on ongoing monitoring and periodic plan review regimes to add, eliminate, or modify actions through adaptive management as information becomes available and until such time as the protection under the ESA is no longer required.

This section provides rough estimates of 5-year and 10-year (total) costs for actions implemented to recovery Oregon Coast coho salmon. 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, Southern Oregon/ Northern California Coast Coho Salmon Recovery Plan, and Central California Coast Coho Salmon Recovery Plan). 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.

To these estimates, we need to add a rough estimate of at least $1 million per year for ODFW’s Aquatic Inventory Project, which we consider essential to monitor the status of habitat on the coast; we would like to see increases in that budget if resources are available, which could reduce the time needed to determine if habitat-based delisting criteria are being met.

The OCCCP includes three time-frame and cost scenarios for conducting habitat improvement, presented in Table 7-1 below, to attain the goal of broad sense recovery (beyond ESA recovery and delisting), including federal, state and landowner costs for a full range of voluntary and regulatory actions. 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.

The cost estimates based on the OCCCP provide useful information for determining recovery costs; however, the estimates are based on several assumptions, identified below, and may not reflect the total cost of recovery. For example, the cost estimates primarily focus on instream habitat restoration work to achieve needed high quality habitat. Additional funds may be needed to increase floodplain connectivity, enhance riparian vegetation, and implement other actions to achieve the desired habitat conditions.

ODFW used the following key assumptions to estimate the costs for the OCCCP, 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 to 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.[51] 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 Oregon coast natural coho salmon ESU."

Comparing the OCCCP estimates (published in 2007) for the 17 year scenario with the annual report tally shows that actual expenditures in the Oregon Coast 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 trend 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, except that the costs will be less for ESA delisting than broad-sense recovery.

NMFS recognizes that, regardless of our recommendations for future actions, federal, state and other sources of funds for recovery actions may not increase over previous expenditures. If the effectiveness of restoration actions continue to be increased as a result of enhanced scientific support for prioritization, along with collaboration among partners, we assume that the cost of recovery efforts will, continue at approximately the same level as in the last 17 years. In 2016 dollars, we estimate costs will be in the $60 to $100 million range in the next 5 years. The costs will depend 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 costs will also depend on success in strengthening programs, 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.

[51] http://apps.wrd.state.or.us/apps/oweb/owrio/default.aspx

Table 7-1. 2007 Estimates of 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
Tillamook	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**

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8. Implementation

Oregon Coast coho salmon recovery is possible in the foreseeable future. Since NMFS first listed the species in 1999, several key threats have been abated and the biological status of the species has improved significantly. Many organizations and individuals continue to invest significantly in habitat restoration and implement other actions to help the species. NMFS anticipates that a focused, effective recovery implementation strategy could serve as the final catalyst for delisting the Oregon Coast coho salmon.

Ultimately, the recovery of Oregon Coast coho salmon will depend on the commitment and dedicated actions of the many individuals and entities who share responsibility for the stewardship of the species' future, and NMFS looks forward to partnering with them in a collaborative effort. Today we face a common challenge: to take the remaining steps needed to bring the species to a level where we are confident that it is and will continue to be sustainable and persistent.

This chapter presents potential elements of an integrated public-private implementation approach to achieve the goals of our recovery plan. NMFS proposes this implementation approach to coordinate the refinement, prioritization, implementation, monitoring and reporting of the recovery strategies and actions in Chapter 6 to abate the remaining threats to the species at the population, stratum and ESU levels. As explained earlier, the key to improving the overall status of Oregon Coast coho salmon in the face of anticipated future reductions in marine survival associated with climate change is improving freshwater and estuarine coho salmon rearing habitat through a combination of successful locally- supported voluntary programs, with regulatory backstops. While we have recommended increased habitat protections through modifications in regulatory mechanisms, we understand that voluntary programs, not regulatory mechanisms, will probably be the primary focus of the recovery effort. The primary focus of this chapter is on voluntary actions.

Our Vision: The Oregon Coast Coho Salmon Recovery Plan serves as the final catalyst so NMFS can delist Oregon Coast coho salmon within the next 10 years.

Overall Implementation Approach: Enhancing Partnerships

Fundamentally, recovery of Oregon Coast coho salmon depends on enhancing partnerships among federal and state agencies, tribes, private landowners, local businesses, non-governmental organizations, and others. NMFS recognizes that partnerships among a variety of different stakeholders can help shape practicable solutions that fit the long-term recovery of the species while also supporting sustainable communities in coastal Oregon.

Enhancing Public-Private Collaboration through Coast Coho Business Plan

NMFS supports the continuation, and development, of public-private partnerships. One example is the Coast Coho Business Plan (a public-private partnership described below) and associated population-level Strategic Action Plans (SAPs). The Coast Coho Business Plan (Business Plan) approach was designed in 2014 by the public-private Coast Coho Partnership, which includes the Oregon Watershed Enhancement Board (OWEB), Oregon Department of Fish and Wildlife, National Marine Fisheries Service, NOAA Restoration Center, Wild Salmon Center (WSC), and the National Fish and Wildlife Foundation.

The Coast Coho Business Plan is intended to:

1. market the unique opportunity to recover Oregon Coast (OC) coho to major funders, and describe the essential role of voluntary habitat protection and restoration efforts;
2. identify the highest priority projects required at the population (watershed) scale to advance regional recovery goals; and
3. aggregate the cumulative costs and anticipated benefits of these projects, and coordinate funding to accelerate implementation.

Projects included in the Coast Coho Business Plan are generated through a one-year planning process in which local communities use a science-based framework to develop a Strategic Action Plan (SAP) for a local coho salmon population.

The Business Plan is envisioned as a living document, in which new SAPs are incorporated as they are completed. As the Business Plan grows, the Coast Coho Partnership will work with additional state, federal, and private partners to direct new and existing funding into SAP implementation. In addition to accelerating the recovery of Oregon Coast coho salmon, the Business Plan and its constituent SAPs will support other coastal priorities as well; most notably, helping communities meet water quality standards and maintain working lands. These outcomes are essential if coastal stakeholders are to achieve the shared goals of improving watershed health and promoting economic security throughout the region. Together, the Business Plan and its SAPs will serve as a nexus among federal, state and local recovery efforts and provide an essential framework to advance the habitat restoration strategies outlined in Chapter 6.

Enhancing Voluntary Conservation Programs

NMFS encourages future conservation efforts that enhance voluntary conservation programs and create new innovative voluntary incentive programs. Together, such programs would help halt the net loss of juvenile coho salmon rearing habitat from rural residential development, agriculture and forestry, as well as actively create additional juvenile rearing habitat. When voluntary conservation programs are reliable and effective, NMFS will rely on them during its delisting determinations (See Chapter 4). For example, the Business Plan framework, with associated commitments of funds from the National Fish and Wildlife Foundation, Oregon Watershed Enhancement Board and others, can significantly increase the success and reliability of voluntary conservation programs.

Expanding and improving the alignment of federal and state voluntary programs that provide technical and financial assistance, and regulatory assurances (e.g., Federal Safe Harbor Agreements) to landowners who are able to implement conservation activities will help accelerate coho salmon recovery. For these efforts to succeed, building cooperation at the local level to help implement high priority recovery actions and meet community needs should be integrated into voluntary programs. Understanding how socio-economic factors influence ranchers and farmers voluntary adoption of conservation practices will be key to building such cooperation. For example, a Natural Resource Conservation Service (NRCS) investigation (Hoag et al. 2012) that examined how farmers and ranchers make decisions on adopting conservation practices revealed that generally, changes in practices must work for the farmer by: increasing revenue, lowering costs, reducing labor or time, or supporting other values important to the farmer/rancher such as stewardship and legacy. This report suggested that financial incentives can be helpful and necessary to improve participation; however, by themselves, they are not sufficient as the only incentive to adopt new practices. A strong network of support (financial, technical, and peers) and flexibility in identifying solutions is therefore needed to promote adoption of conservation practices.

Enhancing State and Federal Coordination and Collaboration

While effective voluntary programs provide the primary catalyst for achieving ESA recovery of Oregon Coast Coho salmon, maintaining this recovery requires effective federal and state support and regulatory backstops that help maintain the species' long-term persistence. Thus, NMFS is actively partnering with the state of Oregon to integrate the implementation of this recovery plan with state efforts, including those through the Oregon Plan for Salmon and Watersheds (ORS 541.898), Oregon Coast Coho Conservation Plan, and Oregon Watershed Enhancement Board activities. Several new initiatives by the state (see Table 8-1) have the potential to enhance Coast Coho salmon recovery efforts. NMFS also continues to work to align federal programs that provide technical and financial assistance and regulatory assurances to help achieve recovery (see Table 8-2). NMFS will continue to work with agencies, tribes and stakeholders to implement coordinated and collaborative programs and projects. (See Chapter 3 for a description of current federal and state regulatory programs and Chapter 4 for criteria.)

With effective incentives, technical support and collaboration, private landowners can voluntarily manage their lands consistent with coho recovery. When voluntary conservation programs are reliable (i.e., certain to occur) and effective, NMFS can rely on them during its delisting determinations (see Chapter 4 for details on our Policy on Evaluating Conservation Efforts).

Key Considerations to Focus Recovery Plan Implementation

- Support, align, and expand voluntary incentive programs.
- Focus actions on reducing the highest remaining threats to recovery in collaboration with affected entities by protecting and restoring juvenile winter and summer rearing habitats in areas with the greatest potential to contribute to recovery.
- Prioritize strategies and actions and watersheds with the greatest opportunities for partnering with communities to engage in coho salmon conservation.
- Continue to build local group capacity by providing increased technical support across the ESU and by providing sufficient funding so they can compete for restoration planning and project funding.
- Identify innovative funding approaches to coordinate and leverage existing funding to

maximize public and private investments, including major expansion and improved accountability of ODA's Focus Area initiative within the range of Oregon Coast coho salmon.

- Work with private landowners, and associated organizations, to explore programs that certify that agricultural products are produced sustainably.
- Identify and reduce existing disincentives that discourage private landowners from working voluntarily on conservation efforts.
- Identify and provide support to create new incentive options that stimulate conservation efforts.
- Identify programs or tools that encourage private landowners to use best management practices and voluntarily apply for regulatory assurances when appropriate.
- Encourage implementation of the recovery plan at the 'ground level' to promote local support, governance and participation.
- Explore a unified coast-wide mitigation program so that the costs of new development or conversion are greater in high-valued coho salmon habitat.
- Encourage agencies to use their authorities to implement recovery plan actions.
- Integrate the elements of our approach to regulatory mechanisms as described in Chapters 4 and 6 with the voluntary approaches.

8.1 NMFS Role in Recovery Implementation

Congress affirms that the purposes of the ESA are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved and a program for the conservation of endangered species and threatened species. Congress also declared that all federal agencies will seek to conserve endangered species and threatened species and utilize their authorities in furtherance of the purposes of the ESA.

The ESA authorizes NMFS to contribute to such conservation programs for species under its jurisdiction by: (1) conducting status reviews to determine if a species should be listed or delisted under the ESA; (2) designating critical habitat; (3) developing and implementing recovery plans; (4) consulting with other federal agencies to ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of listed species or result in adverse modification or destruction of critical habitat; and (5) permitting any act for scientific purposes or to enhance the propagation or survival of the affected species or any incidental taking associated with a conservation plan.

NMFS exercises all of its unique authorities to advance recovery of Oregon Coast coho salmon. Our workforce has extensive experience in salmon conservation. However, NMFS lacks sufficient resources, local knowledge and reach to fully recover Oregon Coast coho salmon on our own. Moreover, developing solutions to complex conservation challenges in isolation can limit creation of innovative, coherent and integrated approaches for Oregon Coast coho salmon recovery that can make a bigger difference. When NMFS can establish, or be the catalyst for, strategic partnerships, long-lasting resolutions can be crafted to accelerate the recovery of Oregon Coast coho salmon for the for the benefit of current and future generations of Oregonians and the American people. Accordingly, NMFS intends to use this recovery plan to organize and coordinate recovery of Oregon Coast coho salmon in partnership with state, tribal, and federal resource managers, and with local stakeholders.

NMFS' will serve as a collaborating partner to the many entities and agencies who share responsibility for the species' future. In this role we intend to be an active participant. This includes a working partnership with OWEB, ODFW and other state agencies, federal and local agencies, and other stakeholders to implement the recovery plan. We intend to provide leadership in implementing the Plan, working closely in collaboration with Oregon's ongoing coho salmon conservation efforts.

At the same time, NMFS will continue to work to ensure that the agency's statutory responsibilities for recovery under the ESA are met. This will include conducting ESA five-year status reviews; and making determinations to delist or change ESA listing status. Finally, NMFS will use the recovery plan to provide information and context for its other responsibilities for implementing the ESA, including implementation of ESA section 4(d), section 7 consultations, and section 10(a)(1)(A) permits. (See Section 1.4 for a description of these responsibilities.)

In addition to our authorities described above, NMFS continues to oversee several voluntary incentive-based conservation programs (described in Table 8-2) that contribute, or could contribute, to Oregon Coast coho salmon recovery.

8.2 Role of State Agencies in Recovery Plan Implementation

State agencies contribute to conservation and recovery by providing financial and technical support for voluntary programs. They also support the success of recovery efforts through implementation of regulatory backstops designed to protect coho salmon habitat and achieve water quality standards

For instance, ODA's (voluntary) Focus Areas, when aligned with coho salmon habitat restoration, have the potential to make significant progress towards water quality (particularly temperature and sediment) and recovery goals. With increased support from other sources (federal, state, local), this voluntary program has great potential. On the regulatory side, ODA's Strategic Implementation Areas (SIA) can ensure compliance with water quality rules and successes in one SIA can serve as a means to encourage compliance in neighboring areas.

In terms of forest practices, development in floodplains, and other examples, effective outreach and communication between regulators and those subject to regulation, combined with more effective incentives, have the potential to increase the overall effectiveness of voluntary programs.

State of Oregon Programs

Public agencies in Oregon offer a diverse range of voluntary conservation programs to local watershed groups, individual landowners and other stakeholders to restore habitat that contribute to coho salmon recovery. On September 16, 2016, Oregon provided to NMFS a multi-agency report regarding state programs that contribute to coho conservation in order to provide an improved understanding of Oregon's efforts to recover Oregon Coast coho (Oregon 2016). Table 8-1 summarizes information on existing state programs from Oregon's report.

Table 8-1. State of Oregon Natural Resource Agency Programs that Contribute to Coast Coho Salmon Recovery.

State of Oregon Programs that Contribute to Coast Coho Salmon Recovery
Multi-agency Programs
Oregon Clean Water Partnership. Initiated in 2016, the partnership aims to improve water quality on rural lands to provide for healthy fish, and healthy watersheds and rural communities. The Partnership is a long-term effort to improve state agencies' coordination of clean water data and monitoring and prioritization of programs and investments with the outcome of improving clean water in rural Oregon, in places where it's most needed.
Habitat Conservation Banking. Oregon is collaborating with NMFS to identify opportunities to establish a conservation bank for anadromous fish habitat in Oregon, including Oregon Coast coho salmon. A strategically focused conservation banking program to preserve, restore and create or enhance floodplain habitats to offset impacts of new development in the floodplain could: (1) improve conservation for coho recovery; (2) reduce risks and costs from flooding; and (3) ease landowner/ municipality compliance with mitigation requirements.
Local Inter-Agency Team Pilot Program. Oregon is working with NMFS to identify priority populations and refine high quality habitat goals for achieving ESA delisting/recovery. Oregon will then establish small Inter-Agency Teams in the identified population areas comprised of one local representative from each state natural resource agency, watershed council, and soil and water conservation districts. The teams will: (1) identify priority stream reaches or watersheds for protection and restoration; (2) identify key local contacts for individual landowners; (3) meet with landowners in priority areas to discuss protection/ restoration needs and options; and (4) identify programs to best achieve desired outcomes consistent with specific landowner needs. Coordination at the state level will assure efficient movement of local team proposals through permitting, funding, or other state processes.
Mid-Coast Water Planning Partnership. This partnership is an example of a place-based planning pilot, co-convened by the City of Newport and OWRD.
Oregon Watershed Enhancement Board (OWEB)
Coast Coho Business Plan. In 2015, OWEB funded the development of the Business Plan framework and its application to Strategic Action Plans developed in three pilot watersheds (the Nehalem, Siuslaw, and Elk Rivers). In 2017, the public-private Coast Coho Partnership will incorporate project priorities resulting from these three pilot SAPs into Oregon's Coast Coho Business Plan. The Partnership will select three additional populations for SAPs annually. Selections are based on letters of interest submitted by local partner organizations working on the coast. Participation in the program is entirely voluntary.
Lottery Contributions. Since 1999, Oregon has committed 7.5 percent of state lottery revenues to projects that enhance native fish and wildlife habitat or improve water quality. More than $163 million has been invested and leveraged in restoration projects in the Oregon Coast coho salmon ESU by OWEB, landowners and other funders. OWEB alone invested nearly $29 million in specifically in High Intrinsic Potential streams to benefit Oregon Coast coho salmon and their habitat, matched with more than $15 million in funding from other sources.
Focused Investment Partnership Grants. In 2015, the OWEB Board established priorities for a new Focused Investment Partnership (FIP) Program. A FIP is an investment that addresses a board-identified priority of significance to the state; achieves clear and measurable ecological outcomes, uses integrated, results-oriented approaches through a strategic action plan and is implemented by a high-performing partnership. Two of the seven priorities are tied to Oregon Coast coho salmon habitat and populations.
Tidegates. OWEB has identified tidegate removal and replacement investments as a priority area to investigate via programmatic effectiveness monitoring. OWEB has funded 11 tidegate replacement/removal restoration projects totaling $3.4 million. OWEB is investing in work with Oregon State University to better inform investments in strategic, high quality tidegate restoration projects.
Soil and Water Conservation District and Watershed Council Capacity Funding. Since 2007, OWEB has invested $9.2 million to support watershed councils and SWCDs along the Oregon coast. This funding supports the staff

capacity of local organizations to complete restoration, outreach and other critical functions along the coast. Moving forward, the OWEB Board has committed to continuing strong capacity investments throughout the state.
Oregon Department of Fish and Wildlife (ODFW)
Western Oregon Stream Restoration Program. Since 1995, the Western Oregon Stream Restoration Program (WOSRP) has provided technical assistance and consultation for state and federal agencies, local governments, watershed councils, and landowners on protection, enhancement, and restoration of fish and wildlife habitats. The WOSRP helps achieve the desired status for coastal coho salmon by developing and implementing stream restoration projects that create high quality coho salmon rearing habitat.
Habitat Protection. ODFW biologists review proposed land and water use actions relative to impacts to listed salmonid species, provide agencies with local knowledge of site conditions, and work with landowners to incorporate habitat restoration projects on their land while equipment is mobilized. Biologists cover a wide range of activities and collaborate with state and federal permitting agencies to help ensure sustainable development while minimizing, mitigating, or eliminating negative impacts to fish and wildlife habitat.
Beaver Management. ODFW works to promote beaver activity where acceptable by landowners. ODFW has created maps that identify potential locations for beaver activity and high quality coho habitat. The agency also convened an advisory work group to bring together various interests and identify information needed to bridge the gap between beaver restoration and damage. ODFW hopes to develop a statewide beaver coordinator position.
Fish Screening and Passage Program. This program benefits coho salmon by approving, re-establishing, improving, and maintaining fish passage and installing and maintaining fish screens. Focused programmatic projects on the coast include the Salmon SuperHWY (an effort in the Tillamook and Nestucca areas to address barriers), the Fish Passage Mitigation Pilot Project, and a culvert repair programmatic agreement with ODOT.
Oregon Plan Fish and Habitat Monitoring Program. This program directly supports monitoring required for the state conservation plan, pending federal recovery plan, status assessments, state and federal management and listing decisions, harvest and hatchery management decisions, habitat action prioritization and effectiveness, and implementation tracking/reporting. This monitoring provides data used to adaptively manage populations in order to ensure long-term sustainability.
Salmon Trout Enhancement Program. The Salmon Trout Enhancement Program (STEP) utilizes volunteers to assist with management outcomes for salmon and trout. STEP volunteers participate in propagation, habitat restoration projects, monitoring, and educational outreach.
Agricultural Water Quality Management Area Program. This program regulates and works with agricultural landowners to achieve and maintain conditions necessary to meet water quality standards.
Pesticide Program. The program educates and licenses pesticide applicators, ensuring appropriate use of pesticides including in and near water bodies with enforcement authority for violations.
Noxious Weed Control Program. The program protects valued natural resources and agricultural lands from the introduction and spread of noxious weeds that displace and compete with native vegetation and desirable economic plants. The agency works with state, federal, and county agencies and private landowners to implement Early Detection and Rapid Response projects or provide assistance through Oregon State Weed Board grants.
Oregon Department of Environmental Quality (ODEQ)
Nonpoint Source Program. The program provides technical and financial support for priority projects that address water quality problems in surface and groundwater resources resulting from non-point source pollution. In the Oregon Coast coho salmon area, ODEQ invested $1,722,962 in nonpoint source projects from 2007-2015.
Oregon Department of Forestry (ODF)
Paired Watershed Studies. Studies through the Watershed Research Cooperative inform adaptive management by challenging scientific assumptions via watershed-level research while simultaneously evaluating forest practices effectiveness at operational scales. Major investigations include the Trask Paired Watershed Study and the Ripstream project.
Continued Investment in Oregon Plan Measures. Since 1995, private forestland owners have made significant investments in improving water quality and fish habitat. Reported cumulative investments 1995 to 2015 were $102 million. Forest landowners completed 5,000 voluntary projects, including cross drain and large wood placement.
Oregon Department of Land Conservation and Development

Oregon Statewide Land Use Program. The program originated in 1973 and provides protection of farm and forest lands, conservation of natural resources, and orderly and efficient development of urban areas. The program works to achieve 19 planning goals, several of which support water quality and salmon habitat.
Oregon Coastal Management Program. The program conserves and protects Oregon's outstanding coastal resource by assisting local governments to develop livable, resilient coastal communities and knitting together the programs and activities of local, state, and federal agencies on the Oregon coast. Mandatory coastal resource management and habitat protection measures are set forth in Statewide Planning Goals
Oregon Department of State Lands
State Removal-Fill Program. The Oregon Department of State Lands has made several improvements to this program since initial coast coho salmon listing in 1999.
Mitigation Programs. Since 2009, the agency has collaborated with the U.S. Army Corps of Engineers and the EPA to develop wetland and stream function-based and watershed-based mitigation programs. The agency's federally-approved In-Lieu Program (ILF) and the mitigation banking program, administered with the U.S. Army Corps of Engineers, provide mechanisms to mitigate impacts off-site.
Watershed Councils
Watershed councils. These local organizations are convened under the authority of county governing bodies as voluntary, non-regulatory groups. They play a fundamental role in watershed restoration activities in Oregon. Supported by OWEB and others, the watershed councils on the coast, along with soil and water conservation districts, are often the primary providers of conservation and recovery efforts. The conservation and recovery efforts will continue to rely on watershed councils as key partners.
Soil and Water Conservation Districts
Soil and Water Conservation Districts. The Oregon Soil and Water Conservation Commission provides assistance and direction to Oregon's Soil and Water Conservation Districts (SWCDs). The SWCDs provide technical assistance and tools to protect and manage and resources. Currently 13 of the SWCDs in Oregon have boundaries that overlap with the Oregon Coast coho salmon ESU. The SWCDs provide on-the-ground facilitation and resources to help encourage local participation in voluntary conservation programs.

8.3 Role of Federal Agencies in Recovery Plan Implementation

NMFS recognizes that a number of federal agencies have ongoing programs and regulatory authorities that contribute greatly to the recovery of Oregon Coast coho salmon. Successful implementation of this NMFS recovery plan will rely to a significant extent on the collaboration and continued contributions of programs initiated by NMFS, the U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service, Natural Resource Conservation Service, Farm Service Agency, Environmental Protection Agency, National Fish and Wildlife Foundation, and other agencies. We describe some of the federal agency contributions below in Table 8-2.

Table 8-2. Federal Programs that Contribute to Coast Coho Salmon Recovery.

Federal Programs that Contribute to Coast Coho Salmon Recovery
NOAA Fisheries and NMFS
Pacific Coastal Salmonid Restoration Fund (PCSRF). The PCSRF, established by Congress in 2000, support salmon and steelhead conservation efforts in California, Oregon, Washington, Idaho, and Alaska. The program is essential to preventing the extinction of the 28 listed salmon and steelhead species on the West Coast and, in many cases, has stabilized the populations and contributed to their recovery course. NMFS is charged with administering PCSRF's competitive grants process, and has awarded states and tribes a total of over $1.1 billion since 2000. The program has also leveraged over $1.3 billion in total state in-kind, and other matching, funds. Since 2012, when NMFS refocused its investments to prioritize on-the-ground restoration, over $4 million of PCSRF dollars have been invested in Oregon Coast coho salmon ESU to support habitat restoration.

Conservation Banks. Conservation Banks are permanently protected lands that contain natural resource values. These lands are conserved and permanently managed for species that are endangered, threatened, candidates for listing as endangered or threatened, or are otherwise species-at-risk. Conservation banks function to offset adverse impacts to these species that occurred elsewhere, sometimes referred to as off-site mitigation. In exchange for permanently protecting the land and managing it for these species, NMFS approves a specified number of habitat or species credits that bank owners may sell. NMFS and the state of Oregon are using Conservation Banking Guidance to consider establishing a conservation bank for anadromous fish habitat in Oregon, including the Oregon Coast coho salmon ESU. Such an approach could steer potential development/ conversion away from essential coho salmon habitats (high intrinsic potential) to better conserve the species.
NOAA Restoration Center. Created in 1991, the Center is devoted to restoring the nation's coastal, marine, and migratory fish habitat. It focuses on opening rivers, reconnecting coastal wetlands, restoring corals, and rebuilding shellfish populations by providing funds and technical assistance, supporting local community engagement, providing collaboration with different partners, and conducting monitoring and socioeconomic research on restoration benefits.
NOAA Fisheries Science Centers. The Northwest Fisheries Science Center provides scientific support for building robust monitoring and research programs to better understand the status and trends of coho salmon. Chapter 9 describes their scientific support for coho salmon conservation.
Safe Harbor Agreements. A Safe Harbor Agreement is a voluntary agreement involving private or other non-federal property owners whose actions contribute to the recovery of species listed as threatened or endangered under the ESA. In exchange for private landowner actions that provide a net conservation benefit, participating property owners receive formal ESA assurances from NMFS without requiring any additional or different management activities by the participants for the duration of the Agreement. NMFS encourages use of Safe Harbor Agreements as conservation tools with willing landowners to recover Oregon Coast coho salmon.
Natural Resource Conservation Service
Environmental Quality Incentives Program (EQIP). The EQIP provides financial and technical assistance to landowners for providing structural or management conservation projects, including projects that conserve or restore riparian habitat, improve water quality, and/or reduce irrigation demands. The Conservation Stewardship Program (CSP) also promotes voluntary conservation practices and makes payments to landowner based on the performance of their conservation activities. From 1995 to 2014, a total of $5.4 million in EQIP funds were invested in Oregon counties that make up the Oregon Coast coho salmon ESU. EQIP program funding has also been successfully targeted and leveraged through other programs, including the National Water Quality Initiative.
Regional Conservation Partnership Program. NRCS offers several large grant programs, including the RCPP, which provide funding for watershed-level restoration projects that are solutions based, innovative, and collaborative. Projects are evaluating within three different funding pools based on scale; whether it falls entirely within a state, is multi-state or national in scope, or is within one of the eight regional critical conservation areas.
Working Lands for Wildlife. This NRCS initiative could be applied to support recovery of Oregon Coast coho salmon. The program is specifically designed to benefit high-priority habitat of selected wildlife species that are declining, candidates for listing, or ESA-listed species. It provides financial and technical assistance as well as regulatory assurances to landowners who voluntarily improve or restore habitat for species targeted by NRCS and its partners for recovery. So far, seven species have been included in this initiative, the Greater Sage-Grouse a notable regional example.
Farm Services Agency
Conservation Reserve Enhancement Program (CREP). The Farm Services Agency administers several conservation related programs, including CREP, which could successfully enroll landowners whose agricultural land serve as Oregon Coast coho habitat. CREP is an incentive-based voluntary program for agricultural landowners to receive compensation and technical assistance for establishing conservation practices that address wildlife habitat, water quality or soil conservation issues. OWEB co-administered CREP in Oregon.
U.S. Fish and Wildlife Service
National Coastal Wetlands Conservation Grant (NCWCG) program. Oregon is a recipient of this grant program, which is designed to acquire, restore, and enhance wetlands in coastal states through competitive matching

grants to state agencies. The primary goal of the NCWCG Program is the long-term conservation of coastal wetland ecosystems.
Partners for Fish and Wildlife. USFWS administers this voluntary program to help protect, enhance, and restore wildlife habitat on privately owned lands. The conservation program provides landowners with technical and financial assistance to restore fish and wildlife habitats in partnership with other federal agencies, state and local governments, educational institutions, businesses, and conservation organizations.
National Fish and Wildlife Foundation
Conservation Grant Program. The National Fish and Wildlife Foundation (NFWF), created by Congress in 1984, is a major conservation-grant maker that offers a variety of conservation grant programs around the nation. One such grant, the Oregon Governor's Fund for the Environment, provides funds to ensure long-term conservation and restoration of Oregon's wild salmon populations and habitats. NFWF and its project partners, including NMFS, have successfully leveraged this grant program through a variety of projects, including the Coast Coho Business Plan, and will continue to use this fund to help support priority Oregon Coast coho salmon conservation projects.

8.4 Role of Non-Governmental Organizations

Non-Government Organizations (NGOs) have provided major contributions to the conservation and recovery of Oregon Coast coho salmon and their continued work will strengthen public-private cooperative efforts to recover Oregon Coast coho salmon. Along the Oregon coast, non-profit, voluntary NGOs provide a variety of types of support that boosts public-private cooperative efforts including, restoration planning and project management, monitoring projects, interface with private landowners, building coalitions, and securing additional restoration funding from foundations and other sources to supplement public funding. Non-profit associations can also be instrumental in identifying sustainable, conservation approaches that depend on working effectively with private landowners (farmers, ranchers, forestry). The Oregon Farm Bureau, Oregon Cattlemen's Association, and the Oregon Dairy Farmers Association work to promote the economic vitality of Oregon's farmers and ranchers while also promoting environmentally sound industry practices. Numerous organizations including the Wild Salmon Center and The Nature Conservancy, land trusts, estuary partnerships and others have been leaders in contributing to important restoration planning and implementation over the last 20 years in coastal Oregon. Effective coordination and collaboration with Oregon's conservation groups and industry associations will be important in building long-term solutions and accelerating recovery of Oregon Coast coho salmon.

8.5 Examples of Successful Cross-Jurisdictional Public-Private Partnerships

While many effective voluntary conservation programs already exist, additional efforts to fine-tune alignment ('stacking') among existing public programs would better incentivize cooperation from private landowners and optimize public investments in strategic locations to advance coho recovery. Below, we describe several successful public-private partnerships utilizing voluntary conservation programs that could be used as models for stimulating Oregon Coast coho salmon recovery.

SageCon Partnership. In 2015, the SageCon Partnership charted a path forward for the conservation of the Greater Sage Grouse in eastern Oregon. Drawing on the diverse capabilities of Oregon's natural resource agencies, along with the USFWS, NRCS, the Bureau of Land Management, SWCDs, county governments, agricultural landowners and representative organizations, tribes, and conservation groups, the focused attention advanced from the SageCon effort is intended to promote the health of the greater sage grouse and its habitat as well as sustainable rural communities and economies in eastern Oregon. The public-private partnership efforts in Oregon to create a comprehensive plan, using both regulatory and voluntary conservation incentive approaches, contributed to the USFWS' decision not to list the greater sage grouse as a threated species under the ESA in 2015. The plan leveraged and better aligned funding across multiple federal and state agencies, created an innovative mitigation system to 'steer' development from highly valued habitats, and promoted ranchers to voluntarily participate in conservation efforts under the ESA. The SageCon Partnership represents how a public-private partnership can build and support a strong regulatory underpinning with effective and reliable voluntary conservation programs can promote species conservation at the landscape scale.

Coast Coho Business Plan Grants. As discussed earlier, in 2014, the Wild Salmon Center partnered with OWEB, ODFW, NMFS, NOAA Restoration Center, and NFWF to design a 'Business Plan' for the conservation of Oregon Coast coho salmon. The overarching Business Plan is intended to be a living document, into which new strategic action plans (SAPs) are incorporated when complete.

In 2015, Oregon funded the program in three pilot SAPs for the Nehalem, Siuslaw, and Elk River watersheds. Plans are now underway and projected for completion in December 2016. The second round of SAPs will be completed in 2017. As a result of this partnership, NFWF has committed $600,000 to projects that result from the development of local strategic action plans. In addition, the Oregon Departments of Forestry and Agriculture have both committed to working in partnership in areas where plans are being developed and implemented.

Wilson River Restoration. The 194-square-mile Wilson River watershed is the largest of five main drainage basins feeding Tillamook Bay on Oregon's northern coast. The dominant land use in the watershed is state and federal forestlands (81 percent of the watershed's total area). Dairy pastures dominate the lowland areas of the watershed. Oregon's Wilson River is popular site for kayakers and canoeists. In 1997, the lower 8.5-mile segment of the Wilson River was found to have dangerously high bacteria levels from bacteria from livestock and human sources, which moved the state's Department of Environmental Quality (DEQ) to place the river on the 303(d) list of impaired waterways. That listing meant that recreational use was not advised. Work began toward finding a solution to Wilson River's water woes by local citizens, dairy farms, nonprofits and natural resource agencies including the Tillamook Estuary Partnership, Oregon Watershed Enhancement Board (OWEB), Oregon State University, USDA Natural Resources Conservation Service (NRCS), USDA Farm Service Agency, DEQ, Oregon Department of Agriculture (ODA), and the Tillamook Soil and Water Conservation District, which leveraged their investments in multiple conservation projects and water quality data monitoring intended to improve and measure the watershed's health. Partners spent millions of dollars to restore and protect Tillamook Bay and its watershed. Projects included 20 riparian enhancements on private land that fostered planting, fencing and invasive species removal to stabilize streambanks and to keep livestock off a buffer of land along the river's edge; purchase of three wetland parcels and improvements to Tillamook County Creamery Association wastewater treatment system that discharges to the river. Farmers invested in additional improvements as well. They built covered manure storage areas and improved the efficiency of sprinkler systems and fertilization programs to prevent runoff from entering waterways. Monitoring has been in place long enough now for scientists to see patterns of improvement. They predict with confidence that conditions will continue to improve over the next 25 years.

Tillamook Estuaries Partnership. The Tillamook Estuaries Partnership (TEP), worked closely with community, state and federal entities to develop and implement the Tillamook Bay Comprehensive Conservation and Management Plan beginning in 1999. The plan recommended 63 actions that could help improve water quality, enhance aquatic habitat and mitigate flooding. In 2003 Tillamook Estuary Partnership (TEP) began offering its Backyard Planting Program BYPP, a cost-free, voluntary assistance program to help. With support from multiple organizations, landowners installed best management practices throughout the Wilson River watershed. Data show a statistically significant decreasing trend in bacteria levels. In fact, the river has met water quality standards since 2005. The program's coordinator works with landowners to develop site specific riparian restoration plans. Between 2003 and 2007, the program helped plant almost 10,000 trees along more than 17 miles of streams in the Tillamook Bay watershed. Numerous partners have worked to restore Tillamook Bay and its watershed, including the OWEB, ODA, ODEQ, ODFW, Tillamook Estuaries Partnership, Tillamook County, Tillamook Bay Watershed Council, USFWS, Tillamook County Creamery Association, Tillamook SWCD, Tillamook Native Plant Cooperative and private landowners. This successful public-private partnership collectively leveraged and spent more than $1.4 million in the Lower Wilson Creek watershed, creating voluntary conservation incentives for private landowners and to carry out restoration projects to improve water quality.

Southern Flow Corridor. For nearly a decade, the Oregon Solutions Consortium – composed of local and state government agencies as well as private citizens – has worked with the Federal Emergency Management Agency, NMFS and the USFWS to gain approval and funding for the Southern Flow Corridor project. The purpose of the project is to reduce life safety risk from floods, reduce flood damages to property and other economic losses from floods, while also contributing to the recovery of federally listed Oregon Coast coho salmon and restoring habitat for other native fish and wildlife species.

The project will remove the levee system near the confluence of the Trask and Tillamook Rivers and be replaced by a setback tidal dike to form the corridor. When the project is complete in 2016, it will reduce flooding in a roughly 3,000-acre area by removing 125,000 cubic yards of fill currently blocking water flow to the bay. As a consequence of removing that material, 14 miles of slough and channels that have been cut off from the rivers for decades will be reconnected, creating valuable overwintering habitat for salmon at the confluence of some of the most productive salmon-producing streams in the Northwest. The success of the project has relied on a shared vision to combine both flood control and river restoration as well as improve inter-agency alignment to maximize resources.

Winter Lake Restoration Project. Another successful public-private partnership for coho conservation is underway in the Coquille River Basin in southern Oregon. The Coquille Basin was once a prime area for salmon breeding, rearing and fishing, but today's salmon runs are a mere fraction of historic highs. Tidal wetlands, critical to the survival of salmon and birds, once covered most of the Coquille Valley. Today, only 5 percent of the historic wetlands in the Coquille estuary remain.

The Winter Lake Restoration Project will restore wetland function and tidal flow on two parcels of land, totaling 420 acres managed by the Oregon Department of Fish and Wildlife and the China Creek Gun Club. The Winter Lake Restoration Project's goal is to improve overwintering habitat for coho salmon. The China Creek Gun Club, Beaver Slough Drainage District, The Nature Conservancy, Oregon Department of Fish & Wildlife, local landowners and the local community have been working together since 2008 to restore ecosystem function and develop infrastructure that meets fish passage criteria. The collaborative and voluntary restoration effort has been built on the shared vision that a healthy working landscape strengthens the local community by creating jobs in Coos County, improving farming and ranching, improves water quality and restoring a thriving environment for fish and birds. The project site is known locally as Winter Lake due to the fact that the entire floodplain is typically inundated during winter months in most years due to high water levels in the Coquille River. This purpose of the project is to improve fish access into the floodplain for overwintering habitat that is limiting to coho salmon and other species, to improve the habitat quality of the site, to improve water quality and flushing within the district, support native plant communities, and replace the existing failing tide gate infrastructure with a new culvert/gate system that improves fish passage and also increases flexibility for BSDD landowners to manage water on the site. The Winter Lake restoration project is another example of how public-private partnerships that create common ground can work together to successful craft solutions that benefit both coho salmon and sustainable agricultural communities.

As these examples of public-private collaboration show, watershed restoration efforts succeed when the interests of communities, landowners, and local jurisdictions align and are considered in problem solving. Solutions that fit for the long-term bring in local communities and landowners as full partners in problem solving - recognizing the need to recover listed species while ensuring the economic vitality of coastal communities. Successful partnerships do not simply build and share better data. Rather, they succeed when individuals and organizations work together and exchange ideas, build relationships, identify common interests, and leverage resources so they solve problems of mutual interest. Such community-based conservation networks support sustainable management of private 'working lands' while advancing the recovery of Oregon Coast coho salmon.

8.6 Implementation and Oversight

Effective implementation of recovery actions for Oregon Coast coho salmon will require coordinating the actions of diverse private, local, state, and federal parties spread across the ESU. NMFS is actively partnering with Oregon to integrate the implementation of this recovery plan with the Oregon Plan for Salmon and Watersheds (ORS 541.898), the OCCCP, and the Oregon Watershed Enhancement Board's activities, at the ESU level including the development of the Coho Business Plan and population-level Strategic Action Plans with site-specific management actions.

NMFS will continue to work with ODFW, OWEB, other state, federal and local agencies, tribes, non-governmental organizations, and others to collaborate in the most effective ways to provide ESU-level coordination of recovery efforts. This will include adapting implementation of the OCCCP with newer state initiatives to help ensure that recovery efforts are closely coordinated.

8.7 Conclusion

As these public-private partnership models of collaboration show, watershed restoration efforts succeed when the interests of communities, landowners, and local jurisdictions align and are considered in problem solving. Solutions that fit for the long-term bring in local communities and landowners as full partners in problem solving ─ recognizing the need to recover listed species while ensuring the economic vitality of coastal communities. At the same time, strong leadership is also critical, especially, when multiple public agencies need to work to align their capacities. It is important for various parties to remain open to innovative approaches to problem solving, thinking out of the box, while maintaining a shared vision of where the coalition is going.

9. Research, Monitoring, and Evaluation and Adaptive Management[52]

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 and to NMFS in future listing determinations. 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 RME guidance, which contains specific recommendations based on the current status of the Oregon Coast coho salmon ESU and habitat and regional guidance. This chapter 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,
- 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.

[52] 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 was used in developing much of this chapter.

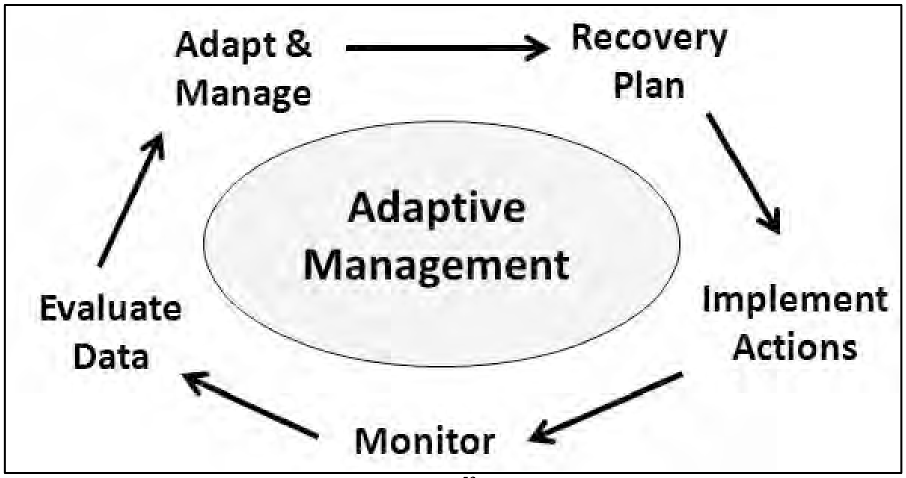

Figure 9-1. The Adaptive Management Cycle.[53]

Several types of monitoring can support adaptive management and help managers make sound decisions; for Oregon Coast coho salmon, the priority for monitoring and evaluation is rearing habitat:

- Implementation monitoring and compliance monitoring, which are used to evaluate whether recovery plan actions are being implemented as directed. To the extent there are available resources, we recommend a tracking system that records how local, state, and federal agencies and landowners have implemented key actions to increase habitat complexity and improve water quality (including on forest, agricultural, and rural lands) with clear schedules for implementation and monitoring. We have described a randomized sampling program that would 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, and recommend that the compliance rate should be equal to or greater than 90 percent.[54]
- 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).

[53] This figure and substantial information in this section comes from the Lower Columbia Recovery Plan, June 2013.
[54] (From Crawford and Rumsey 2011).

The most important critical uncertainties at this time include the condition (including net change) of freshwater and estuarine rearing habitats 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 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 and risks 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.
- Population-level impacts from predation, especially in the Lakes Stratum where non-native fish are a threat. To determine the significance of this threat, NMFS and/or ODFW could periodically (as resources allow) conduct, compile, and make available the status of invasive species and diseases known to affect coho salmon.
- 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.
- Poor ocean conditions may increase the risks to salmon associated with predation (Limburg et al. 2016). 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.

NMFS intends to work with ODFW on adaptive management, including consideration of the monitoring approach described in the Coastal Multi-Species Conservation and Management Plan (ODFW 2014).

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 Oregon Coast coho incorporate new guidance as it becomes available. One example that is 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.[55]

- 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

[55] Roni and Beechie 2012.

incorporated a number of suggestions from this document in our Listing Factor 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/.

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. Recognizing that monitoring programs are expensive and that budgets are limited, we underscore the importance of continued funding for Oregon's long-term monitoring program to track progress and adjust our efforts to achieve Oregon Coast coho salmon 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 programs described in the OCCCP, are for the most part still active and critically important, however numerous agencies are developing additional methods for monitoring and evaluating the status and changes in selected habitats. For example, the NWFSC and several agencies are developing methods (Beechie et al. 2016) to use remote sensing to track the net change of key habitat features (e.g., stream complexity - pools, ponds, and alcoves; connected off-channel habitat; riparian condition, and water quality) over time. NMFS expects these developments to complement the ongoing work of ODFW and others, and provide valuable information for us to consider in future listing determinations (see section 4.3.2).

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 by the NWFSC that could improve our understanding of the combined and relative effects of actions across the life cycle. This and other life-cycle models 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 Oregon Coast 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 Chapter 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?
- What is the net change of key habitat features in key portions of the independent populations over time?
- Is water quality (including cold-water refugia) improving?
- Is it a reasonable assumption that limited harvest of natural-origin coho salmon under Amendment 13 to the Pacific Fishery Management Council's Pacific Coast Salmon Fishery Management Plan will not impede recovery?
- Are the current RME efforts adequate to answer these questions?

We recommend that ODFW, NMFS, ODEQ, 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. We recognize the need for additional resources to implement these recommendations.

Draft hypothesis #1:

Habitat protection and restoration will increase survival and numbers of Oregon Coast coho salmon.

<u>Questions:</u>

1-1 Can the use of remote sensing provide a census, and track the net change, of key ecosystem and habitat features?

Draft hypothesis #2:

With the reduction in threats from harvest and hatcheries, if other factors (e.g., freshwater and estuarine 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. This would provide evidence related to the resilience of the ESU.

Questions:

2-1 What analyses are available to test this hypothesis?

2-2 Are the current RME programs adequate to test this hypothesis?

RME 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 #3:

The current regulatory mechanisms are adequate to prevent further degradation of Oregon Coast coho salmon habitat, including water quality.

Questions:

3-1 What does the latest habitat monitoring tell us about habitat trends and the role of regulatory mechanisms?

3-2 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.

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