CHANGES TO
THE OREGON COASTAL COHO ESU ASSESSMENT
PART 3 PECE A

Commenters offered a number of suggestions for adding information to this analysis. These include:

- A summary of compliance/enforcement information for regulatory agencies
    - Response: Additional information has been added under Criteria 6 about compliance and enforcement information and in individual agency reports for agencies with regulatory authority
- Information about existing Measure 37 claims
    - Response: Information about claims filed with the state and counties in the ESU through March 31, 2005 has been added under Criteria 2 and in Part 4(F) DLCD Urban Growth Management.
- Information about ODOT's road maintenance program and culvert work
    - Response: Summary information about the road maintenance program is now found under Criteria 4 and the culvert information is found under Criteria 5
- Information about aggregate and gravel resources/uses
    - Response: Information about DOGAMI's regulatory program has been added under Criteria 6, including specific information about permitted activities in the ESU
- Discussion of recent staff losses, and field staff shortages
    - Response: Information about changes in staffing levels in the ESU has been included under Criteria 1. While there have been some declines in field staff positions for some agencies, the state believes it has the staffing necessary to implement its conservation efforts in the ESU.
- Inclusion of STEP efforts as part of the voluntary participation
    - Response: STEP is now included under Criteria 6.
- Additional information on the Oregon Watershed Restoration Inventory including a break out by year, quantification of loss of fencing after installation, an explanation of the expected under reporting, and a map showing this data for the ESU
    - Response: Table 2 now shows the restoration treatments by year from 1997-2003.
    - A 2002 OWEB study (Anderson and Graziano, 2002) determined that 83% of fences were intact statewide. There is no specific data available for the Coastal coho ESU. When the state provides funding for fencing it requires that an agreement be established with the landowners to maintain the fencing for some period of time.
    - Information has been added under Criteria 6 that explains the perceived under reporting of restoration work completed.
    - The state attempted to create a map to reflect the information in Table 2 but found that because of the volume of projects completed the map became one of dots on dots on dots. As an alternative we recommend two options for reviewers. First, maps of restoration projects completed during

this time period can be found for each of the independent populations at http://mtjune.uoregon.edu/website/OWEB/Assessment. Second, this information can also be found in The Oregon Plan 2001-03 and 2003-05 biennial reports found at http://www.oweb.state.or.us.

- Information about the Fall Creek Research Hatchery
    - Response: Information about the Hatchery has been added under Criteria 6.
- Oregon Plan expenditures broken out for the ESU in Table 4
    - Response: Table 4 now includes an additional column showing how much of the total Oregon Plan expenditures are in the ESU. Of the total $88.5 million in Oregon Plan expenditures in the 2003-05 biennium $26.1 million is expended in the Oregon Coastal coho ESU.
- A request for a qualitative analysis of completed watershed assessments and action plans
    - Response: No analysis has been completed. However watershed assessments that have been completed used the OWEB Watershed Assessment Manual or an equivalent methodology.

Oregon Coastal Coho Assessment

Part 3A: Policy for the Evaluation of Conservation Efforts: The Certainty That the Conservation Effort Will Be Implemented

State of Oregon[1]

May 6, 2005

[1] For reference purposes, primary author is the Governor's Natural Resource Office, Salem, Oregon.

I. Introduction

In October 1995 Governor John A. Kitzhaber, M.D. directed state agencies to cooperate in the development and implementation of a state led initiative to restore coho salmon in two Evolutionarily Significant Units (ESUs) that encompass the entire Oregon coast. The effort was a

response to a proposal by the National Marine Fisheries Service (NMFS) to list coho salmon as threatened under the Endangered Species Act (ESA) in these ESUs. As the work progressed in 1996 he invited federal natural resource agencies to join the effort.

Although initial work focused on the details of improving the status of coho salmon in the coastal ESUs, early work led to the realization that the life history needs of the species could only be met by addressing the underlying issue of watershed function. Several basic issues were all crucial to species restoration and all were considered by the state in the design of a comprehensive restoration program:

- limiting the adverse impacts of fisheries;
- reducing the adverse impact of hatchery operations; and
- providing sufficient amount and quality of habitat to support the species' needs for spawning, rearing and migration.

Whereas the first two issues could be addressed through direct agency management action, providing for the habitat needs of the species required a landscape, or whole watershed approach, to management. Salmon require suitable habitat to support their life history needs from headwater streams to the ocean, a range of habitats that is crisscrossed by multiple ownership and land use characteristics. Thus, providing for the habitat needs of the fish could not be accomplished within any single agency's administrative jurisdiction or within any single land ownership or land use category. Sustainable coho populations require suitable habitat networks (watersheds) simultaneously influenced by local, state and federal agencies, and that regulate economic activities including forestry, agriculture, recreation and urban development.

Oregon's initial conservation planning effort quickly evolved along the following approach:

- First, address the species' need for conservation by making appropriate adjustments to fish harvest and hatchery programs (actions within the jurisdiction of the Oregon Department of Fish and Wildlife);
- Second, address the species' life history needs by making appropriate adjustments to watershed management (conservation, restoration, and enhancement of habitat within the jurisdiction of all state and federal agencies with regulation, management or ownership responsibility within the ESU); and
- Finally, enlist private landowners and other citizen stakeholders to actively support and participate in watershed restoration work.

The effort was expanded in 1996 to include plans to address water quality problems, through the Healthy Streams Partnership, under the federal Clean Water Act (CWA). In 1996 14,000 miles of stream and over 20 lakes were listed statewide on Oregon's 303(d) list of water quality impaired water bodies.

Former Governor John A. Kitzhaber, M.D. worked with his natural resource policy staff and the Natural Resource Cabinet to prepare a plan to address the conditions that were reflected by both ESA and CWA problems through a state-led strategic initiative. The original plan, called the Oregon Coastal Salmon Restoration Initiative (OCSRI), was later expanded to include a Steelhead Supplement after proposed listings in four ESUs in Oregon. Finally, the approach was expanded to all at-risk salmonids through Executive Order 99-01, following another round of proposed ESA

listings. What is now called the Oregon Plan for Salmon and Watersheds (OPSW) includes the original strategic objectives, and all salmonid species and the watersheds that support them.

The Oregon Plan that was adopted by the Oregon Legislature in March 1997 was a combination of actions designed to address the fishery management and watershed based life history needs of coho salmon. Everything in the habitat area of the Plan was intended to conserve and restore watershed function (including water quality). None of the habitat work was intended to improve the condition of coho at the expense of other species. Every element of the habitat work contained in the plan was intended to provide for conservation and restoration of watershed function.

Some of the foundation for this effort was built before 1995, including the passage of SB 23 in 1987, creating the Governor's Watershed Enhancement Board (GWEB) and HB 2215 in 1993, calling for the creation of local voluntary watershed councils. These bills formed the basis for watershed restoration funding, developing and implementing local watershed assessments, action plans, projects and monitoring. Also passed in 1987, the Instream Water Rights Act allowed agencies to apply for instream water rights to protect recreation, water quality and fish and wildlife habitat. In addition, SB 1010, passed in 1993, created a mechanism for addressing water quality problems associated with agricultural lands. Sufficient funding for addressing the expanded 303(d) listed streams was provided in 1997 as part of the Oregon Plan.

In addition, Oregon Department of Fish and Wildlife (ODFW) had already adjusted hatchery operations and harvest levels in response to declining coho populations on the coast before 1997. And many of Oregon's environmental statutes were enacted in the 1970s, 1980s and early 1990s providing better protection of watersheds, water quality and the many fish and wildlife populations that depend on healthy watersheds.

In 2003 the state initiated an assessment of the effectiveness of the Plan, beginning in the Oregon Coast coho Evolutionarily Significant Unit (ESU). Our purpose, first and foremost, was to assess the effectiveness of the Oregon Plan to determine how the state was doing in its efforts to restore Oregon Coast coho.

Part of this assessment includes analyzing the biological status and effectiveness of the conservation efforts under the federal Policy to Evaluate Conservation Efforts (PECE). NOAA Fisheries has again proposed Oregon Coast coho for a threatened listing as a result of a series of court decisions affecting the original listing determination. After considering abundance, productivity, persistence, distribution and diversity of Oregon Coast coho, the state's analysis of the biological status of Oregon Coast coho indicates that this population is a viable population.

Under the ESA, the federal agencies must "take into account those effort, if any, being made by any State…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" when making a listing determination. (16 USC 1533 (b)(1)(A)) The PECE lays out criteria for reviewing certain conservation efforts by states or others in making a listing determination. The state has analyzed those conservation efforts relating to Oregon Coast coho that have not yet been fully implemented or that have been implemented but where the full effects of the conservation effort is not yet known using the PECE framework.

It is important to note that this phase of the assessment is *not* an analysis of the sufficiency of the Oregon Plan to constitute a recovery plan for the species under the federal ESA.

The Oregon Plan included a specific monitoring approach to be carried out by certain agencies including ODFW, DEQ and ODF in particular. This assessment is the first attempt to pull together all the monitoring data collected since the start of the Oregon Plan in 1997 with baseline data and analyze the status of the species to determine where we stand with our efforts to address the factors for decline for Oregon Coastal coho outlined in 1997. Once this assessment in completed, the plan will be adapted as needed to address continuing concerns or new concerns raised by the analysis. The analysis will point out areas of effective use of resources and areas needing adjustment.

It is expected that the monitoring program will be adequately funded to continue into the future, allowing the state to detect any changes in conditions that need to be addressed through revisions to Oregon Plan actions.

III. Policy to Evaluate Conservation Efforts (PECE) Analysis

A. The certainty that the conservation effort will be implemented

As part of this assessment of Oregon Coast coho, the state has assessed its regulatory and non-regulatory conservation programs under the federal Policy for the Evaluation of Conservation Efforts When Making Listing Decisions (PECE Policy). This policy focuses on conservation efforts that have yet to be implemented, and those that have been implemented but that have yet to show their full effect. Oregon has been implementing the Oregon Plan since 1997, beginning with the Oregon Coastal Salmon Restoration Initiative (OCSRI) to address Oregon Coast coho, and has developed a seven year track record upon which to draw, adding strength to the certainty that the state can and will continue to implement its conservation efforts to restore these salmonids to sustainable and harvestable levels.

In addition, many conservation efforts had been undertaken prior to the Oregon Plan that were intended, at least in part, to address legacy issues adversely affecting salmonids and watershed health in Oregon. These include enactment of land use laws, forest practice laws, water quality laws, and fill and removal laws in the 1970s, as well as significant changes to fish harvest management and hatchery operations in the early 1990s.

In order to analyze the certainty that the conservation effort will continue to be implemented, the state identified the state and federal programs that make up the state's conservation effort and analyzed each under the PECE Policy criteria. These include:

- Forest management programs, including state forest management, private forest management and federal forest management under the Northwest Forest Plan;
- Water quality programs, including monitoring, updating water quality standards, NPDES permitting, water quality certification for instream work and removal and fill activities, nonpoint source pollution prevention programs, developing Total Maximum Daily Loads (TMDLs) and implementation plans, and providing technical and financial assistance;

- Agricultural management programs, including Agricultural Water Quality Management program, Confined Animal Feeding Operation program, Pesticides program, Weed Control and Invasive Species programs, and Soil and Water Conservation District programs;
- Water use programs, including monitoring and distributing water for instream water rights, and regulation of water rights;
- Fisheries harvest management programs;
- Hatchery management programs, including the state's Hatchery Management Plan and Native Fish Conservation Policy;
- Dredge, fill, and in-water construction programs, including the Removal-Fill Program, Wetland Management and Planning Program;
- Urban Growth Management, including the Statewide Planning Program and Statewide Planning Goals for Agricultural Lands, Forest Lands, Urbanization, Natural Resources and Estuarine Resources; and
- Watershed restoration programs.

The PECE lays out nine criteria by which the federal agencies will evaluate the likelihood that a conservation effort will be implemented. Below are the nine criteria with a summary analysis of the state's conservation programs and overall conservation effort. Following the summary analysis are the individual agency reports with their full analyses of the likelihood the agency will be able to implement or continue to implement its conservation efforts as part of the overall Oregon Plan for Salmon and Watersheds in the Oregon Coast coho ESU. In addition, the full report on Oregon's watershed restoration program in the ESU is included.

PECE Policy Criteria and Analysis

1. *The conservation effort, the party(ies) to the agreement or plan that will implement the effort and the staffing, funding level, funding source, and other resources necessary to implement the effort is identified.*

In 1997 the Oregon Legislature passed a series of bills implementing and funding the Oregon Plan. In HB 5042 $30 million was provided to fund new state agency staff (63 FTE) at several natural resource agencies, watershed council capacity building, and on the ground project work. This was the full amount requested to implement the plan in the Oregon Coast coho ESU. HB 3700 established a supplemental timber tax to provide $13.6 million of the $30 million with the condition that the tax would only apply if no coastal salmonids were listed in ESUs wholly within Oregon's borders. A fishing license surcharge provided $1 million and the Oregon Concrete and Aggregate Producers' Association (OCAPA) provided $400,000. The remaining funding came from the state's general fund. When Oregon Coast coho were listed in 1998, and the timber tax was repealed as a result, the Emergency Board stepped in and filled the remaining funding gap ($8.8 million) with additional general fund resources.

Also in 1997, SB 924 defined the Oregon Plan as the OCSRI program and activities and the Healthy Streams Partnership Agreement (to meet Oregon's CWA responsibilities). The bill also

established an oversight framework that included the Joint Legislative Committee on Salmon and Stream Enhancement, the Independent Multidisciplinary Science Team (IMST), the Healthy Streams Partnership (HSP) and the Coastal Salmon Restoration and Production Task Force. In addition, the bill strengthened GWEB's statutes.

The state established a team structure that continues today, to provide on-going direction for the Plan. The structure includes the:

- Natural Resources Cabinet, to address major policy issues that have interagency implications;
- Core Team, to discuss interagency policy issues related to implementation of the Plan;
- Implementation Team, to discuss and address barriers to implementation of the Plan;
- Monitoring Team, to design and implement a statewide monitoring strategy; and
- Outreach Team, to assist with outreach and education efforts.

A ballot measure and several pieces of legislation have passed since 1997 that further define the Oregon Plan and provide assurance that it will be funded and implemented over time, reviewed periodically, and adapted as needed to ensure the effectiveness of the actions taken under the Plan to restore at-risk species, restore watershed health and improve water quality statewide.

In 1998 Oregonians enacted Ballot Measure 66 by a two-to-one margin. This measure, amending the Oregon Constitution, dedicates 15% of the net proceeds of lottery revenue to parks and salmon and watershed restoration. The funding is split with 7.5% to parks and 7.5% to salmon and watershed restoration. The measure became effective July 1, 1999 and continues until 2014 at which time voters will be asked whether they want to continue to dedicate these funds for these purposes. This measure provides a continuous source of funding for the Oregon Plan.

In addition, in 1998, Congress began to make annual appropriations to the Pacific Coast Salmon Recovery Fund (PCSRF). For FFY 2005, $12 million is available to Oregon to help implement the conservation efforts under the Oregon Plan.

In order to implement Measure 66 the legislature passed House Bill 3225 during the 1999 session. Measure 66 required that a single agency administer the salmon and watershed restoration funding. HB 3225 amended the existing statutory framework for what was then known as the Governor's Watershed Enhancement Board (GWEB) to create a new agency – the Oregon Watershed Enhancement Board (OWEB), and to designate OWEB as the single agency responsible for administering Measure 66 salmon and watershed funds... The Board was expanded to include 6 citizen representatives and non-voting representation from the National Marine Fisheries Service and the Environmental Protection Agency. The bill also expanded the responsibilities of OWEB to include setting statewide and regional goals and priorities for funding decisions, reporting biennially to the legislature on the expenditure of Measure 66 funds, developing guidance and protocols for watershed assessments and watershed action plans, and supporting the development and implementation of a standardized data collection, management and reporting system.

Also in 1999 Governor Kitzhaber signed Executive Order 99-01 in January that expanded the Oregon Plan statewide, with a stated objective of protecting and restoring salmonids and improving water quality. The EO replaced and broadened an earlier Memorandum of Understanding between

the state and NMFS. The EO directs specific agencies to carry out certain tasks to improve and strengthen the Oregon Plan. This EO remains in effect today under Governor Kulongoski's administration.

In 2001 three additional pieces of Oregon Plan legislation were enacted: Senate Bills 945 and 946, and House Bill 3002. SB 945 assigned OWEB the responsibility for reporting biennially to the legislature and governor on implementation and effectiveness of the Oregon Plan. In addition OWEB was charged with developing a statewide monitoring program for the Plan. The bill codified the mission statement and goals for the Plan. It also added a list of the Oregon Revised Statutes (the regulatory framework), and federal and local government efforts to the description of the Plan. Those ORS are listed in the table below.

SB 946 made OWEB responsible for coordinating data and data needs of agencies related to the Plan and disseminating those data to local, state and federal agencies and others working on the Plan.

Oregon Statutes included in OPSW under SB 945

ORS Chapter	Topic
196.105 to 196.125	Columbia Gorge Protection
196.600 to 196.905	Wetlands
197	Land Use Planning Coordination
274	Submerged & Submersible Lands
366	State Highways
390	State & Local Parks; Recreational Programs; Scenic Waterways; Recreation Trails
465,466, 468 and 468b	Hazardous Waste & Materials; Environmental Quality; Water Quality
469.300 to 469.563, 469.590 to 469.619, 469.930 and 469.992	Regulation of Energy Facilities
477	Fire Protection of Forests & Vegetation
496, 497, 498, 501, 506, 507, 508, 509, and 511	Fish & Wildlife Laws
517.702 to 517.989	Mineral Exploration
527.310 to 527.370, 527.610 to 527.770, 527.990 (1) and 527.992	Insect & Disease Control; Forest Practices
530	Acquisition & Development of State Forests
536 to 543A	Water Resources Administration, Watershed Enhancement
543A.005 to 543A.415	Hydroelectric Projects
568.210 to 568.808 and 568.900 to 568.933	Soil & Water Conservation Districts, Agricultural Water Quality Management Program

HB 3002 created a 13 member Salmon Recovery Task Force with the charge to define recovery for the purposes of restoring anadromous salmonids populations to a point that they may be removed

from ESA status. The Task Force was also directed to establish criteria to evaluate salmon recovery.

In 2003 House Bill 2138 passed, implementing the Task Force report by defining "recovery," and the fish performance attributes that will be used to gauge success. In support of this definition the statute also defines "listed unit," "native fish," "naturally produced," "population" and "self-sustaining." In addition, the bill directs the governor to negotiate with federal officials to make sure the Oregon Plan satisfies the requirements of the ESA.

In the 2001-03 and 2003-05 biennia some staff reductions occurred in natural resource agencies as a part of significant budget reductions enacted to address a serious revenue shortfall in the state. This has resulted in the loss of some water quality staff at DEQ and some field staff at ODF.

The work being done under this assessment is one of the steps being taken to ensure that Oregon Plan programs satisfy the requirements of the federal ESA. In addition, the state has been involved in the Subbasin Planning process being used in the Columbia Basin as the basis for development of federal recovery plans.

2. *The legal authority of the party(ies) to the agreement or plan to implement the formalized conservation effort, and the commitment to proceed with the conservation effort are described.*

Oregon has in place an extensive set of laws and rules that provide the authority for the state's conservation efforts. These include statutory guidance on the Oregon Plan in general, under the first criterion above, and the specific laws and rules that guide the conservation responsibilities of particular agencies and private entities. Oregon's natural resources agencies, including Department of Forestry (ODF), Department of Agriculture (ODA), Department of Fish and Wildlife (ODFW), Department of Environmental Quality (DEQ), Department of State Lands (DSL), Water Resources Department (WRD) and Department of Land Conservation and Development (DLCD), have been granted the legal authority to carry out various laws governing the management of the state's natural resources.

Agencies have been directed by both the governor and the legislature to implement the conservations efforts described in the Oregon Plan. These same agencies and other entities have made a commitment to the conservation effort that extends back to 1997 and continues into the future. The commitment includes approval of agency measures by various boards and commissions that provide policy direction to agency staff as well as incorporation of the Oregon Plan priorities in individual agency programs, strategic plans and performance measures.

Information on the specific legal authorities for these conservation efforts is provided in response to criterion six below.

One concern that NOAA Fisheries staff have identified tentatively is the possible effects of Oregon Ballot Measure 37. In November 2004 Oregon's voters passed Ballot Measure 37, requiring compensation for land use laws, with exceptions (including laws required to comply with federal

law and pollution control laws), that decrease the fair market value of private real property. In lieu of compensation, government may in certain cases elect to modify, remove or not apply the law that triggered the compensation claim and allow the owner to use the property for a use permitted at the time the owner acquired the property. Measure 37 adds some uncertainty, particularly in areas of land use and growth management, to whether state and local government will be able to continue certain regulatory conservation efforts described in this report. At this time, however, the measure is not expected to affect significantly the state's authority to carry out the conservation efforts described in this assessment.

Through March 31, 2005, nearly 250 claims had been filed against the state. Most claims are based on laws that are enforced in some manner by the Department of Land Conservation and Development. Only 16 of these claims fall within the Oregon Coastal Coho ESU, involving approximately twenty five tax lots. Additional details about these claims can be found in Table 1 in Part 4 (F) Urban Growth Management.

The Oregon Attorney General has recently issued legal advice concerning Measure 37 that helps clarify some of the uncertainties concerning the likely affects of the measure.

3. *The legal procedural requirements (e.g. environmental review) necessary to implement the effort are described, and information is provided indicating that fulfillment of these requirements does not preclude commitment to the effort.*

Oregon does not have a state required environmental review similar to the federal National Environmental Policy Act (NEPA) process. However several agencies have legal procedural requirements that are imposed by statute as a precondition to further regulation. In general, these requirements do not affect the agencies' ability or authority to carry out existing conservation efforts.

One example of such requirements is the statutory preconditions to further regulation of forest practices by the Oregon Board of Forestry. Before the Board may adopt more stringent regulations, it must make a series of determinations concerning the need for such rules and whether there are less burdensome means of accomplishing the purpose(s) of the rules.

DEQ establishes water quality standards through rulemaking, and has extensive rules for developing and implementing TMDLs and issuing water quality permits. While DEQ is delegated authority under the Clean Water Act for its water quality programs, certain elements, such as establishment of water quality standards and TMDLs, require approval by the Environmental Protection Agency (EPA). DEQ must meet requirements of the federal Clean Water Act to change or update standards, update the 303(d) list of water quality limited streams and get EPA's approval for TMDLs. These approvals are another example of legal procedural requirements that could affect future actions under the Oregon Plan, but that do not concern existing plan actions.

DEQ also reviews all federal permits and licenses under the authority of section 401 of the CWA. This review is to ensure that the proposed action is consistent with the state's water quality standards that are intended to protect cold water fish as a beneficial use.

State statute requires the Oregon Board of Forestry, in consultation with the Environmental Quality Commission, to establish Best Management Practices and other rules applying to forest practices to ensure that to the maximum extent practicable non-point source discharges of pollutants resulting from forest operations do not impair the achievement and maintenance of water quality standards established by the EQC. DEQ and ODF conducted a sufficiency analysis for the Forest Practices Act in 2002. Conclusions include the finding that at the landscape scale the current protections are sufficient but that there is some risk current protections may not be sufficient at a site-specific scale for some small and medium streams. However, the significance and scope of this risk is uncertain. As a result additional work is being done in this area.

Rules for state forest management require formal adoption by the Oregon Board of Forestry (BOF) for all of ODF's forest management plans (FMP). Once approved, the FMP is adopted by the BOF as an administrative rule. This legal procedure (OAR 629-035-0030) actually ensures ODF commitment to its conservation effort, an FMP, and requires its implementation by the State Forester. Executive Order 99-01, issued by Governor Kitzhaber and continued by Governor Kulongoski, further commits ODF to participation in the non-regulatory Oregon Plan when managing state forest lands.

ODA's pesticide program is operated under an MOA with EPA, thus, EPA retains formal oversight of this program. EPA also retains indirect oversight of the state's Agricultural Water Quality and CAFO programs through EPA's approval of TMDLs and their implementation plans.

DSL regulates fill and removal activities in the waters of the state, including wetlands. State agencies (DEQ and ODFW) are provided opportunity to comment on these permits. Some of these activities may also require a federal permit from the Corps of Engineers under section 404 of the CWA, and/or section 10 of the Rivers and Harbors Act, in which case DEQ will do a water quality certification. DSL reviews permit requests for protection, conservation and best use of the water resources of the state and to avoid interference with or injuring public navigation, fishery and recreational uses of the waters. No significant additional future regulatory actions of DSL are contemplated for this ESU.

ODFW hatchery operations may require water rights from WRD, subjecting them to the same public interest review as other water rights requests. In addition, wastewater permits are often required for the operation of hatcheries to ensure that do not adversely affect water quality. The regulatory actions concerning fisheries management and harvest are already in place for the ESU. No significant additional regulatory actions of ODFW are contemplated for this ESU.

4. *Authorizations (e.g. permits, landowner permission) necessary to implement the conservation effort are identified, and a high level of certainty is provided that the party(ies) to the agreement or plan will implement the effort will obtain these authorizations.*

Most state agencies have already received the necessary authorizations for the work they are doing under the conservation effort. Where landowner permission or permits are desired or needed state

agencies have established protocols in place for obtaining them. Oregon's regulatory agencies generally have the legal authority to gain access to private lands for compliance and enforcement purposes. This includes the use of warrants if needed.

Some of the actions under the conservation effort require federal permits or authorizations. For instance, ODFW must get incidental take permits (ITPs) from NOAA Fisheries and US Fish and Wildlife Service (USFWS) for its research and monitoring efforts. ITPs are also required for certain fish harvest activities. These ITPs are currently in place, and it is expected they will continue to be granted in the future.

While DSL has permitting authority for work requiring the removal or fill of materials in waters of the state, obtaining DSL permits for restoration work has not been a major problem. Many of these same restoration efforts require a 404 permit from the US Army Corps of Engineers, which can also involve federal consultation under the ESA. Over the past five years, the state has developed a streamlined process for the review and authorization of these types of actions.

DEQ's water quality standards and TMDLs require EPA approval. We have developed a good working partnership with EPA that has resulted in approval of most of the state's water quality standards and all of the TMDLs submitted to date. EPA is currently reviewing the state's submittal of standards for toxic compounds, which brings the state up to date with EPA's national criteria.

The Oregon Department of Transportation (ODOT) has implemented statewide the Routine Road Maintenance program, a subset of the activities described in Limit 10(i) of the July 10, 2000 final rule prohibiting take of 14 threatened salmon and steelhead evolutionarily significant units. ODOT committed to implementing the Routine Road Maintenance program through best management practices described in its 'Routine Road Maintenance Water Quality and Habitat Guide Best Management Practices Revised 2004 (Guide)'.

Under the program, ODOT implements best management practices (such as erosion control measures, modifications to activities, timing and equipment, pollution prevention techniques, etc.) that minimize impacts to natural habitat and water quality. In addition, ODOT submits an annual report to NOAA Fisheries that summarizes the program. Other elements of the program include evaluating the effectiveness of the Guide every 5 years. Consequently, ODOT coordinated with NOAA Fisheries and ODFW to revise the Guide and in July 2004, ODOT received reauthorization of the Routine Road Maintenance program. Major additions to the Guide include storm water management, maintenance compounds and the development of tree corridor plans.

ODOT, NOAA Fisheries and ODFW rolled out the revised Guide to over 1000 ODOT Maintenance employees and the Association of Oregon Counties.

Oregon's voluntary watershed restoration efforts may, depending on the project type and site, require landowner approval, permits, consultation or other authorizations. Some of these requirements have been an impediment to getting work done. There are occasions where the time to work through the process delays the project for a year or more. There are also some landowners who decided not to participate in restoration activities because of permit conditions and processes, and the uncertainty with regard to take liability created by the listing and subsequent promulgation of the 4(d) rule.

The Oregon Watershed Enhancement Board, in cooperation with other state and federal agencies, developed a set of aquatic habitat guidelines to be followed when on the ground restoration projects are being implemented. OWEB, and other state agencies, require that these guidelines be followed as a condition of their grant funding.

5. *The type and level of voluntary participation (e.g. number of landowners allowing entry to their land, or number of participants agreeing to change timber management practices and acreage involved) necessary to implement the conservation effort is identified, and a high level of certainty is provided that the party(ies) to the agreement or plan will implement the conservation effort will obtain that level of voluntary participation (e.g. an explanation of how incentives to be provided will result in the necessary level of voluntary participation).*

Voluntary actions in the Oregon Coast coho ESU are especially significant to efforts to restore these salmonids because the species is primarily distributed on private lands rather than public lands in the ESU. There are a number of Oregon Plan partners that engage in voluntary efforts including watershed councils, soil and water conservation districts, STEP volunteers, and local governments, as well as private agricultural and forest landowners.

Watershed councils are the primary forum for the voluntary participation in watershed restoration at the local level. There are 16 watershed councils in the Coastal coho ESU as shown below in Table 1. These groups meet monthly, conduct watershed assessments, develop action plans which prioritize subbasin and watershed restoration projects, design and implement projects, and monitor their watersheds for baseline data and trends to determine the effectiveness of their actions.

The state tracks many of the voluntary efforts through the Oregon Watershed Restoration Inventory (OWRI) at OWEB. It is important to note that this database does not track all the restoration work being done in Oregon. Many landowners are doing restoration work using their own resources and, while they are encouraged to report this work to OWEB, they are not required to do so. Based on an analysis of the data the state believes there is under reporting for agricultural lands in particular. Below is a summary from 7 years of data reported to the OWRI for the Oregon Coast coho ESU. Table 2 shows the restoration treatments completed and Table 3 shows the dollars invested.

TABLE 1- WATERSHED COUNCILS

Monitoring Unit	Watershed Council
North Coast	Necanicum, Lower Nehalem, Upper Nehalem; Ecola; Tillamook; Nestucca-Neskowin
Mid Coast	Mid-coast including Salmon & Drift Creek, Yaquina, Alsea, Siletz; Siuslaw
Umpqua	Umpqua; Elk; Smith
Mid-South Coast	Tenmile Lakes; Coos; Coquille;

	Floras/New; and Elk-Sixes

TABLE 2

Treatments by Year for Restoration Projects (OR Coast ESU from OWRI 1997-2003 & IRDA 1998-2003)

Restoration Treatments	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**Total**
Instream: Miles Treated	83	101	74	83	61	96	27	524
Number of Instream Projects	135	216	140	98	76	90	50	805
Fish Passage: Number of Stream Crossings Improved	120	234	195	147	175	162	107	1140
Miles Accessible due to Stream Crossing Improvements	155	276	711	209	170	176	121	1818
Riparian: Miles Fenced	39	57	34	39	28	24	10	230
Riparian: Miles Planted	43	79	61	44	69	65	18	380
Road: Miles of Road Closures and Decommissionings	25	62	113	87	112	73	48	521
Road: Miles of Road Improvements	215	245	334	260	182	173	149	1558
Wetland: Acres Restored	34	27	0	130	0	10	0	201
Wetland: Acres Created	40	123	1	0	0	1	0	165
Wetland: Acres Improved	2	16	68	75	184	1	0	346

The state has a reliable long term source of funding for restoration actions under Ballot Measure 66. With 65% of the funds dedicated to "capital expenditures," over $30 million is available biennially to fund restoration and protection activities. Funding for "operational expenditures" includes biennial support for watershed councils and technical assistance to develop restoration projects.

OWEB is in the process of developing basin scale priorities for funding restoration activities in the state. The priorities will be adopted by Board rule. This process is expected to be completed by the end of 2005. The results of this assessment will be used to establish priorities for funding restoration efforts in the Oregon Coast coho ESU. It is expected that funding projects to improve stream complexity, with an emphasis on overwintering habitat, will become a high priority for funding throughout the ESU.

Since the late 1990's, ODOT has been addressing fish passage at culverts throughout the state, including the Coastal Coho ESU, either through replacing a culvert that does not provide fish passage with a culvert/bridge that provides fish passages, or retrofitting an existing culvert to improve fish passage.

ODOT has spent over six million dollars and replaced 22 culverts in the Coastal Coho ESU, opening approximately 56 miles of upstream habitat that had previously been blocked. Replacement culverts were installed throughout the ESU.

In addition, ODOT has spent over $490,000 to retrofit 40 culverts to improve fish passage in the ESU. The typical improvement involved installing baffles or weirs. Baffles provide roughness to the culvert and provide resting spots for the fish. Weirs pool the water, increasing water depth and also provide resting areas. ODOT Research, working with OSU, OWEB and other interested parties conducted a research project to determine the effectiveness of the culvert retrofits. The research was not conclusive; however, the research demonstrated that retrofitted culverts can improve fish passage. As a result of the retrofits, over 137 miles of habitat is more accessible to migrating fish.

The culvert retrofits occurred predominately in mid coast basins.

TABLE 3- RESTORATION INVESTMENTS

Key Facts Regarding Restoration in the Costal Coho ESU 1997 – 2003	
Total Investment - $107 million • Road work –$52 M • Fish Passage - $25M • Instream - $13M • Riparian - $7M • Other & Combined - $10M	**Typical annual restoration investment** • $12 - $22M
Distribution of Restoration across the ESU North Coast - $40M Mid Coast - $31M Umpqua - $27M Mid-south Coast - $19M	**Source of restoration funds** • Federal – 31% • State – 34% • Private – 30% • Other – 4%
OWEB grants – total $23 million • Restoration - $13M • The remaining $10 M was distributed among Assessments, Council Support, Education, Monitoring, and Acquisition	**Monitoring Investment – total $16 million** (State funds only)

Under ODA's agricultural water quality management program, broad performance objectives for improving water quality in agricultural and rural areas are developed by local landowners along with plans to meet these objectives. Individual farmers are encouraged to develop individual farm plans to comply with adopted plans. Technical assistance is provided to landowners by the Natural Resources Conservation Service, ODA's field staff, and local soil and water conservation districts. Financial incentives are available to help implement the plans including the OWEB Small Grant Program and regular grant program, DEQ's 319 Program and federal grant sources such as the Environmental Quality Incentive Program (EQIP), Wildlife Habitat Improvement Program (WHIP), Wetland Reserve Program (WRP) and Conservation Reserve Enhancement Program (CREP).

Agricultural landowners are subject to enforcement action for compliance with rules adopted in conjunction with the agricultural water quality management area plans. In addition, confined animal feeding operation (CAFO) regulations and permits control some agricultural operations. Between the available technical assistance and grant resources, and the potential for enforcement action if farms and ranches do not comply with the adopted plans and regulations, adequate incentives exist for agricultural landowners to comply with these requirements.

Included as part of ODF's conservation efforts is a voluntary commitment by private forest landowners, represented by the Oregon Forest Industries Council, Oregon Small Woodlands

Association, Oregon Forest Resources Institute, OSU Extension Service, Associated Oregon Loggers and others. The commitment includes actions to improve roads, provide for fish passage, enhance habitat through the placement of large wood instream, and actively manage streamside forests to accelerate improved riparian function.

Table 4 is a summary of the voluntary activities related to improving riparian function for the ESU on all land ownerships. This is not a complete listing of landowner activities, but reflects those reported to the Oregon Watershed Restoration Inventory. Efforts by private landowners to make improvements on their property that favorably impact the environment are on going and often not reported because they do not involve government resources. We expect this level of activity to continue into the future.

TABLE 4 – RIPARIAN SUMMARY

Year	Number of Projects (n)	Miles of Restoration					
		Riparian Planting	Riparian Fencing	Voluntary Tree Retention	Hardwood Conversion	Other Riparian Projects	Total Miles of Riparian Restoration
1997	194	56.1	61.7	39.8	8.9	0.1	167
1998	208	37.7	20.3	58.6	5.0	2.4	124
1999	226	35.7	22.8	47.6	6.3	0.0	112
2000	231	33.5	32.8	74.3	0.5	0.4	142
2001	203	121	45.7	47.7	0.2	0.0	215
2002	128	33.7	31.0	31.5	0.0	0.0	96.2
2003	182	7.6	7.4	67.4	0.4	0.0	82.8
All Years	**1372**	**326**	**222**	**367**	**21.2**	**3.0**	**938**

WRD and ODFW worked collaboratively to identify streams where there was a need to improve instream flows for salmonid restoration and a high likelihood that instream flows could be increased. This information is being used by non-governmental organizations like the Oregon Water Trust and local watershed councils to identify specific opportunities for instream flow restoration on a voluntary basis.

Voluntary streamflow restoration (through acquisitions, instream leases, instream transfers, and allocations of conserved water) has restored over 25 cfs of flow in the coho ESU. These flow restoration projects have been focused in the Mid-South Coast and Umpqua monitoring units where consumptive use of water is highest.

ODFW's Salmon and Trout Enhancement Program (STEP) engages volunteers in the ESU in habitat restoration efforts, hatchery fish management and educational activities. In addition ODFW is constructing a new hatchery research facility on Fall Creek (Alsea watershed) to research ways to better manage hatchery fish to assist with conservation and recovery efforts.

6. *Regulatory mechanisms (e.g. laws, regulations, ordinances) necessary to implement the conservation effort are in place.*

Oregon Department of Fish and Wildlife (ODFW) has regulatory authority to manage hatchery and fish harvest programs affecting waters of the state. ODFW works through the Pacific Fishery Management Council to develop and implement harvest programs for ocean fisheries beyond the three-mile limit.

ODFW adopted the Native Fish Conservation Policy (NFCP) in 2002 and Fish Hatchery Management Policy (FHMP) in 2003 by rule. The purpose of the NFCP is to ensure conservation and recovery of Oregon's native fish species. The purpose of the FHMP, along with the Fish Health Management Policy, is to describe the hatchery tool and its uses, with the intent of maintaining genetic resources and helping ensure conservation of both naturally produced and hatchery produced native fish. In addition, ODFW has submitted Hatchery Genetic Management Plans (HGMP) to NOAA Fisheries for all coho hatchery operations in the ESU.

Hatchery operations in the Upper Umpqua and Salmon River have been identified in this assessment as continuing threats to the viability of Oregon Coast coho populations in these two areas. ODFW will address these hatchery programs as the NFCP and FHMP are implemented for this ESU on a timeline consistent with the federal recovery planning process.

Oregon's state, private and some federal forests are regulated under an extensive set of laws and rules addressing forest practices and management of forestlands to protect forest resources including timber, water, soil and fish and wildlife habitat.

A key impetus behind passage of the first Forest Practices Act (FPA) in 1971 was protection of water quality under the Clean Water Act. The FPA, and ODF's rules to implement the Act, have been strengthened several times since they were first adopted, as better science has become available about the impact of forest activities on other forest resources. ODF has been implementing and reviewing proposed rule changes for the past 5 years (the final set of proposed rules are tentatively scheduled for public comment in 2005) to provide additional protection for water quality and riparian areas, particularly on medium and small streams.

The FPA sets standards for any commercial activity involving the establishment, management or harvesting of trees on Oregon's forestlands. It regulates these forest operations on all non-federal lands (private, state-owned, and county- or city-owned) and a limited amount of federal lands (e.g.; Bureau of Reclamation). Operations on lands managed by the USDA Forest Service and USDI Bureau of Land Management are not directly regulated under the FPA. These two federal agencies are "designated management agencies" under agreement with the Environmental Quality Commission and their management plans and standards must meet or exceed the Oregon Forest Practices Act requirements.

The FPA rules cover a wide range of issues pertaining to forest operations and resource protection. In general, the rules are designed to minimize impacts of forest activities on other forest resources, including water quality, and fish and wildlife habitat. To a limited degree the rules address other

issues including scenic considerations and public safety. Among other things, the rules focus on minimizing sediment delivery to channels, providing 50-year flow and juvenile fish passage through culverts, maintaining function of riparian areas, and protecting water quality, air quality, wildlife and fish habitat. It is important to recognize that the rules are designed to minimize impacts rather than to ensure that operations have no impact. This is a practical approach balancing the need to maintain an economically viable forest industry to avoid the conversion of forest lands to residential uses, with the need to protect other forest resources and functions.

The FPA Water Protection Rules identify and distinguishes among streams, lakes, and wetlands in seven geographic regions across the state. The rules further distinguish each stream by size and type. Stream size is distinguished as small, medium, or large, based on average annual flow and beneficial use. This approach endeavors to recognize that forests are dynamic, with regional differences resulting from inherent characteristics and disturbance regimes. Stream type is distinguished as fish use, domestic use, or neither.

State forest lands are managed to achieve the greatest permanent value (GPV), which means healthy, productive, and sustainable forest ecosystems that over time and across the landscape provide a full range of social, economic, and environmental benefits to the people of Oregon (OAR 629-035-0020).

Federal forests in the Coastal coho ESU are managed under the Northwest Forest Plan and Aquatic Conservation Strategy (ACS). The ACS includes prescriptive protections for aquatic species, development of watershed analyses, and watershed restoration and protection actions based on the results of the analyses.

Oregon's agricultural lands are regulated through a series of laws and rules that address agricultural water quality management plans, confined animal feeding operations (CAFOs), pesticides, weed control and invasive species, and soil and water conservation districts. ODA has the authority to adopt water quality management plans for agricultural lands where those lands are contributing to known water quality problems. Plans have been completed throughout the state and are now being implemented. In addition, ODA has authority to regulate CAFOs. In 2001 a legislative change was made to bring the program into compliance with EPA's CAFO regulations. Permitted CAFOs have been inspected annually since 1999.

ODA also regulates all aspects of pesticide use, not just agricultural use. The program is implemented under an agreement with EPA. ODA has the authority to regulate pesticide user licensing, registrations, and use reporting. In addition ODA has the authority to carry out a pesticide use compliance monitoring program. While the state has regulations and rules regarding reporting of pesticide use, no funding was provided during the 2003-05 biennium. As a result no reporting is occurring. The 2005-07 Governor's Recommended Budget includes $1.4 million to fully fund this program. In addition to the ODA regulation of pesticides, the Forest Practices Act applies and regulates pesticide use on forestlands. This means that on forestlands, both the "label requirements" adopted by ODA and specific best management practices adopted under the Forest Practices Act are applied.

ODA works with the State Weed Board and Oregon Invasive Species Council to prevent the introduction and spread of weeds and invasive species.

ODA also works closely with Oregon's 45 soil and water conservation districts. Districts are established statutorily as units of local government. Soil and water conservation districts cooperate with watershed councils throughout the ESU to implement projects that have conservation benefits.

WRD regulates the use of the state's water for beneficial use, including instream uses through its watermasters. Water is regulated under a water right system with priority dates. Water rights may be issued for instream uses including recreation, water quality and fish and wildlife needs. In the Oregon Coastal coho ESU, 800 instream water rights exist in over 3,700 miles of stream. Of the 54 instream water rights measured at continuous gauging stations in the ESU from 1991-2002, 39 were met more than 80% of the time.

The statute allowing for instream water rights was not passed until 1987. These rights are junior rights to rights already established, and were typically issued for up to the 50% exceedance flow of the stream (the stream flow that is met 50 percent of the time on average). For these reasons, instream water rights may not be continuously met year round on streams. However, water rights may also be transferred to instream uses, keeping the same priority date as the original water right. In addition, many of the minimum streamflows that existed under earlier statutes were converted to instream water rights with their original (earlier) priority dates.

DEQ has federally delegated authority to regulate water quality in Oregon through the Clean Water Act and broader authority through state statutes. This includes establishment of water quality standards, monitoring of water quality conditions, development of total maximum daily loads and implementation plans for impaired waterbodies, and issuance of NPDES permits for point-source discharges.

DSL has regulatory authority over fill and removal activities in the waters of the state and conservation of the state's wetlands. As part of these regulations DSL has designated Essential Indigenous Salmonid Habitat areas, where fill or removal of any amount of material requires a permit. DSL also administers a removal-fill permit program on State Scenic Waterways. Fill or removal of any amount of material in State Scenic Waterways requires a permit. Outside of these areas DSL regulates fill and removal activities involving 50 cubic yards or more of material. One area that remains unregulated is the removal of large wood from streams since wood is not part of the definition of "material" under the removal statutes. Discussions continue about how best to address this issue.

Mining at and above the 2 year high watermark on all upland areas other than tribal land is permitted by DOGAMI. In-stream and up to the 2 year high-water mark is permitted by DSL. DOGAMI statutory authority resides in ORS 517.750 – 517.992 and OAR 632 DIVISION 30,33,35,37 AND 38.

Permits include a mine plan, reclamation plan, a financial security to insure reclamation is completed and any conditions the agency deems necessary to insure that there will be no significant adverse impacts during mining and that reclamation can be implemented as proposed.

Clearly one of the most sensitive issues to be dealt with is mining in the floodplain. As a result of the 96-97 floods DOGAMI developed guidelines for the protection and enhancement of mine areas on the floodplain.

In addition, in 1998 DOGAMI entered into a Memorandum of Agreement (MOA) with DEQ to administer the NPDES 1200A general storm-water permits and the WPCF 1000 permits to increase regulatory effectiveness at floodplain sites. The MOA was an inter-agency response to the Oregon Plan.

DOGAMI believes that potential turbidity is of the greatest concern at these sites. Protection of riparian function goes "hand in hand" in controlling sediment from mine sites. To that end any permitting on the floodplain is cognizant of the need to keep any turbidity within Clean Water Act standards. All permits issued by DOGAMI are circulated to pertinent state natural resource agencies and are conditioned to incorporate comments of the agencies. One note here: the eligibility of a site to be mined is authorized by the local land use authority and public comment is addressed at that time by the land use authority.

The foundation of the program is on site inspections to insure the mine plans and reclamation plans are sequenced properly and are in compliance. The program completes 1,500 on-site inspections per biennium with priority given to floodplain sites. In addition ~300 sites are flown annually which provides aerial photogrammetry for boundary control of these sites and a GIS layer.

In terms of rock quality, competent rock (based on ODOT specifications) is in short supply in the ESU. There are currently 138 DOGAMI (17% of total permits) permitted sites in the ESU boundary. Of those 17 are considered floodplain sites. In addition 67 sites have storm-water permits. Those sites produce ~ 4.5 million tons of rock or about 10% of the statewide production. Total acres disturbed by mining in the ESU are currently 1,800. The largest production area is by far the Umpqua basin with the largest production demands in the Roseburg area.

Floodplain mining clearly needs to be regulated to prevent off-site impacts. The agency responding to the flood events of 96-97 and listing of some salmonids soon after, has significantly changed reclamation goals. There are clearly opportunities to broaden floodplain functioning particularly within the recent (75 year) meanders of streams and rivers and that is now a major policy incorporated in floodplain permits.

DLCD is statutorily charged with implementing the Statewide Comprehensive Planning Program which was first adopted in 1973. The Land Conservation and Development Commission adopted by rule a set of Planning Goals (19 in total), having the full force and effect of law, that govern land use planning across the state. Local jurisdictions are required to adopt a comprehensive land use plan that is consistent with the Goals. DLCD reviews the plans and amendments to the plans for this consistency. The overarching purpose of the Program is to protect farm and forest land and other natural resource values, while requiring urban density development to occur within urban growth boundaries. The Governor's 2005-07 Recommended Budget includes resources to conduct a 30 year review of the land use program.

Regulatory agencies have a proven track record of using their authorities to enforce Oregon's environmental laws when necessary. Both ODA and DSL identified some issues with timely response to complaints in the past. These agencies now have procedures in place to respond timely to complaints of potential violations. Specific agency information on enforcement and compliance data can be found in Part 4 Agency Reports in response the PECE Part A Criteria 6.

7. *A high level of certainty is provided that the party(ies) to the agreement or plan that will implement the conservation effort will obtain the necessary funding.*

Funding for the Oregon Plan has become more certain since the passage of the first budget in 1997. Several events have combined to provide a stable and steady source of funds to pay for state agency efforts and the work of Oregon's watershed councils and soil and water conservation districts.

In 1997, in addition to passing a $30 million budget for the Oregon Plan, the legislature passed Senate Bill 372 that created a Salmon License Plate with a special surcharge dedicated to parks and salmon restoration efforts. There is a $30 biennial surcharge for these special plates, with 50% net of expenses going to OWEB for salmon restoration projects. The Board has dedicated these revenues, currently about $30,000 per month, to road related projects such as culvert work and road decommissioning that help improve fish habitat and water quality.

As mentioned earlier, Ballot Measure 66 passed in November 1998 with 7.5 percent of the net proceeds of the state lottery dedicated to fish and wildlife protection, restoration, and enforcement efforts. This has provided a stable source of funding even in a period of declining budget revenues through 2014. For the 2003-05 biennium $54.7 million is available to fund Oregon Plan efforts with these revenues. For the 2005-07 biennium the Governor's Recommended Budget (GRB) includes $61 million in lottery funds for this purpose.

Beginning in federal fiscal year 1999 the Pacific Coastal Salmon Restoration Fund was created to provide annual appropriations from Congress to help with ESA restoration efforts in the Pacific Northwest states with ESA listings. For the 2003-05 biennium $33.8 million has been available to the State of Oregon for its salmonids restoration efforts. The GRB for 2005-07 includes $16 million in federal funds. It is anticipated that FFY 06 funds will also become available to the state during the 2005-07 biennium.

Funding for the Oregon Plan has grown significantly since 1997 as a result of these actions. In the 1997-99 biennium $30 million was budgeted for the Plan, with $10 million for additional state agency staffing (63 FTE) and monitoring to carry out state measures and $20 million to fund local efforts including staffing for watershed councils, assessment and action plan development, outreach and education efforts and restoration projects. In the current biennium $88.5 million has been appropriated statewide from all sources to directly fund the Plan. Of this amount over $26 million is being spent in this ESU. Table 4 shows the allocation of the funds by fund source under the Legislatively Approved Budget (LAB) for the current biennium. An additional $8.3 million in federal funds expenditure limitation above the LAB was approved by the Emergency Board in April 2004.

TABLE 4- 2003-05 BIENNIAL BUDGET

LAB 2003-05 M-66 Lottery and PCSRF Federal Allocations

	General Fund	M-66 LF Operations	M-66 LF Capital	PCSRF	Coastal Coho ESU Expenditures
Available Resources May '03 M-66 forecast and 01-03 unallocated		**18,244,226**	**36,498,645**	**25,852,000**	
Congressional Earmarks Columbia Hatcheries				**1,100,000**	
ODFW Mass Marking Trailers				**2,094,323**	
ODFW					PCSRF Coho 5,500,000
Coastal Monitoring				**878,000**	
Oregon Plan Monitoring				**3,893,636**	
Fall Creek Hatchery Research Center[1]			5,125,000		5,125,000
Fish Screens Program			4,000,000		500,000
Fish Screens Program Support	(206,424)			**206,424**	
Spawning Surveys	(22,067)	22,067			22,067
Water Policy / Fish Flows	(264,082)			**264,082**	
Outreach and Education	(224,000)			**224,000**	
Oregon Plan Coordination					
Oregon Plan Implementation					
Habitat Biologists	(424,674)			**424,674**	
Wildlife Diversity					
Land Owner Assistance					
Habitat Protection	(30,000)	30,000			30,000
Seal Predation	(224,133)	224,133			224,133
Oregon Plan Implementation[1]					
Aquatic Surveys[2]	(362,724)			**362,724**	
Fish Passage[2]	(375,455)			**375,455**	
Totals	(2,133,559)	276,200	8,000,000	**6,628,995**	11,401,200
OSP/Fish&Wildlife					
Oregon Plan Base		4,064,126	846,821		1,399,130.97
Commercial Fish Enforcement		862,624			718,853.33
Totals	0	4,926,750	846,821	**0**	2,117,984.30
DEQ					
TMDL Development	(3,375,000)	3,375,000			230,040
Willamette TMDL Acceleration	(387,071)			**387,071**	0
Volunteer Monitoring Coordinator	(210,000)			**210,000**	84,000
Oregon Plan Monitoring	(782,182)			**782,182**	582,182
Totals	(4,754,253)	3,375,000	0	**1,379,253**	896,222

Water Resources						
Oregon Plan Data		(800,000)			**800,000**	136,574
Instream water rights, tech assist		(1,200,000)			**1,200,000**	205,461
	Totals	(2,000,000)	0	0	**2,000,000**	342,035
OWEB						
LCREP						
Capital Project Grant Fund				24,221,497		4,750,000
CHIP[3]			650,000			650,000
ESA Linkage					**469,519**	469,519
PCSRF Admin Allowance					**660,000**	198,000
IMST					**600,000**	150,000
LCREP			200,000			
Local Watershed Councils			1,000,000		**3,100,000**	880,000
Council Supplemental Funding						
OWEB Base Operations			4,062,013			350,000
	Totals	0	5,262,013	24,221,497	**4,829,519**	7,447,519
Forestry						
Cumulative Effects		(96,346)			**96,346**	67,442
Data Collection and Monitoring		(973,973)			**973,973**	681,781
Oregon Plan Coordination		(283,921)			**283,921**	198,745
Education and Outreach		(74,967)			**74,967**	52,477
Forest Practices		(2,592,211)			**2,592,211**	combined w/tech assist
Technical Assistance/Forest Mngt.		(698,492)			**698,492**	1,088,514
	Totals	(4,719,910)	0	0	**4,719,910**	2,088,959
Agriculture						
Agricultural Water Quality		(3,375,000)	3,375,000			528,735
Riparian / Wildlife Habitat Weed Control		(370,357)		2,082,809		147, 710
Riparian / Wildlife Habitat Pest Control		(1,347,518)		1,347,518		
Soil & Water Conservation Districts		(1,700,000)	1,000,000		**3,100,000**	1,188,688
SWCD M-66 Support			0			
Pesticide Use Reporting						
	Totals	(6,792,875)	4,375,000	3,430,327	**3,100,000**	1,865,133
	Total Allocated	(20,400,597)	18,214,963	36,498,645	**25,852,000**	26,159,052.30
	Remaining Unallocated		29,263	0	**0**	0
Available New Revenue						
Target		107,012				
		(20,293,585)				

[1]Includes $1,125,000 from the Restoration and Protection Research Fund.
[2]Other Fund expenditures are reduced and this OF revenue is used to backfill GF in other ODFW programs.
[3]Funded with interest on Operations in Research Fund

7/23/03 OWEB version

The 2005-07 Governor's Recommended Funding includes $77 million in Oregon Plan expenditures, including new general fund resources to fund TMDL implementation work and the Pesticide Use Reporting System.

8. *An implementation schedule (including incremental completion dates) for the conservation effort is provided.*

Many of the original implementation schedules for the Oregon Plan have been completed. For instance, all of the agricultural water quality management plans and rules have been completed for this ESU. Each set of rules adopted have compliance deadlines for conditions to be met, which are found in the Department of Agriculture report. ODA also reviews implementation of these plans biennially.

Watershed assessments and action plans have been completed for most of the ESU.

Many agency efforts are ongoing efforts and do not have specific implementation schedules at this point. This includes ODFW's hatchery and fish harvest management efforts, which have been implemented and will continue to be monitored and adapted as needed. DSL's wetlands protection and fill and removal programs, and DLCD's land use program are on-going responsibilities. WRD has performance measures and annual performance targets for its efforts to monitor instream water rights and its efforts to restore streamflows in watersheds with the greatest need for flow restoration. WRD does not currently track these two performance measures at the Coastal coho ESU scale. While those data are not currently available, performance for both of these measures could be tracked at the coho ESU scale in the future. The targets for both measures could apply on this smaller geographic scale as well.

DEQ is following its schedule to complete Total Maximum Daily Loads in the ESU as indicated in their report. To date, four TMDLs have been developed within the Coastal Coho ESU. These are the Nestucca, Tillamook, Nehalem, and North Coast Basins. Other TMDLs in the ESU are scheduled to be completed as follows: Umpqua, 2005; Sixes, Coos, Coquille, 2006; and Alsea, Siletz-Yaquina, Siuslaw 2008.

ODF is working on changes to its rules dealing with riparian protection on private lands in response to the recommendations of the Forest Practices Advisory Committee. At this time, rules have been drafted but the rule review process has not yet started. This is expected to occur in 2005. In addition, private forest landowners will continue to voluntarily address legacy road issues through 2012.

On state forest lands, a 10 year implementation plan was adopted in 2003 for the Northwest and Southwest Oregon Forest Management Plans. The plans may be reviewed prior to 2013 if new information becomes available as a result of planned watershed assessments.

The federal Northwest Forest Plan and Aquatic Conservation Strategy provide a predictable framework for conservation on federal forest lands. The Forest Service has developed a Coastal Watershed Restoration Partnership to address aquatic restoration needs in coastal watersheds.

9. *The conservation agreement or plan that includes the conservation effort is approved by all the parties to the agreement or plan.*

Through a series of legislative actions (described above) from 1997 to 2003, the Oregon Plan has been funded, adopted and codified by the Oregon Legislature.

Executive Order 99-01 was issued by Governor Kitzhaber and continued by Governor Kulongoski. This Order expands the Plan statewide and directs agencies to complete certain tasks.

As an interagency plan, all of the necessary agencies were involved in the development of the overall plan and their specific contributions to the conservation effort. The various boards and commissions that oversee these agencies approved their agency's commitments (measures) through formal action.

Summary

The State of Oregon has in place the regulatory and non-regulatory programs and funding necessary to implement its conservation efforts under the Oregon Plan for Salmon and Watersheds in the Oregon Coast coho ESU. The Oregon legislature has enacted several pieces of legislation that codify the Oregon Plan. Funding for the Oregon Plan increased significantly between the 97-99 and 03-05 biennia and it is expected that the Oregon Plan budget will grow again in the 05-07 biennium.

The state agencies that participate in the Oregon Plan have the legal and regulatory authority, resources, authorizations, staffing, and commitment to carry out their conservation efforts. The agencies have been directed by the legislature, through legislative action, and by the governor, through executive order, to carry out their conservation commitments. The various boards and commissions that provide policy direction to the agencies have also approved the conservation efforts for their respective agencies.

Incentives, in the form of financial support, technical assistance and potential enforcement actions under regulatory backstops, ensure that the actions contemplated under the Oregon Plan on private lands will occur. In short, most of the conservation efforts described in the Oregon Plan for this ESU have been implemented or are close to being completed. To the extent that there is any uncertainty concerning these efforts, that uncertainty lies with the effects that these efforts will have over the long-term.

As documented in this assessment, it is highly unlikely that there would be a significant deterioration in the habitat conditions that the Oregon Coast coho depend on in the foreseeable future. In part, this is due to the extensive monitoring the state has put in place. With careful monitoring, and a set of conservation efforts that appear to have at least stopped if not reversed long-term negative trends in key habitat functions across the ESU, it appears that there is no future

threat to habitat that could not be controlled through appropriate changes in state management, or (if necessary) through federal action to reevaluate the ESA status of the ESU.

Oregon is committed to moving forward with development of a conservation plan for Coastal coho regardless of NOAA's listing decision. This plan will be developed in consultation with the Coastal Coho Stakeholder Team and NOAA Fisheries. Oregon's Native Fish Conservation Policy requires development of such a plan. Should Coastal coho be listed the plan will be drafted to serve as both a federal recovery plan as well as a state conservation plan.

CHANGES TO
THE OREGON COASTAL COHO ASSESSMENT
PART 3 PECE B

May 6, 2005

Introduction

Oregon has received and reviewed comments on the Coastal Coho Assessment from approximately 20 sources, including Oregon's Independent Multidisciplinary Science Team, NOAA, the Stakeholder Work Group, various representatives of environmental and resource industries, and citizens. The State appreciates the effort and commitment of reviewers and has taken all suggestions under consideration. These review comments, collectively, have been extremely constructive and have helped authors of various Assessment documents improve the technical content and clarify Oregon's message. The revision of Coastal Coho Assessment documents incorporates revisions that were deemed appropriate and executable given constraints of time and resources. Oregon has focused revisions on areas of the report judged to be most important to provide a thorough evaluation of minimum ESU viability and to present Oregon's interpretation of management programs and restoration actions related to future viability of the ESU.

Responses to NOAA Fisheries Northwest Regional Office Comments on Part 3B: Policy for the Evaluation of Conservation Efforts: The Certainty That the Conservation Effort will be Effective

NOAA Fisheries; P. 5, Risks to Viability: The methodology used to determine the ranking of risk factors which remain a threat to viability is not provided. In addition, the information in Figure 1 seems to contradict a statement on page 4 that says that hatchery-related impacts are generally the primary or secondary threat to viability. Figure 1 does not support this statement.

- The methodology to determine risk factors was revised by the State and is included in Part 1 Synthesis Report and is referenced to the Synthesis Report in Part 3B. Figure 1 and comments were also revised accordingly.

NOAA Fisheries; P. 8, Legacy of Past Management: The chapter concludes that because the ESU has been judged to be viable, then the habitat quality and quantity is sufficient to maintain a viable ESU. What information is this conclusion based on? The chapter seems to contradict this conclusion when later in the paragraph it identifies a concern about lack of high quality overwintering rearing habitat. How will Oregon achieve the goals of improved stream complexity without identifying how programs need to modified or changed to overcome continuing degradation due to legacy effects and increased habitat-altering activities across the landscape? How will Oregon monitor changes in riparian condition when its current monitoring practices are not detecting habitat changes?

- The State developed a new section "Biological Status of Coho and the Relationship to Habitat Conditions in the ESU" that describes the relationship of viability to current and future habitat conditions and the sensitivity of ESU viability to changes in habitat conditions.
- The State disagrees with the supposition that current programs need to be modified to overcome continuing degradation due to legacy effects and increased habitat-altering activities on the landscape. We find no evidence that habitat conditions continue to decline, current monitoring programs will be able to detect small changes in the next 3-8 years, if habitat conditions are changing, we expect change to be small and take time, thus the importance of the monitoring program. In terms of future changes to habitat, the State has included findings from the CLAMS project which suggests riparian conditions are likely to improve at varying rates over the next 100 years. These finding, in combination with existing regulatory and non-regulatory programs, led Oregon to conclude that habitat conditions are unlikely to decline over the next 100 years and are in fact more likely to improve.

NOAA Fisheries; P 10, Forest Management: The chapter states that too many restrictions on private foresters would cause them to sell their land and more invasive activities would occur. A discussion is needed as to the history of past attempts at offering incentives to encourage longer rotations, greater riparian buffers and other measures which would protect not only coho, but preserve watershed functions and advance the goals of the Oregon Plan.

- Oregon has added additional detail this discussion concerning revisions to forest practices over time and the State's expectations in the future.

NOAA Fisheries; P. 14, Near-stream Sources: Citations to supporting agency chapters and to scientific literature should be provided throughout this section.

- Citations or references to supporting agency chapters were added.

NOAA Fisheries; P. 19-20, Summary of the Effectiveness of Water Quality Programs: The chapter should provide better supporting information for statements that anticipated improvements to water quality over time suggests that water quality is not a significant threat to the coho ESU. This would seem to depend on the current state of water quality as well as on how long it will take to improve. The NMFS could find no explanation in any of the agency chapters for how Oregon determined the effects of water quality on viability of the ESU.

- Oregon developed new analyses and supporting discussion to clarify the State's conclusion that water quality was not a significant risk factor to the viability of the coho ESU. More detailed discussion can be found in Part 4 (C) ODFW (3) Habitat Report and the Synthesis Report.

NOAA Fisheries; P 24, Streamflow Protection: The paragraph beginning with "Based on…", has a cut and paste error. The paragraph needs to be reworded for the text to fit with the surrounding text.

- The State conferred with NOAA Fisheries on these statements and NOAA concluded it was an error in comprehension on their part.

NOAA Fisheries; P. 23: The Water Resources Department chapter describes the agencies' performance measures that include reporting requirements and target performance levels related to monitoring of instream water rights (see, p. 5). The department sets targets each year of how many streams to regulate for instream water rights and the number of high priority basins to have flow restoration. However, these goals and targets address the entire State. The report should include reporting requirements and target performance measures at the ESU or smaller scales, or explain that such data are not available.

- The WRD report was revised and the findings were reported for the ESU.

NOAA Fisheries; P. 25, Restoration Effectiveness: The Oregon Watershed Enhancement Board (OWEB) restoration chapter (p. 12) refers for the answer to Policy for Evaluation of Conservation Efforts (PECE) Criterion #2 to chapter 3B (p. 26), but p. 26 of chapter 3B refers to the OWEB chapter. This needs to be reconciled; if needed, please refer to specific pages in any other relevant agency chapters (restoration projects OWEB manages occur through the work of various agencies and local groups).

- The OWEB chapter was revised to address the pertinent questions in the PECE policy. Chapter 3B refers to the OWEB chapter for details.

NOAA Fisheries; P. 25, Restoration Effectiveness: In this chapter, there is no mention that there are parameters identified that will show when success has occurred or the progression of the Oregon Plan in achieving its goals. The restoration work conducted so far does address limiting factors of coho but there needs to be discussions here of how/when will OWEB evaluate their level of work and funding support for projects in the ESU. These benchmarks will be important when determining when and if funding should be shifted from the ESU to another geographic area or when certain types of projects should be funded over others.

The Oregon Plan has provisions for monitoring and reporting progress on implementation. The assessment does a good job discussing the lack of an effectiveness monitoring program and how Oregon is addressing this issue. They appear to be on the forefront of addressing the major issues with their monitoring and reporting system which show dedication and certainty that this will continue to be refined.

- A discussion of OWEB benchmarks was added to Part 4 (H) Restoration which describes OWEB benchmarks. These benchmarks reflect statewide goals, not ESU-specific ones. Benchmarks for the ESU will be developed as part of the

conservation/recovery plan the State and NOAA Fisheries are developing with the Stakeholders Team.

NOAA Fisheries; Comments on Adaptive Management

The Oregon Plan does provide somewhat of a structured system to evaluate progress, but the benchmarks through the Oregon Shines vision are too broad for this scale of analyses. A more specific adaptive management program needs to be derived to address how the Oregon Plan is achieving specific goals in geographic areas smaller than on the scale of Oregon. A discussion of how an adaptive management program would be implemented to address the recovery of the ESU is necessary to ensure that the Oregon Plan is on the correct path. When will another assessment such as the one being conducted today occur?

The OWEB chapter states that this the first time adaptive management principles have occurred and is providing necessary information for planning future funding allocations. However, the assessment does not mention when adaptive management practices, such as this assessment here, will occur again. This should be stated in order to trigger conducting an assessment such as this again to measure progress in the ESU through the Oregon Plan.

- An appendix to Part 3B was developed that describes in detail Oregon's commitment to adaptive management, both programmatically and for the ESU specifically. Addition discussion on adaptive management is also found in the Synthesis Report under the section "Lessons Learned and Adaptive Management".

NOAA Fisheries; P. 12, Reducing the Threat on Privately Managed Forestlands: First bullet: The forest practice rules do not require retaining large diameter trees in riparian areas, provided that basal area targets are met after harvesting. Third bullet, riparian areas may include 70-99% of potential large wood sources from adjacent riparian areas, but harvest rules do not require that such a high percentage of wood sources be retained after harvest.

- The first bullet was changed to "The goal for large and medium fish-bearing streams to attain mature forest condition in riparian areas is likely to meet coho habitat needs in the long-term by creating and maintaining large diameter trees in riparian areas that will be available for recruitment to streams".
- The third bullet was changed to "The goal to attain mature forest condition in riparian areas is likely to meet coho needs by creating and maintaining large diameter trees in riparian areas that will be available for recruitment to streams".

NOAA Fisheries; P. 13, first bullet: "The rules provide alternative prescriptions for managing riparian areas that do not meet mature forest condition in ways that will achieve that condition in a timelier manner." Has this been demonstrated, or is it a

hypothesis? Our view is that the uncertainty in these alternative prescriptions should be acknowledged by stating that the prescriptions are "intended to" achieve that condition.

- This bullet was changed to reflect the "intention" of the rules "The rules provide alternative prescriptions for managing riparian areas that do not meet mature forest condition in ways that are intended to achieve that condition in a timelier manner".

NOAA Fisheries; P. 13, Monitoring Results: This paragraph downplays the results of ODF monitoring that clearly indicate reductions in shade and large wood for small and medium fish-bearing streams in western Oregon following harvesting by saying that "there was uncertainty that the goals for large wood recruitment and shade would always be met under the current rules for small and medium streams." While that may be true for medium streams, for which reductions in shade and large wood recruitment were not statistically significant, it is not true for small fish-bearing streams, for which reductions were statistically significant.

The following text was included to more accurately reflect the findings from ODF's monitoring programs.

- A detailed discussion of the benefits and impacts of riparian protection measures are provided in Part 4(D) ODF B1 Riparian Areas, providing estimates on the likelihood that the FPA strategies will be effective at providing large wood recruitment and shade in both the short term and longer term. To summarize, available research and monitoring suggests that over time, and depending on how riparian areas are managed, the FPA Rules are estimated to maintain 46-92% of large wood potential recruitment on large streams, 30-80% on medium streams, and 12-26% on small streams. Changes in large wood recruitment were not statistically significant for medium or large streams. Likewise, Dent (2001) observed reductions in shade averaging 1% on large streams, 7% on medium streams, and 12% on small streams. Again, the findings were only statistically significant on small streams. The study concluded that the 1994 rules were not likely to meet the goals as described in the FPA on small and medium streams. This, even though the findings were not statistically significant for medium streams.

  ODF and ODEQ combined this information with other results regarding shade, to evaluate the sufficiency of the FPA in meeting water quality standards (ODF and ODEQ 2002). They made a series of recommendations for increasing tree retention to be consistent with achieving mature forest conditions in a timely manner. The Board of Forestry is currently considering a rule package to increase leave tree requirements on small and medium streams. This package also addresses portions of IMST (1999) recommendations for increased leave tree requirements on small and medium streams. See Part 4(D) Chapter A1, for more information on this topic.

NOAA Fisheries; P. 20-21, TMDL Implementation (Temperature): It is hard to evaluate the conservation contribution of the work listed on agricultural lands without having

information on what proportion of impaired areas has been addressed, or information about effectiveness of these projects (*e.g.*, spot monitoring pre- and post-project).

- ODA has added additional information to their report documenting the conservation efforts on agricultural lands.

Responses to IMST Review Comments on Part 3(B)

Clarity of Intent: The State has added additional text describing and clarifying the intent of Part 3(B).

Balance: The State has presented a more balanced analysis of effectiveness, based on the guidance offered by the IMST. For each of the components of the conservation effort that were evaluated, we evaluated certainty based on the past performance of individual programs, demonstrated ability to adapt to new information and the programs approach to monitoring and evaluating conditions and the possible need for change in the future. Some programs have significant track records of implementation, monitoring and evaluation and adaptive management based on past results providing greater certainty about their demonstrated ability to change implementation based on new information. Other programs are at the initial stages of implementation with few results to document effectiveness. In these cases, we evaluated the processes in place to monitor and evaluate progress in the future and acknowledged a greater uncertainty in their likely effectiveness. In addition, we brought in recent findings from the CLAMS project to address what types of changes there are likely to be in the next 100 years in riparian conditions and land use patterns in the ESU.

Unsupported Assertions: In general, we directed the readers to the specific technical reports to the assessment that provide the additional detail to the conclusions we reached in Part 3 (B). Where specific references or details were important to the findings, they were incorporated directly into the report.

Discrepancies between supporting technical reports and PECE Certainty Analysis: We addressed the specific issue raised by the IMST and attempted to report our findings consistently among the many reports that make up the assessment.

Circularity of viability/habitat discussion: The State developed a new section "Biological Status of Coho and the Relationship to Habitat Conditions in the ESU" that describes the relationship of viability to current and future habitat conditions and the sensitivity of ESU viability to changes in habitat conditions.

Certainty regarding conclusions of Viability Assessment: The State developed the following response to concerns about the consequences of being wrong in the viability assessment or our evaluation of habitat conditions.

- Despite poor habitat conditions relative to reference conditions or water quality standards, we find little evidence that habitat conditions continue to decline in the

ESU. There was no consistent trend in physical habitat and the water quality index at large river monitoring sites was stable or improving. Regulatory programs designed to maintain or restore ecological functions associated with riparian and aquatic areas as well as the upland areas that directly influence stream ecosystems are in various stages of implementation. Non-regulatory programs are focused on the principal threats to viability (habitat complexity, water quality, riparian conditions) and will continue to evolve in response to this assessment. Even if the State is wrong and habitat conditions are declining, the regulatory and non-regulatory programs are directed at the predominant threats to viability. Through monitoring and adaptive management processes, we have the opportunity to evaluate the activities we are conducting in the Oregon Coast coho ESU and continue to direct activities at critical needs and critical uncertainties.

Evaluating uncertainty quantitatively: The State developed a more detailed assessment of the uncertainty associated with the monitoring programs, along with acknowledging the range of qualitative uncertainty associated with the conservation programs that are being implemented in the ESU.

Unwarranted certainty regarding implementation and effectiveness of policies and practices: The State attempted to provide a more balanced perspective of the pros and cons of conservation efforts to the best of our knowledge. Due to time constraints, we did not evaluate the potential effect of various levels of reduced funding on program implementation and effectiveness in the future.

Assertions about the State's ability to respond to and mitigate declines: The State has added additional detail to the discussion about our ability to monitor and respond to future changes. The IMST cites the example of the lower Columbia coho as a rapid, short-term decline as evidence the State couldn't respond in a timely manner. What they fail to acknowledge is those declines occurred as marine survival dropped significantly while the Region continued to harvest coho at a 70+% harvest rate. The ocean started the decline and harvest drove them to near extinction. Current regulatory programs would not allow any where near these levels of impact and in fact the recent rebound in the Coastal coho ESU has demonstrated the conservative nature of current harvest management by providing for much more rapid rebuilding of populations than anyone anticipated.

We have also included additional information on the sensitivity of the monitoring program to detect change, the likely timeframes change would occur (qualitatively) and information from the CLAMS project that suggests riparian conditions are not likely to get worse in the next 100 years. In fact, riparian conditions are likely to improve at varying rates depending on ownership for at least the forested portions of the landscape. Our collective assessment of this body of information is that there is no compelling information to suggest habitat conditions are going to become worse in the future.

Water Quality: We provided additional analyses that demonstrated that summer rearing capacity in the ESU is 3-fold greater than winter habitat capacity, therefore indicating

winter habitat conditions are the probable freshwater bottleneck to increased productivity. We also acknowledge the linkages between water quality, riparian conditions, and habitat capacity which suggest working simultaneously on both these fronts is likely to result in maximum benefits for both aquatic systems and water quality.

State's adaptive management framework: The State provided additional in the form of an appendix to Part 3(B) which describes in detail the statutory and programmatic responsibilities and commitments of State programs in general and the ESU specifically.

Oregon Coastal Coho Assessment

Part 3B: Policy for the Evaluation of Conservation Efforts: The Certainty That the Conservation Effort Will Be Effective

Final Report

State of Oregon[1]

May 6, 2005

[1] For reference purposes, primary authors are Bruce McIntosh and Jay Nicholas, Oregon Department of Fish and Wildlife and Oregon Watershed Enhancement Board, Salem, Oregon.

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Introduction

The Oregon Coastal Coho Project is a multi-faceted approach to assessing the status of the Oregon Coast coho ESU and conservation efforts implemented to restore the species. The State's analyses demonstrate that the ESU currently exceeds viability criteria necessary to avoid becoming threatened with extinction in the foreseeable future (Part 2, Viability Analysis). Part 1 (Synthesis Report) integrates viability analysis (Part 2), an evaluation of past and present conservation efforts implemented to stabilize and/or reverse factors for decline, and Part 3 (PECE A and B) analyses into a summary of the status of the fish and an evaluation of ongoing conservation efforts. Part 3 (PECE A and B) focuses on current or future conservation efforts that have yet to be implemented or that have been implemented but where the effects of the efforts will occur over an extended period of time and are not yet fully known. PECE Section A focuses on the certainty of implementation while this section (B) focuses on the certainty that the conservation effort will be effective.

This report (Part 3 (B) PECE) is a mixture of quantitative and qualitative analyses of the ***certainty of effectiveness*** of current regulatory and non-regulatory programs that address threats to the viability of the Oregon Coast coho ESU. Where empirical data, research or modeling is available to support assumptions or conclusions they are provided. Where data is lacking or programs are in early stages of implementation, the State describes the goals and objectives of the programs and our expectations with regards to these actions in the future.

In order to analyze the certainty that the conservation effort will continue to be effective, Oregon identified the state and federal programs that make up the conservation effort in the Oregon Coastal Coho ESU and analyzed each under the PECE criteria. Details about individual programs are found in Parts 4(A – J) and include the following programs:

- Forest management programs, including state forest management, private forest management and federal forest management under the Northwest Forest Plan;
- Water quality programs, including monitoring, updating water quality standards, NPDES permitting, water quality certification for instream work and removal and fill activities, nonpoint source pollution prevention programs, developing Total Maximum Daily Loads (TMDLs) and implementation plans, and providing technical and financial assistance;
- Agricultural management programs, including Agricultural Water Quality Management program, Confined Animal Feeding Operation program, Pesticides program, Weed Control and Invasive Species programs, and Soil and Water Conservation District programs;
- Water use programs, including monitoring and distributing water for instream water rights, and regulation of water rights;
- Fisheries harvest management programs;
- Hatchery management programs, including the state's Hatchery Management Policy and Native Fish Conservation Policy;

- Dredge, fill, and in-water construction programs, including the Removal-Fill Program, Wetland Management and Planning Program;
- Urban Growth Management, including the Statewide Planning Program and Statewide Planning Goals for Agricultural Lands, Forest Lands, Urbanization, Natural Resources and Estuarine Resources; and
- Watershed restoration programs.

In this document, we address the questions put forth in Part B of the PECE document (68FR15100). The focus of this document is those Factors for Decline that remain as *threats* to the present or future viability of the Oregon Coast coho ESU. We describe the conservation efforts in place and their likelihood to halt or reverse the threats the actions may impose. The PECE describes six criteria by which the federal agencies will evaluate the likelihood that a conservation effort will be effective. Below are the six criteria with a summary analysis of the state's conservation programs and overall conservation effort.

PECE Analysis Part B: The Certainty That The Conservation Effort Will Be Effective:

1. <u>The nature and extent of threats being addressed by the conservation effort are described, and how the conservation effort reduces the threats is described.</u>

Our assessment of the current threats to the Oregon Coast coho ESU was developed based on the findings in Part 2 (Viability Analysis). Viability criteria for abundance, productivity, distribution/diversity, persistence, and genetic variability were developed and applied to the 21 functionally and potentially independent populations, designated by the NOAA Fisheries Oregon Coast coho Technical Recovery Team (TRT; Lawson et al., 2004). The results of these population-based analyses were then integrated into intermediate scale (strata) and ESU-based assessments of viability to determine the status of the ESU. Fourteen of the twenty-one populations passed all five of the population viability criteria and seven failed one or more criteria.

Oregon determined population bottlenecks for the 21 coho populations that comprise the ESU. This analysis is an important new element of Oregon's effort to create future conditions that will strengthen ESU viability. Whereas conservation and restoration efforts from 1997 to 2004 were conducted in an attempt to address all factors for decline, the results of a risk factor analysis has the potential of providing more effective focus to conservation and restoration work. The methodology used to determine the rankings for risk factors is described in Part 1 (Synthesis Report) of the Oregon Coastal Coho Assessment.

Oregon's intent was to identify the *primary* risk factor that limits production for each population in the ESU, regardless of whether or not the population passed the viability criteria. This risk factor is referred to as a population *bottleneck:* the risk factor that most limits the population. In theory, then, efforts to improve viability or production of the population would address the population bottleneck first.

Oregon believes that it is most useful to identify bottlenecks at the scale where restoration or management action could affect a positive response to improve ESU viability. In most instances, this means the population. However, some management actions are implemented so broadly that they affect the ESU. The following two examples illustrate these contrasting situations.

1. Management action to reduce impacts of fishery mortality in the ocean would affect many populations across the ESU.
2. A restoration project designed to improve fish passage at a culvert would affect only an individual population.

Regardless of whether a specific population currently *does or does not* meet biological criteria, restoration work designed to address a population bottleneck should serve to strengthen the population and, thus, strengthen the existing viability of the ESU. In addition, Oregon used these determinations to focus their analysis on specific programs when evaluating the "certainty the conservation effort will be effective" under PECE.

Population bottlenecks identified via Oregon's risk assessment are displayed in Table 1. A scarcity of stream complexity (crucial to over-winter survival of juvenile coho) was the most common primary risk factor bottleneck and water quality was the most common secondary bottleneck in these populations. Stream complexity was the primary bottleneck for 13 of 21 populations and a secondary bottleneck for 8 of 21 populations. Water quality was not a primary bottleneck for any populations; however, it is a secondary bottleneck for 15 of 21 populations. Other risk factors that were identified as primary population bottlenecks include: hatchery impacts (2 populations), exotic fish species (3 populations), water quantity (2 populations), and spawning gravel (1 population). Identification of these population bottlenecks provides a useful context for work to both conserve present conditions and to create improved future conditions for the ESU that should strengthen viability beyond its present condition.

Conservation Efforts Directed at Threats to Habitat

The certainty of effectiveness (reducing the threat) is based upon four basic principles:

1. Addressing factors for decline by changing historic management practices;
2. Conserving existing conditions that support viability of the ESU by addressing current and future threats to ESU viability;
3. Creating future conditions that further strengthen ESU viability and support achievement of broad Oregon Plan objectives; and
4. Monitoring to detect future trends and support adaptive management.

This section focuses on regulatory and non-regulatory programs that address the threats to coho habitat as identified in our analysis of risk factors for the Oregon Coast coho ESU. Our emphasis is on programs that influence stream complexity, water quantity and water quality, along with restoration programs enacted to restore watershed health, water quantity and water quality.

Table 1. Primary and secondary life cycle bottlenecks for functionally and potentially independent populations in the Oregon Coast coho ESU.

Population	Primary Bottleneck	Secondary Bottleneck	Viability Status
Necanicum	Stream Complexity	--	Pass
Nehalem	Stream Complexity	Water Quality	**Fail**
Tillamook	Stream Complexity	Water Quality	**Fail**
Nestucca	Stream Complexity	--	Pass
Salmon	Hatchery Impacts	Stream Complexity	**Fail**
Siletz	Stream Complexity	--	**Fail**
Yaquina	Stream Complexity	Water Quality	Pass+
Beaver	Spawning Gravel	Stream Complexity	Pass+
Alsea	Stream Complexity	Water Quality	**Fail**
Siuslaw	Stream Complexity	Water Quality	Pass+
Lower Umpqua	Stream Complexity	Water Quality	Pass+
Middle Umpqua	Water Quantity	Stream Complexity Water Quality	Pass+
North Umpqua	Hatchery Impacts	Stream Complexity	**Fail**
South Umpqua	Water Quantity	Stream Complexity Water Quality	Pass+
Siltcoos	Exotic Fish Species	Stream Complexity Water Quality	Pass+
Tahkenitch	Exotic Fish Species	Stream Complexity Water Quality	Pass+
Tenmile	Exotic Fish Species	Stream Complexity Water Quality	Pass+
Coos	Stream Complexity	Water Quality	Pass+
Coquille	Stream Complexity	Water Quality	Pass
Floras	Stream Complexity	Water Quality	Pass
Sixes	Stream Complexity	Water Quality	**Fail**

This section focuses on regulatory and non-regulatory programs that address the threats to coho habitat as identified in our analysis of risk factors for the Oregon Coast coho ESU. Our emphasis is on programs that influence stream complexity, water quantity and water quality, along with restoration programs enacted to restore watershed health, water quantity and water quality.

In the past, evaluations of habitat-related threats to this ESU have focused on known and potential impacts of historical patterns of land management on watershed function, most directly manifested by impacts to riparian areas which can translate into degraded water quality and reductions in habitat quality and quantity. The legacy of past management practices, such as splash damming, stream cleaning, stream channelization, agricultural practices, urbanization, and the diking and filling of wetlands and estuaries have left significant imprints on the landscape. Regulatory programs enacted in the last 35 years have continued to evolve in response to new information and needs of present and future generations. More recently, through efforts like the Oregon Plan, non-regulatory

programs have been put in place to address additional needs to protect and restore watersheds.

Biological Status of Coho and the Relationship to Habitat Conditions in the ESU

Oregon concludes that the Oregon Coast Coho ESU is biologically viable, an assessment based on the performance of populations as evaluated by specific, scientifically based, criteria (Part 2, Viability Analysis). To pass the viability criteria, both individual populations and the ESU as a whole must demonstrate sufficient productivity to maintain populations through periods of poor marine survival. Productivity, measured in this way, is a product of coho adaptation, resilience, and behavior as expressed over a mosaic of habitats. The quality of freshwater habitats is the most critical factor that supports this productivity, and a key focus of Oregon Plan restoration efforts. Our analysis, based on the empirical record, demonstrates that most populations retain sufficient productivity in freshwater habitats to maintain meet viability criteria through environmental conditions similar to or slightly worse than those experienced over the last forty-plus years.

Sensitivity of ESU Viability to Changes in Habitat Quality

In the status assessment, we conducted a sensitivity analysis to determine the effect of varying levels of life cycle survival on the persistence of populations. Our sensitivity analysis of changes in life cycle survival are premised on the assumption that changes on survival are carried throughout the life cycle, regardless of which stage it occurs. During periods of poor marine survival, coho salmon freshwater productivity above replacement levels is limited to areas of the highest habitat quality (Nickelson and Lawson, 1998). Our sensitivity analysis of life stage survival rates concludes that these rates (egg to smolt survival in particular) are key indicators of habitat quality. Decreases in the quality of these habitats directly affect life stage specific survival that carries through the remainder of the life cycle reducing the overall productivity of a population. This process operates over the full range of environmental conditions, but the critical impact of habitat capacity on coho productivity is most clearly expressed during periods of poor marine survival.

Our analysis of life cycle survival and habitat capacity concludes that the ESU could sustain moderate reductions (<15%) in productivity yet remain viable (see Table 10, Coho Assessment Part 2: Viability Analysis). Holding marine survival constant, the amount of high quality habitat is likely the primary driver of population productivity. These findings are consistent with past research (Nickelson and Lawson, 1998) and new analyses by the Coastal Coho Technical Recovery Team (TRT, unpublished data). Nickelson and Lawson (1998) found that those populations with the poorest habitat quality (Tillamook and Nestucca) would see substantial increases in the risk of extinction ($p = 0.05$) when habitat quality decreased by 20% or more. Preliminary analyses from the TRT, based on ODFW's current habitat data, shows that those populations with the lowest levels of high quality habitat have lower probabilities of persisting over the next 100 years using the Nickelson-Lawson model (P. Lawson, personal communication). The availability of high quality habitat remains the critical bottleneck to increased productivity in freshwater for most populations.

Current Status of Habitat in the ESU

ODFW's analysis of stream channel and riparian data collected from 1998 to 2003 indicates no consistent trend in stream habitat conditions within the Oregon Coast Coho ESU (Part 4(C) ODFW (3) Habitat). These results are consistent with a study by Thom and Jones (1999) who assessed change in habitat from 1993-99 for all Oregon coastal streams. Although our ability to detect significant trends is affected by the low statistical power of our analyses, we believe that short of catastrophic habitat changes (which have not occurred) we would not expect to see significant changes in habitat variables over the short time span we have been monitoring habitat with our random surveys. Improvements in habitat conditions will occur on a longer time scale as large trees are recruited into riparian areas and upland areas continue to stabilize.

ODEQ's analysis of 31 long-term water quality monitoring locations within this ESU demonstrates overall improvement in the water quality of larger rivers and streams (Part 4(B) Water Quality Report). Thirty-nine percent of sites showed improving water quality and no sites had decreasing water quality from 1993 to 2002. The water quality index was excellent to good at 42% of the sites while only 19% had poor to very poor water quality. While sites used by this program are typically located on larger rivers and streams, they reflect the integrated water quality impacts from point and nonpoint sources as well as the natural geological, hydrological, and biological impacts on water quality for the watersheds they represent. Additional ODEQ sampling from randomly selected sites in smaller streams found that 54% exceed water temperature standards and 41% exceed fine sediment standards, suggesting the high summer stream temperatures are a concern. However, an analysis by ODFW concluded that winter habitat, and not summer habitat, is the likely freshwater bottleneck to coho productivity in all populations. Further discussion of these findings is found in Part 4 (C) ODFW (3) Habitat Report of the assessment. This is not to diminish the importance of water quality issues at the local scale. Our current understanding of what limits coho productivity places water quality as a secondary consideration. We also recognize the synergistic relationship between water quality, riparian conditions, and habitat complexity. Efforts to protect and restore these processes and functions will all benefit coho salmon.

Coho streams in this ESU currently are characterized by a general scarcity of large wood in the channel, lack of large conifers in riparian areas, reduced interactions with off-channel alcoves and flood plains, and presence of fine sediment in gravels. Complex, low-gradient habitats that include large wood instream, large riparian conifers, off-channel connectivity and clean gravels are key components of over-wintering habitat for juvenile coho in coastal watersheds. During periods of poor marine survival (3% marine survival), freshwater productivity is reduced to the areas of highest quality overwinter rearing habitats. By quantifying and mapping high quality habitat in the ESU by populations, we determined there are about 900 miles of high quality overwinter rearing habitat in the ESU (Figure 1, see Part 4 (C) ODFW (3) Habitat Report for additional details). This represents about 14% of the overwinter rearing habitat available to coho salmon, but may underestimate the availability of high quality winter habitat as it is based

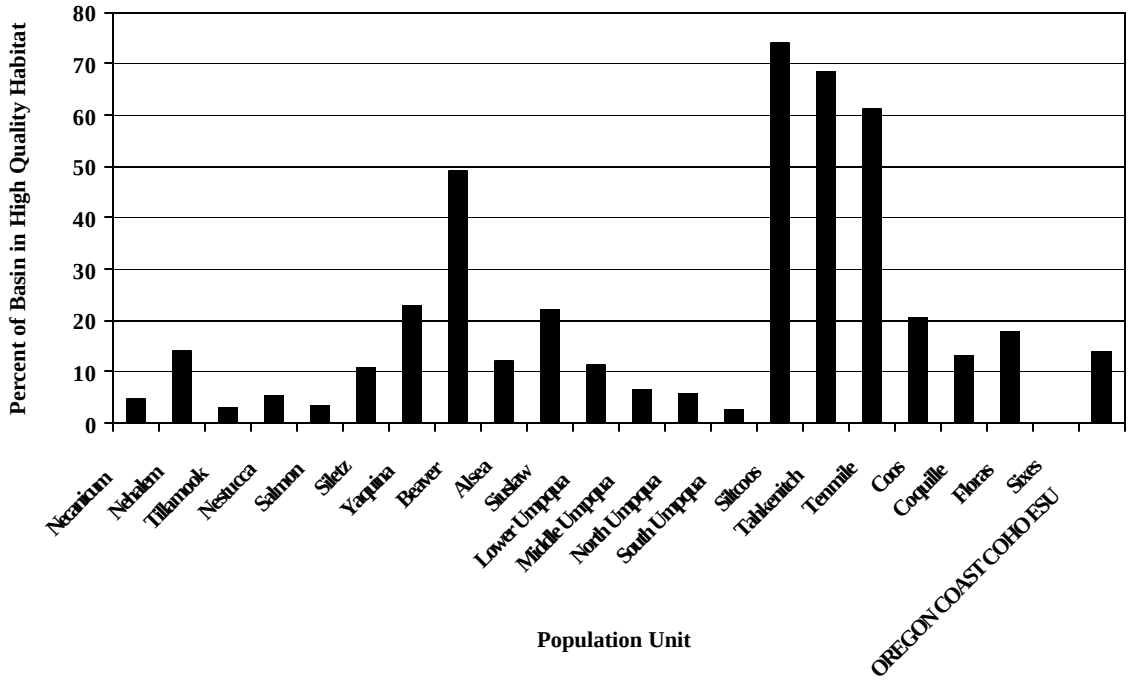

Figure 1. Percentage of habitat determined to be high quality for winter rearing for each of the functionally and potentially independent populations in the Oregon Coast coho ESU, based on current habitat conditions.

on surveys of wadeable streams. Areas downstream of wadeable streams may provide additional high quality habitat in the form of off-channel habitats, beaver ponds and wetlands. On-going mapping of wetlands and estuaries in the ESU by DSL will be a critical next step in identifying important areas of additional habitat or opportunities for restoration. Even though Oregon has determined that the ESU is currently viable, the relative scarcity of high quality overwinter rearing habitat is of concern. Our analysis of the quantity and distribution of high-quality habitat is a basis for protecting existing habitats and focusing restoration to create additional habitat. It is also a baseline to monitor future changes as conservation efforts are enacted.

Future Trends in Habitat Conditions

The Coastal Landscape Analysis and Modeling Study (CLAMS), a joint venture between Oregon State University and the USDA Pacific Northwest Research Station, has developed the most comprehensive analysis of future trends in forest conditions in coastal watersheds (Spies et al., in press). CLAMS analyses were based on current forest management in the ESU as guided by the federal Northwest Forest Plan and the state's Forest Practices Act. The analyses did not consider the potential influence of restoration programs in the ESU or riparian management on urban or agricultural lands.
From the CLAMS analysis of future trends in riparian forest cover adjacent to reaches with high intrinsic potential for coho salmon and steelhead in the Oregon Coast coho

ESU, we arrive at the following conclusions. Under current forest management rules, the frequency of the larger (>50-cm dbh) forest-cover classes is expected to increase on fish-bearing streams over the next 100 years. Public lands currently contribute most of the larger diameter classes and this is expected to continue into the future. In 100 years, larger diameter classes will make up approximately 75% of riparian areas on federal lands, 60% on state forest lands, but no more than 25% on private lands. While larger diameter trees increase adjacent to all fish-bearing streams, the increase is only half as much along high intrinsic potential reaches for coho salmon as for steelhead. This reflects that high intrinsic potential reaches for coho salmon are concentrated on private lands whereas those for steelhead are more evenly distributed across public and private ownerships (Burnett et al., in press). Based on these findings, the amount of large wood delivered from sources adjacent to fish-bearing streams is anticipated to increase.

The amount of large wood expected to be delivered to perennial channels from intermittent channels will depend on the amount of large wood stored in intermittent channels and the likelihood that this wood is transported downstream. The amount of large wood stored in an intermittent channel will vary based on the landscape processes that deliver wood to that channel and on the policies governing riparian management. Whether or not any stored wood is delivered to perennial channels downstream is primarily determined by the likelihood of debris-flow initiation and transport. Where debris flows are prevalent and the channel network is conducive to transport (high gradients, low tributary junction angles), as much of 50% of the large wood may be delivered from intermittent to perennial streams in unmanaged watersheds (Reeves et al. 2003). In such areas, large wood is expected to decrease for perennial streams on private lands because most intermittent streams are unlikely to store much large wood in the future if current riparian management policies remain in place.

These conclusions suggest that the availability of larger trees for recruitment into streams from adjacent riparian areas will increase over time on fish-bearing streams while the ability to recruit wood from intermittent streams will vary across the landscape. The potential for wood recruitment is likely to vary across the forest ownerships, with the highest potentials on public lands and lower potentials on private lands. Whether these projections are adequate to improve coho habitat is uncertain, but the likelihood that habitat will be worse in 100 years under current policies than it is today seems low.

The CLAMS analyses did not consider what is likely to happen to riparian vegetation on agricultural or urban portions of the landscape. CLAMS did look at land use change adjacent to HIP reaches. Developed uses (non-forest uses) are expected to remain relatively low across the ESU but in certain areas (North Coast and Mid-South Coast) are expected to increase particularly adjacent to high intrinsic potential reaches for coho salmon. Based on our assessment of current regulatory and non-regulatory programs, the State concludes that we are likely to see slow improvements in riparian vegetation on agricultural lands under current rules with uncertainty about how much and where the changes will occur. Further consideration of this issue will be taken up in the development of the joint federal and state conservation plan for coastal coho.

Despite poor habitat conditions relative to reference conditions or water quality standards, we find little evidence that habitat conditions continue to decline in the ESU. There was no consistent trend in physical habitat (acknowledging low power to detect one) and the water quality index at large river monitoring sites was stable or improving. Regulatory programs designed to maintain or restore ecological functions associated with riparian and aquatic areas as well as the upland areas that directly influence stream ecosystems are in various stages of implementation. Non-regulatory programs are focused on the principal threats to viability (habitat complexity, water quality, riparian conditions) and will continue to evolve in response to this assessment. Even if the State is wrong and habitat conditions are declining, the regulatory and non-regulatory programs are directed at the predominant threats to viability. Through monitoring and adaptive management processes, we have the ability to evaluate the activities being conducted in the Oregon Coast coho ESU and to continue to direct activities at critical needs and critical uncertainties.

Current Habitat Management Programs

Numerous programs regulate land management in the Oregon Coast Coho ESU. On forested lands, federal lands are managed under the Northwest Forest Plan (NFP) and the myriad of federal laws that direct forest management. The Northwest Oregon Forest Management Plan and the Elliot State Forest Management Plan guide management of State forestlands in the ESU. On private timberlands, land management is regulated under Oregon's Forest Practices Act. Management of agricultural lands is guided by a variety of programs, including Agricultural Water Quality Management (SB 1010), Confined Animal Feeding Operation (CAFO), Pesticides, Weed Control and Invasive Species programs, removal-fill regulation, and land use controls. The state's management of urban lands is carried out through the statewide comprehensive land use planning program. State and federal agencies administer a number of Clean Water Act authorities that regulate activities affecting water quality and wetlands. In addition, there are a variety of restoration efforts conducted by a range of entities, including watershed councils, Soil and Water Conservation Districts (SWCD), and a range of federal and private programs. Funding for restoration is administered by OWEB (Ballot Measure 66 funds, Pacific Coastal Salmon Recovery Fund) and ODFW (Restoration and Enhancement program) at the state level. A number of restoration grant programs are administered by federal agencies (e.g., EPA, NOAA Fisheries, USFWS, and NRCS). Finally, several programs developed non-regulatory measures under the Oregon Plan to bolster the collective efforts to protect and restore aquatic habitats.

Oregon Plan programs reduce the threats to habitat conditions necessary for ESU viability and restoration with a three-pronged approach: regulatory, non-regulatory, and monitoring. As an example, all riparian areas adjacent to coho streams in the ESU receive some kind of protection. These protections include water quality management plans and rules on agricultural lands, riparian reserves on federal forestlands, restricted riparian management areas on state and private forestlands, setbacks from development, and riparian improvement projects. What follows is a description of the regulatory and

non-regulatory restoration programs and how they reduce the threats associated with aquatic and riparian conditions in the Oregon Coast coho ESU.

Conservation Efforts Directed at Forest Management

This discussion of forest management programs in the Oregon Coast coho ESU is based on supporting documentation found in Parts 4(D) Forestry, (E) Federal Forest Management, and (J) Technical Reports of the Oregon Coastal Coho Assessment. Current forest management programs have the potential to impact coho salmon through changes to instream habitats, riparian conditions, water quality and fish passage. Oregon's risk analysis identified stream complexity and water quality as primary or secondary risk factors that currently limit the viability or recovery potential of the ESU's constituent populations. We evaluated current forest management programs in relationship to these risk factors and assessed their effectiveness at addressing current and future risks to ESU viability.

Oregon's forests are held by a rich variety of owners - federal, tribal, state, and local governments, as well as private industrial owners and family forest landowners. The owners manage for a variety of objectives and values and provide for an array of benefits resulting from different actions in different places at different times. Across these ownerships, forest management strategies can be grouped into four broad categories: Wood production, Multiple-resource, Reserve, and Residential value emphasis. Currently, federal lands (37% of the ESU) are dominantly in the reserve strategy, state-owned lands (9%) dominantly in the multiple-resource, and private lands (37%) are dominantly in either the wood production or residential value strategies. Based upon these four strategies, different approaches are used to provide for protection of habitat and water quality, with approaches being very "precautionary" on federal and state-owned lands. An adaptive Oregon Forest Practices Act (FPA) and a strong but flexible Land Use Planning Program are the cornerstones of forest resource protection on private lands in Oregon. While some may perceive protections provided under the FPA as less precautionary than protections on state or federal lands, by ensuring that private forest uses remain viable in the long-term, Oregon avoids the conversion of these private forestlands to other land uses that are likely to pose more significant threats to habitat and water quality. Comparable data from California and Washington clearly demonstrate the success of Oregon's integrated strategy of forest practices and land use protection. For example, the Natural Resources Conservation Service (NRCS) has reported that "Washington's forestland is being converted to other uses at a rate that exceeds the rate of conversion in the Pacific Northwest region and the nation as a whole" (Clinton and Lassiter 2002).

Oregon Plan actions describe a set of activities along riparian areas to increase leave tree retention along fish-bearing streams as well as to leave trees along small non-fish bearing streams where tree retention is not other-wise required. These types of activities are being implemented on state and private forest land. Other Oregon Plan riparian activities include livestock exclusion fences and tree planting. These types of activities typically occur along agricultural land. The incentives for landowners to participate in these

programs were to support the Oregon Plan and associated goals for improved watershed conditions. Parts 4(D) ODF Chapter B1 Riparian Areas and 4(D) ODF Chapter A1 Forest Practices Act describe in detail implementation of these non-regulatory activities.

In general, these activities increase the numbers of trees left on non-fish bearing and fish bearing streams above that required by the Forest Practices Act. The desired effect is to reduce risks to coho associated with otherwise low levels of large wood recruitment from near-stream and upland sources. Increased tree retention along non fish-bearing streams increases upland sources while increased retention along fish-bearing streams increases near-stream sources of large wood. Increased retention along fish-bearing streams may also benefit coho if shade levels are increased and stream temperature reduced. Effectiveness of these measures has not been demonstrated with a field study. Future monitoring will focus on the effectiveness of these practices to increase large wood recruitment from near-stream and upland sources, the effects on shade and stream temperature.

Current forestland protections have virtually eliminated (since the mid-1980s) the removal of large downed wood from stream channels and riparian areas. Riparian protection strategies vary based upon ownership, but all strategies now require retention of trees in a manner that will result in increased inputs of large wood over time as compared to the very limited buffers protected prior to the mid-1980s. Significant investments in road and drainage systems have been made over the last decade, resulting in improved fish passage, reduced risk from road-induced sedimentation and other drainage-related risks from transportation systems. Overall, timber growth in the ESU exceeds harvests and the amount of large diameter trees is increasing both in riparian and upland areas (Johnson and Spies, 2001).

Reducing the Threat on Federally Managed Forestlands

This discussion of federal forest management in the Oregon Coast coho ESU is based on supporting documentation found in Part 4(E) Federal Forest Management of the Oregon Coastal Coho Assessment.

For federal lands, a goal of the Northwest Forest Plan (NWFP), as enacted through the Aquatic Conservation Strategy (ACS), is to protect and restore salmon and steelhead habitat on federal lands. The nine objectives under the ACS are implemented primarily through the designation of riparian reserves and key watersheds along with watershed analysis to guide management actions and watershed restoration to address watershed function. Through these actions, federal land management activities directly or indirectly address factors for decline associated with physical habitat, water quality, water quantity, and biological condition. On the basis of this approach and the implementation record since 1994, NOAA Fisheries concluded in the June 14, 2004 proposed listing determinations for 27 ESUs of west coast salmonids, that "where the standards are implemented, the resulting conditions will be consistent with the recovery of salmon and *O. mykiss* ESUs" (50 CFR Parts 223 and 224).

Following 3 years of NWFP implementation, NOAA Fisheries subsequently reviewed the adequacy of 14 individual Long Range Management Plans (LRMP), as modified by the NWFP and its ACS, for conserving Oregon Coast and Southern Oregon/ Northern California Coast coho salmon. The results of these reviews are described in two conference opinions (NMFS, 1997 and 1998) that document NMFS' determinations that the programmatic direction for Federal land management actions embodied in the 14 LRMPs would not be likely to jeopardize the continued existence of OC coho salmon. Moreover, the opinions concluded that implementation of management direction in the LRMPs and Riparian Management Plans will result in substantially improved habitat conditions for these ESUs over the next few decades and into the future. Improved habitat conditions will result in increased survival of the freshwater life stages of these fish. Implementation of actions consistent with the ACS objectives and components—including watershed analysis, watershed restoration, reserve and refugia land allocations, and associated standards and guidelines—will provide high levels of aquatic ecosystem understanding, protection, and restoration for aquatic habitat dependent species.

Reducing the Threat on State Managed Forestlands

State managed forestlands are administered under Board of Forestry Forest Management Plans (FMPs). The biological and ecological objectives of the FMPs are to maintain and/or restore the ecological functions of aquatic and riparian areas as well as upland areas that directly influence aquatic and riparian areas. The intent is to manage for proper functioning aquatic systems by providing diverse aquatic and riparian conditions over time and space. This approach is intended to more closely emulate the historical conditions maintained by the natural disturbance regimes under which native species evolved. Desired future conditions for non-fish bearing streams are differentiated for those that are perennial streams, seasonally high-energy streams, and potential debris flow track reaches. Aquatic and riparian conditions are linked with landscape processes such as mass soil movements and hydrologic regimes. The FMP uses a blended approach to manage riparian and aquatic habitat at the landscape and site-specific levels. Through this approach, the FMP addresses physical habitat, water quality, water quantity, and biological condition factors for decline. The Independent Multidisciplinary Science Team (IMST) cited this approach as having a high likelihood of restoring and maintaining properly functioning aquatic systems (IMST 1999).

The water protection rules require the establishment of riparian management areas (RMAs) on most streams that are within or adjacent to a harvest unit. The RMA width requirements vary depending on the stream classification (OAR 629-635-300). Oregon Department of Forestry (ODF) classifies streams by "Type" and by stream size. The "Type" designations include Type F for fish-bearing streams, Type N for non-fish-bearing streams and Type D for domestic water sources without fish presence. Stream sizes are based on average annual stream flow in cubic feet per second (cfs). The stream size classifications are small (< 2 cfs), medium ($\geq$2cfs and <10 cfs), or large ($\geq$10cfs). Desired conditions are explicitly described for (a) fish-bearing and large and medium non-fish bearing streams and (b) small-non-fish bearing streams. The desired future conditions described in the Forest Management Plan have been designed around a

scientifically based understanding of habitat requirements for anadromous and native fish. Therefore, if the desired conditions are met, the program is likely to reduce the threat to coho sustainability on state-managed lands, and potentially speed up the time within which restoration is achieved. While the FMPs are in the early stages of implementation, Oregon submits that the blended approach is likely to be effective at reducing the threat from forest operations on state lands to coho viability for the following reasons:

- The goal to attain mature forest condition in riparian areas is likely to meet coho needs by creating and maintaining large diameter trees in riparian areas that will be available for recruitment to streams.
- The FMP has explicitly described basal area targets for achieving mature forest condition (80 – 100 years) and relates that to a typical number of large trees per acre (40-45 32-inch conifer trees).
- The FMP makes a commitment to leave riparian areas untouched that meet the mature forest condition.
- Riparian areas are 170 feet wide with varying management options to meet the mature forest condition within the 170 feet. The mature riparian forest goal, commitment to maintain these once achieved, and the wide buffers widths are likely to capture 70-99% of the large wood recruitment (Murphy and Koski 1989, Van Sickle and Gregory 1990, McDade et al. 1990, Bilby and Bisson 1998).
- The wide buffers and standard management targets designed to mimic mature forest conditions are highly likely to maintain shade and thus stream temperature.
- The FMP describes alternative approaches for managing riparian areas that don't meet mature forest condition in ways that will achieve that condition in a timelier manner.
- The FMP describes goals and options for aquatic habitat restoration.
- Upland strategies designed to minimize impacts of roads on aquatic and riparian ecosystems recognize the connectivity between aquatic habitat and upslope management practices.
- The FMP incorporates upland strategies that attempt to manage the risk of landslides so as to maintain and restore these areas to mimic historic process of upland large wood recruitment and routing to streams.

In addition to the reduced threats associated with the blended approach, the state forests program has devised a plan to further reduce the threat to anadromous fish in 17 watersheds identified as Salmon Anchor Habitat. Within these watersheds additional precautions have been outlined, in part with prescriptive elements. These elements include:

- No harvest on all fish-bearing streams and medium type F streams.
- Limitations on harvest along perennial, seasonal, and debris-flow prone non-fish bearing streams.
- No harvest within 50 feet of perennial and debris-flow prone, small, type N streams,
- No harvest within 25 feet of seasonal small type N streams.

- Additional leave-tree requirements (15-25 conifer trees and snags per acre) within 100 feet.
- No ground based equipment operation is allowed within 50 feet of the aquatic zone on all small type N streams.
- There are specific limitations on timber harvest activities associated with specific basins. Examples include caps on the percent of watersheds that can be clearcut harvested (ranging from 10 – 25%)

These strategies accomplish the following with regard to reducing the threat to coho habitat:

- They virtually eliminate the possibility that that there will be reductions in shade on fish-bearing streams associated with timber harvest.
- They lower the risk that harvesting will reduce shade on non-fish bearing streams.
- No harvest within 100 feet of the stream is highly likely to capture 70 to 99% of the large wood recruitment potential (Murphy and Koski 1989, Van Sickle and Gregory 1990, McDade et al. 1990, Bilby and Bisson 1998).
- Increased retention of trees along non-fish bearing streams provides large wood recruitment to fish bearing streams that is associated with debris torrents.

Reducing the Threat on Private Forestlands

Private land management is likely to restore substantial coho habitat over time because:

- The goal for large and medium fish-bearing streams to attain mature forest condition in riparian areas is likely to meet coho habitat needs in the long-term by creating and maintaining large diameter trees in riparian areas that will be available for recruitment to streams.
- The rules have explicit basal area targets for achieving mature forest condition (80 – 100 years) and relates that to a typical number of large trees per acre (40-45 32-inch conifer trees).
- The goal to attain mature forest condition in riparian areas is likely to meet coho needs by creating and maintaining large diameter trees in riparian areas that will be available for recruitment to streams.
- The rules provide alternative prescriptions for managing riparian areas that do not meet mature forest condition in ways that are intended to achieve that condition in a timelier manner.
- The rules provide options and incentives for aquatic habitat restoration.
- Upland strategies designed to minimize impacts of roads on aquatic and riparian ecosystems recognize the connectivity between aquatic habitat and upslope management practices.
- Economically efficient practices and adaptive management promote retention of private forestland in continued forest use.

- Social acceptance by the regulated community provides for very high levels of compliance.

A detailed discussion of the benefits and impacts of riparian protection measures are provided in Part 4(D) ODF B1 Riparian Areas, providing estimates on the likelihood that the FPA strategies will be effective at providing large wood recruitment and shade in both the short term and longer term. To summarize, available research and monitoring suggests that over time, and depending on how riparian areas are managed, the FPA Rules are estimated to maintain 46-92% of large wood potential recruitment on large streams, 30-80% on medium streams, and 12-26% on small streams. Changes in large wood recruitment were not statistically significant for medium or large streams. Likewise, Dent (2001) observed reductions in shade averaging 1% on large streams, 7% on medium streams, and 12% on small streams. Again, the findings were only statistically significant on small streams. The study concluded that the 1994 rules were not likely to meet the goals as described in the FPA on small and medium streams.

ODF and ODEQ combined this information with other results regarding shade, to evaluate the sufficiency of the FPA in meeting water quality standards (ODF and ODEQ 2002). They made a series of recommendations for increasing tree retention to be consistent with achieving mature forest conditions in a timely manner. The Board of Forestry is currently considering a rule package to increase leave tree requirements on small and medium streams. This package also addresses portions of IMST (1999) recommendations for increased leave tree requirements on small and medium streams. See Part 4(D) Chapter A1, for more information on this topic.

The private and state forests programs at ODF have an ongoing study in the coast range that continues to evaluate the effectiveness of the forest practice rules and FMP strategies (described above). Preliminary results from this study describing baseline conditions will be available in 2005.

Large Woody Debris

The Oregon Department of Forestry has demonstrated the use of adaptive management to revise rules when scientific analyses suggest a change is needed to meet desired conditions. As new rules are adopted it will be necessary to continue monitoring and research to determine if there is increased effectiveness associated with changes in rules for large wood recruitment and shade. In the absence of empirical data or model projections on how the new rules might perform, the following discussion represents our professional judgment of how current rules are likely to effect the recruitment of large woody debris from riparian and upslope sources.

Large Wood Recruitment

For the sake of clarity, the following terminology will be used to define large wood sources for this discussion.

Near-stream riparian: Areas directly adjacent to the stream. Large wood is delivered simply by the tree falling directly into the stream from the adjacent streambank or hillslope.

Upstream riparian: Near-stream riparian sources that are upstream of the reach of concern. High water and/or a debris flow transport the large wood to its current location after initially falling into the stream from the riparian area.

Upslope: Zero-order channels (zero-order channels are small, unbranched draws), hollows, or hillslopes. Areas outside of the riparian area. Large wood is delivered by a landslide or landslide-debris flow combination that moves the wood into the stream channel from these areas.

Near-stream Sources

A review of the literature shows that 70 to 99 percent of potential large wood input *from adjacent riparian stands* originates from within the first 30 meters, or about 100 feet, of the stream (see Part 4 (D) ODF Chapter B1 Riparian Areas for further discussion). It is also possible, however, for 70-99 percent of the potential large wood input from riparian stands to originate from within the first 50 feet of the riparian forest. The majority of larger pieces of large wood, such as key pieces, originate from within a distance less than 100 feet. The bulk of the potential *riparian area* inputs of large wood come from vegetation in close proximity to the channel, with diminishing amounts coming from distances farther from the stream. It should be emphasized that these studies did not intend to examine upslope source areas. They analyze potential large wood inputs in terms of the total large wood potential from riparian areas only.

Under the current forest practice rules, riparian management areas for small, medium and large streams are 50, 70, and 100 feet wide, respectively. Given the summary of literature discussed above it is likely that increases in tree retention within 50 – 70 feet of the stream will contribute to increases in large wood recruitment from small and medium streams. The summary also supports ODF's conclusions that 100-foot wide riparian management areas (as required on large fish-bearing streams) can adequately protect large wood recruitment functions if managed appropriately.

Critics have expressed concern that the riparian rules do not adequately address large wood recruitment because landowners will disproportionately harvest large trees from riparian areas, preventing smaller diameter trees from ever maturing into trees that are important for large wood recruitment. Recent data from ODF demonstrate that in general, landowners do not disproportionately harvest large diameter trees from riparian areas. The average diameter within RMAs (within 50, 70 and 100 feet) of small, medium, and large streams did not change significantly with harvesting (p-value = 0.74, 0.48, and 0.18 respectively).

Upstream and Upslope Sources

Source areas for potential inputs of large wood are not limited to near-stream sources. Upstream or upslope areas can also be a source of large wood for fish-bearing streams. In steep landscapes, where the occurrence of debris flows is a normal part of the disturbance regime, relatively large pieces of wood in small streams can play an important role in maintaining salmonid habitat. High stream flows and debris flows are both mechanisms by which large wood can be transported from relatively small stream channels downstream to larger channels. Debris flows can periodically move very large pieces of wood from a hillslope or hollow downslope to fish-bearing streams where the large wood can interact with the channel and form fish habitat. In these cases, small stream channels can play a significant role in contributing key pieces of large wood to downstream riparian functions. These sources of large wood have been referred to as both "upslope" and "upstream" sources.

Available scientific information suggests the relative inputs from upslope sources ranges from 10-50%. In terms of upslope sources, the relative importance of potential large wood from zero-order channels and hillslopes to a given stream reach becomes less and less the larger the channel network is above that reach. The larger the channel is along a given reach, the greater the percentage of potential large wood originates from near-stream and upstream riparian sources. This will vary, however, depending on the topographic characteristics and landslide/debris flow potential. An area where debris flows rarely occur and where the slopes are relatively mild will have virtually all of the large wood originating from near-stream and upstream riparian sources. An area that has frequent landslide/debris flow activity and relatively steep slopes, on the other hand, may have a significant portion of the large wood potential in upslope sources originating from the zero-order channels and hillslopes.

Where shallow rapid landslides are rare or do not occur, the dominant mechanism for transporting large wood downstream is stream flow. For this population of streams, the hydrologic regime will determine what sizes of large wood will be stable and hydrologically functional in the channel.

The current forest practice rules establish a systematic process for identifying locations where landslides might occur. This is the first step in managing to reduce the landslide-associated management risks. The science and technology for identifying debris flow-prone terrain and channels is available and key drivers from that science have been incorporated into ODF's approach. Recent analysis documented that at least 78% of the landslides that occurred in the 1996 storm event were identified as "high risk sites" for landslides - confirming the value of that identification process.

While research has established that the rates of erosion are higher in younger stands than in older stands, it has also established that landslides occur with or without forest management and supply both sediment and structure such as large wood and boulders to streams. Therefore, ODF's focus is on creating an environment where when landslides do occur, they are beneficial to aquatic habitat. The science and technology for

identifying debris flow-prone terrain and channels is available, however, the marriage between science and management strategies to reduce threats is not as well developed and requires more research and monitoring. Currently, the FPA requires leave trees in debris flow paths that have the potential to impact public safety. While these rules are geared towards public safety, it stands to reason that the practice would be beneficial to aquatic habitat as well. Research has also established that such areas provide high quality and complex aquatic habitat. Modeling exercises to evaluate leave tree management practices, while not available at this time, could inform management and monitoring strategies.

There is no scientific or monitoring data on whether the High Landslide Hazard requirements to leave trees on headwalls are reducing the threats to coho associated with debris flows. Acknowledging that these rules are geared towards public safety, it stands to reason that in the event of a debris torrent, a landslide that contributes wood as well as sediment and boulders could better mimic historic processes. Future analyses from CLAMS will be available that attempt to model likely large wood recruitment under various management scenarios, with a focus on landslide and debris flow sources of wood.

Stream Shade

While it is well accepted that shade is critically important to controlling stream temperature, it is important to recognize that a focus on maximizing shade may reduce goals for large wood recruitment. Stand structure (i.e. basal area, stand density, and live crown ratio) plays an important role in determining the range of shade over streams and how this range will be affected by adjacent forest harvest activities. Stream shade levels reflect expected stand development characteristics. Open-grown stands (low basal area) tend to have higher live crown ratios and lower shade than dense stands (high basal area) with low crown ratios**.** Shade is expected to increase as a stand grows after harvest or disturbance, and is maximized during the stem exclusion stage (i.e., limited to no understory development such as herbs, shrubs, and seedlings). For the stand to move into the understory reinitiation stage, and later into older forest structure, light must filter through the forest canopy. Shade levels will vary as overstory trees succumb to age or disease, as suppressed trees are released, or die, and disturbances create openings.

Basal area alone is not predictive for shade. However, combined with other stand structure parameters, increasing basal area in western Oregon could result in higher shade on east-west flowing streams. The lower basal area requirements on small and medium streams are predicted to provide less shade than on large streams, particularly if the trees had larger diameters and higher live crown ratios. ODF's analyses suggests an increase in basal area on small and medium streams, as is being considered by the Board of Forestry, is likely to result in increased shade on small and medium streams.

Conversely, the analyses also highlight the potential downfalls of managing strictly for shade. If shade were the primary goal, the riparian area would be managed towards the stem exclusion stage. The stem exclusion stage is likely to promote small diameter trees

of poor vigor and, therefore, is unlikely to meet the other important functions of riparian areas. Managers must carefully consider their objectives for stream shading in relation to stand structure and the myriad of other "goods" produced by a riparian stand.

Roads and Landslides

ODF has strong regulatory (FPA) and management programs (FMP) that require notification of road construction in and around critical locations such as streams and landslide-prone areas. The regulations are an enforceable Best Management Practices program designed to minimize effects on water quality and aquatic habitat. The regulatory program reduces sediment inputs from roads no longer in use by requiring maintenance or proper vacating practices. The FPA and FMP reduce the threats associated with landslides with a systematic approach for identifying high landslide hazard locations. These programs reduce the threats associated with road-related landslides by avoiding road locations in critical landslide-prone areas, decreasing disturbance area associated with roads, and reducing hydrologic connectivity to streams. Forest Practice rules require traffic control during wet periods when hauling is contributing to erosion and delivery of sediment to streams and the use of high-quality rock surface on roads.

There are non-regulatory actions identified under the Oregon Plan relating specifically to roads. The program is referred to as the road hazard and risk reduction project (RHRR). The three major elements of the project are (1) surveying roads using the Forest Road Hazard Inventory Protocol, (2) prioritizing problem solutions, and (3) repairing problem sites identified through the protocol. Examples of activities include road condition surveys, fish passage improvements, replace structures to provide passage of the 50-year peak flow, increase number of cross drains, use of durable surfacing (now required by law), rock ditches, sidecast pull back, reconstruction on legacy roads, and vacate, close, and relocate roads. Landowners also voluntarily retain trees on small non-fish bearing streams to increase potential large wood delivery to fish bearing streams when landslides and debris flows occur.

The RHRR project reduces the threats from roads by conducting detailed surveys to identify hazards and risks to streams, and specific repairs that are above and beyond FPA road maintenance minimums and towards new road standards. This project has been applied extensively on Private Industrial (32% of the ESU) and State (9% of the ESU) forestlands, for a total of 41% of the ESU. These activities have been applied on limited non-industrial forestlands (20% of the ESU). Any road repair activities that might have occurred on Federal lands (38 percent of the ESU) were not consistently reported to the Oregon Watershed Enhancement Board and therefore are difficult to compare. Monitoring and research demonstrate that requirements such as durable surfacing can reduce sediment delivery by 75 to 90 percent or more. Monitoring suggests that the numbers of road-related landslides has decreased although they remain larger than non-road related landslides. Rule revisions currently in draft format would potentially decrease threats associated with landslides by increasing large wood delivery from small non-fish bearing streams during episodic events when sediment is also delivered by

debris flows. Harvest restrictions currently emphasize public safety. The management approaches that address landslides for public safety may be at odds with goals for aquatic habitat. However, one commonality is the retention of large trees along depositional reaches of debris flow paths and potential harvest restrictions around landslide prone areas. Watersheds designated as Salmon Anchor Habitat, under the state FMP may further reduce threats associated with landslides by increasing retention of trees along non-fish bearing streams which could increase large wood recruitment associated with debris torrents. ODF has a strong monitoring program that facilitates rule revision processes to improve resource protection.

The same principles apply for reducing road-related sediment with non-regulatory actions as with regulatory programs (see the discussion in Part 4 (D) Chapter A1 Forest Practices Act). The added value of the non-regulatory programs is the application of well-understood BMPs to roads that are not regulated by the regulatory programs and/or additional practices that are not required by the regulatory program. The added benefits include:

- Identifying hazards to aquatic ecosystems (critical locations such as streams and landslide-prone areas) with the use of a common field protocol;
- A commitment to repair and improve problems;
- And, additional decreases in sediment input to streams and barriers to fish passage beyond that required by law (*road conditions surveys, prioritization, and improvements*).

The same principles apply for reducing landslide-related threats with non-regulatory actions as with regulatory programs (please see the discussion on how regulatory programs are reducing the threat). The added value of the non-regulatory programs is the application of additional practices that are not required by the regulatory program such as leaving trees along small non-fish bearing streams. There is no scientific or monitoring data on whether or not the Oregon Plan measure to leave trees on small Type N streams is effective at reducing the threats to coho associated with debris flows. However it stands to reason that in the event of a debris torrent, a landslide that contributes wood as well as sediment and boulders could better mimic historic processes.

Effectiveness of Forest Management Programs That Address Threats to the Oregon Coast coho ESU

Current forest management programs have the potential to impact coho salmon through changes to instream habitats, riparian conditions, water quality and fish passage. Based on the existing regulatory programs described above, the state contends there is a low risk that key parameters of forestland habitat (e.g., large trees in riparian areas, shade) in this ESU are likely to deteriorate in the foreseeable future.

The state has provided several documents to address the certainty and uncertainty of our conclusion that existing forestry-related regulatory programs create a low risk that key parameters of forestland habitat (e.g., large trees in riparian areas, shade) in this ESU are

likely to deteriorate in the foreseeable future (Part 4(D) ODF Chapter B1, Part 4(D) ODF Chapter B2, Part 4(J) OP TR1, Part 4(J) OP TR2, Part 4(J) OP TR3, and Part 4(E)). The documents discuss available research and monitoring on land use and cover patterns and effectiveness of roads, landslides, fish passage and riparian management regulatory programs on state, private, and federal forest land. We find no empirical data or modeling results to suggest that upland or riparian conditions are going to decline in the near-term (5-20 years) or long-term (100 years). Indeed, it is far more likely that the inputs necessary for proper function will improve stream complexity under the current programs addressing forest practices on federal, state and private lands. For example, the availability of large conifers in riparian areas for recruitment to stream channels is likely to increase across all ownerships, based on unpublished data from the CLAMS project. The rate of increase varies across the range of ownerships, with increases greatest on federal lands and lower on private lands.

Riparian Areas

Leaving riparian buffers along streams are now a common approach to protecting aquatic habitat. However, the practice is generally less than 30 years old. Prior to the early 1970s there were no regulatory requirements for the retention of riparian vegetation. With the implementation of the Oregon Forest Practices Act in 1972, minimal buffers were required on forestland streams "important for fish." By the mid-1980's more substantial buffers that required retention of some conifers were in place for streams "important for fish" on forestland. It was not until 1994 that riparian management areas requiring substantial conifer retention were in place for "all fish-bearing streams." Requiring riparian management areas along "all fish-bearing streams" versus just streams "important for fish" likely increased streams receiving riparian protection on private forestlands by 30 percent. Buffers along streams in agricultural and urban settings are even more recent. Thus, for many lands where land use conversion or timber harvest has occurred n the ESU, it is now reasonable to expect that the majority of vegetation is less than 40 years of age and reflects a likely bias toward hardwood composition. Although second growth trees may recruit wood into streams at a higher rate than more mature stands, the total volume of wood is less, smaller in diameter, more highly mobile and more subject to decay than in mature forests. Conversely, where timber harvest or land use conversion has not occurred, due to fire suppression and/or reductions in beaver populations, both understory and overstory vegetation composition are likely also different. The implications for these differences are unknown, but may result in higher levels of shade, and/or lower levels of large wood recruitment than if fire suppression didn't occur or beaver populations were greater.

Re-establishing riparian function by way of riparian buffers is expected to take 50 to 100 years. Therefore it is unreasonable to expect a signature in the status and trends as a result of management changes that began within the last 30 years. However, it is reasonable to expect that conditions will continue to improve under current management practices and even more as the practices continue to adapt to new information. As a result, Oregon does not believe that forest practices are a significant threat to the viability of the Oregon Coast coho ESU. Where the joint state/federal effort to develop a

conservation plan for the ESU identifies constraints to meeting *desired conditions* that relate to forest management, the State will seek solutions that address these needs.

Finally, adaptive management principles are in place on state and private forest land to address uncertainties with regard to riparian management rules and strategies. The adaptive management programs are described in detail in the state reports. As an example, private and state forests programs at ODF have an ongoing study in the coast range to evaluate the effectiveness of the forest practice rules and FMP strategies. Preliminary results from this study describing baseline conditions will be available in 2005.

Roads

The vast majority (70%) of the ESU is comprised of private industrial and federal forest ownership. An estimated 32% of the ESU is in private industrial forest ownership and 38% is in Federal ownership. Information on the effectiveness of road construction and maintenance practices suggests that existing forestry-related regulatory programs for road construction, management, and restoration are effective at minimizing sediment delivery to streams, minimizing the size and occurrence of road-related landslides, and improving fish passage (Part 4(D) ODF Chapter B2, Part 4(J) OP TR1). Old roads make up the majority of roads, and while there have been many improvements reported, we have little data on road conditions neither at a landscape scale nor across ownership boundaries. This data gap was anticipated by the Oregon Plan Road Hazard Identification and Risk Reduction project, with a plan for monitoring in 2007.

Landslides

Harvest restrictions around landslide prone areas and along debris flow paths vary across forest ownerships. However, all forest ownerships have increased regulatory leave-tree requirements as compared with early forest-management practices ((Part 4(D) ODF Chapter B2). While it stands to reason, that such increases will increase large wood delivery to streams during debris flow events, no monitoring or research are currently available on the effectiveness of these strategies.

Fish-Passage

Oregon submitted two reports on the effectiveness of fish passage strategies (Part 4(D) ODF Chapter B2, Part 4(J) OP TR2). Oregon has incorporated state of the art science on fish passage into guidelines for complying with the laws and non-regulatory measures. Limited monitoring, research, and literature reviews suggest strategies within Oregon guidance have a high degree of certainty to pass fish. The certainty of these conclusions is high in part because of the availability of monitoring data specifically targeted to evaluate current strategies. Uncertainties are associated with the amount and types of data available (e.g. physical attributes of the crossing rather than actual fish movement), and limited information on long-term effectiveness.

Conservation Efforts Directed at Water Quality

This discussion of water quality programs in the Oregon Coast coho ESU is based on supporting documentation found in Parts 4(A) Agriculture and (B) Water Quality of the Oregon Coastal Coho Assessment.

The State's analyses of risk factors to the viability of the Oregon Coast coho ESU concluded that across the ESU as a whole, winter habitat (i.e. habitat complexity) is a higher priority for restoring coho populations than water quality, with the exception of the Umpqua populations (See Part 1 Synthesis Report). Further analysis demonstrated that for summer rearing to become the primary life cycle bottleneck in all populations except the Umpqua, the proportion of stream miles that exceed the temperature standard (assuming exceeding the water temperature standard results in zero smolt production) would have to reach 68% on average (current ESU average = 54%). This translates into a 26% increase in the miles of streams that would have to exceed the temperature standard relative to current conditions (ODFW, unpublished data). This is not to say that there are not significant water quality problems in coastal watersheds that need to be addressed through the Clean Water Act; they are just not the primary constraints to meeting viability criteria for the populations that make up Oregon Coast coho ESU.

State Programs That Address Water Quality Threats

ODEQ has responsibilities for protecting Oregon's waters from point source and nonpoint source pollution and restoring Oregon's waters when water quality standards are not being met. The general framework for this program is (1) identify water quality goals (standards), (2) prevent pollution and protect water quality by administering permits and various technical and financial assistance programs, (3) monitor and assess water quality, and (4) implement and oversee efforts needed to restore water quality when standards are not being met. ODEQ carries out its responsibilities through a variety of programs and activities that are briefly described below.

Water Quality Standards

ODEQ establishes water quality standards to protect beneficial uses of the State's waters, such as fish and aquatic life, recreation, irrigation and domestic water supply. The standards are established at the levels needed to protect the most sensitive beneficial uses. For example, cold water species such as salmonids are generally the most sensitive to water temperature, so the temperature standard is established based on the need to protect salmonid spawning, rearing and migration.

Point Source Permits

ODEQ issues and enforces point source permits under its delegated Clean Water Act authorities to ensure that the wastewater discharges into waters of the state do not cause a violation of water quality standards. The permits set limits for the discharge of pollutants from each source. ODEQ also implements state laws that protect groundwater quality by

requiring permits for installing subsurface sewage disposal systems (septic systems) and for the application of wastewaters to land. ODEQ periodically inspects permitted facilities to ensure compliance and responds promptly to incidents of non-compliance. More information on ODEQ's permit program can be found at: http://www.deq.state.or.us/wq/wqpermit/wqpermit.htm

Nonpoint Sources

ODEQ protects Oregon's waters from nonpoint source pollution by providing technical assistance and financial incentives for nonpoint source pollution control activities. The program is guided by a 5-year plan that ODEQ develops and EPA approves. The plan encompasses the elements described under section A.5 of Part 4(B) Water Quality.

This program focuses on working with a variety of partners in both regulatory and non-regulatory cooperative activities. ODEQ's partnership with local entities and associations has facilitated fruitful and productive relationships with private landowners and other land managers and leveraged additional resources to address nonpoint source problems. For example, ODEQ's nonpoint source grants (Section 319 grants) require a 40% local match. In addition, the framework for nonpoint source protection at the local level that ODEQ has helped to create has enabled watershed councils and other groups to secure additional state and federal funding for watershed enhancement projects. All of these activities increase awareness and understanding of the importance of watershed protection and prompt more citizens to take actions that improve water quality, which will ultimately contribute to broad scale watershed improvements. More information on ODEQ's nonpoint source program can be found at: http://www.deq.state.or.us/wq/nonpoint/nonpoint.htm

Water Quality Monitoring

ODEQ implements two primary monitoring programs that assess the status and trends of the water quality: a statewide ambient monitoring program focused on large rivers and a network of randomly selected sites on wadeable streams (1st through 3rd order). These are described in more detail in Section B-1 of Part 4 (B) Water Quality Report. ODEQ also collects water quality data through a variety of special studies, such as those needed for developing TMDLs and permits. Every two years (as required by EPA under Section 303(d) of the Clean Water Act), ODEQ prepares a report of statewide water quality conditions and identifies water bodies that are not meeting water quality standards. ODEQ uses water quality data to identify water quality problems and design appropriate responses to resolve those problems. ODEQ is also beginning to make more use of biological data to provide an integrated assessment of aquatic conditions and to identify the stressors that may be contributing to impairments. More information on ODEQ's water quality monitoring program can be found at: http://www.deq.state.or.us/lab/wqm/watershed.htm

Total Maximum Daily Loads

Waterbodies that are identified through the 303(d) process described above as being impaired 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. The TMDL allocates the pollutant load among point sources, nonpoint sources, background levels, reserve capacity and a margin of safety. This information is used to guide TMDL implementation efforts. More information on ODEQ's TMDL program, as well as links to completed TMDLs, can be found on ODEQ's website at http://www.deq.state.or.us/wq/TMDLs/TMDLs.htm.

TMDL Implementation

Once water quality problems are "diagnosed" and load allocations are made through a TMDL, water quality impairments are addressed in a variety of ways.

- ODEQ revises point source permits if necessary to reduce the pollutant load arising from point source discharges.
- The Oregon Department of Agriculture works with local stakeholders to develop and implement Agricultural Water Quality Management Area Plans (AWQMAPs) to address the pollutant load reductions required by the TMDL.
- Pollution controls on state, private and some federal lands forestlands are addressed under the Oregon Forest Practices Act or alternatively through non-regulatory measures, especially when dealing with legacy issues. Federal land managers (BLM and USFS) develop and implement Water Quality Restoration Plans to address the TMDL as described in a Memorandum of Agreement between each agency and ODEQ.
- Municipalities address pollution carried into waterways by storm water runoff either through their NPDES Storm Water permit or through implementing a TMDL Implementation Plan that they are required to develop and submit to ODEQ within 12-18 months of completion of a TMDL.
- ODEQ assists those responsible for implementing TMDLs through targeted financial assistance (non-point source grants and Clean Water State Revolving Fund loans) and technical assistance (participation on committees convened to review and revise AWQMAPs or develop other watershed restoration plans; consultations with watershed councils and land owners on the design of restoration projects; assisting small communities with the development of TMDL Implementation plans and identification of effective strategies; etc.).

The Oregon Department of Agriculture (ODA) has specific legal authorities and is responsible for addressing water pollution associated with agricultural lands and activities through Agricultural Water Quality Management (SB 1010), Confined Animal Feeding Operation (CAFO), Pesticides, Weed Control and Invasive Species, and Soil and Water Conservation Districts. These programs collectively work with the agricultural community and general public to develop and implement economically viable, basin-

specific strategies that protect the waters of Oregon from agricultural impacts while allowing for a viable agricultural industry.

The following sections briefly describe the legal and institutional framework of each of these programs and how they address threats to the Oregon Coast coho ESU.

Agricultural Water Quality Management (SB 1010)

The SB 1010 process is triggered in an area when state or federal law requires a water quality management plan. Area plans and rules identify local water quality problems associated with agricultural lands, conditions in the watershed that need to be addressed to meet water quality standards, and ways to correct those problems.

The state Board of Agriculture provided ODA with the following policy directions for area plans and rules development around the state:

- Develop goal-oriented approaches, not prescriptive approaches.
- Accommodate differences between geographic areas.
- Focus on non-regulatory initiatives and approaches to plan goals
- Provide clear enforcement provisions to be utilized where needed as a backstop.
- Proactively address agricultural water quality issues.
- Address fish habitat concerns related to water quality so as to provide the broadest possible protection for farmers and ranchers relative to both water quality and fish regulatory programs.

A goal-oriented approach, which is also referred to as an outcome-based approach, refers to identifying conditions on the land that are needed for prevention and control of water pollution. This is in contrast to a practices based approach, in which the program identifies specific practices that must be used by landowners. The state chose a goal-oriented approach because it believed that a prescriptive approach would not be effective in light of Oregon's diversity of geography and crop production. One important advantage of a goal-oriented approach is that landowners often voluntarily go above and beyond the minimum requirements of a practices-based approach. In a practices-based approach, landowners often feel that traditional regulatory language does not allow them much opportunity to respond to requirements, whereas an outcome-based approach can encourage individual initiative and creativity.

Confined Animal Feeding Operation Program (CAFO)

The state's policy is to protect the quality of the waters of this state by preventing animal wastes from discharging into waters of the state. In further defining the state's CAFO program, process wastewater includes any water that comes into contact with any raw materials, products, or by products including manure, litter, feed, milk, eggs, or bedding. Wastewater treatment works and/or disposal systems are defined in OAR 603-074-0010(24) as all or any part of a system or systems used in connection with a CAFO or holding operation for the collecting, conveying, storing, treating, or stabilizing of manure,

litter, process waste water or contaminated storm water runoff.

The CAFO program was expanded by the state legislature in 2001 to bring the program into compliance with EPA's CAFO regulations. This has expanded the types of CAFOs that must have a permit to be consistent with EPA's definition. The new definition removes the exclusion of larger CAFOs that have facilities where animals are confined for four months or less duration and facilities without a prepared surface and without wastewater treatment works.

Pesticide Management

The ODA Pesticide Division regulates all activities of pesticide use in Oregon, not just agricultural use (ORS 634). The pesticide program is achieving the expectations of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as it pertains to pesticide through the oversight of EPA (as laid out in an MOA between the two agencies). The label contains the guidelines and regulations as they relate to aquatic species and is the means by which this program addresses violations.

ODA is the EPA –designated agency to enforce FIFRA in Oregon. The State has had a Pesticide Control Act since 1973, which in part, allows ODA to further regulate pesticide use, across the entire state or within a specific area. The Oregon Department of Forestry (ODF) also administers the Forest Practices Chemical Rules, which are designed to protect water quality and other natural resources on forestland. These rules establish further requirements to ensure that forest use of pesticides, and petroleum and other chemical products, are not '…injurious to water quality or to the overall maintenance or terrestrial wildlife or aquatic life…"

Soil And Water Conservation Districts (SWCD)

Oregon's 45 Soil and Water Conservation Districts (SWCDs) are organized under Oregon Revised Statutes (ORS) Chapter 568 and are governed by an elected board of directors who serve without pay. SWCDs identify and address natural resource concerns within their respective boundaries and work with local, state, federal and private interests to deliver conservation services. SWCDs provide direct technical assistance to landowners to plan, design, survey, and implement conservation practices and systems.

SWCDs also serve as Local Management Agencies (LMA) for the department and assist with development and implementation of agricultural water quality area management plans. The coastal SWCDs include Clatsop, Coos, Curry County, Lincoln, Siuslaw, Tillamook County, and Umpqua SWCDS. The coastal SWCDs have provided assistance to landowners that have contributed to streambank stability and improvement in riparian condition, livestock manure management, and education and outreach related to salmon and watersheds. Through these means the SWCDS effectively address riparian condition, sediment, water temperature, pH, dissolved oxygen, bacteria, and excessive nutrients from agricultural and rural lands.

Effectiveness of Water Quality Programs That Address Threats to the Oregon Coast coho ESU

Much of the water quality improvement that has occurred over the past several decades in areas such as the Oregon Coast coho ESU can be attributed to point source controls. The key remaining water quality problems – which largely relate to nonpoint source pollution and flow and channel modification – will take time to be resolved. At this time, we are not able to demonstrate an improving trend in water quality correlating to the timeline for implementation of the Oregon Plan, but there are some indications that improvements will occur. One sign of progress is reflected in the on-the-ground efforts of landowners and others and the partnerships being forged to conduct TMDL implementation activities. Another indication is found in the analysis of data from the Oregon Water Quality Index for watersheds where TMDLs have been in place for a longer period of time. These efforts are described below.

Near term indicators of success are best measured by changes in land management, improved riparian protections, level of participation in enhancement projects and an improved understanding of water quality through monitoring efforts. The following summary of TMDL and Agricultural Water Quality Management Plan implementation activities in the ESU illustrates how this is taking place.

TMDL Implementation Activities in the Coastal Coho ESU

To date, four TMDLs have been developed within the Coastal Coho ESU. These are the Nestucca, Tillamook, Nehalem, and North Coast Basins. The major water quality problems identified were stream temperature, bacteria, and sediment.

Each TMDL includes a Water Quality Management Plan (WQMP) that identifies specific actions needed to abate the aforementioned water quality problems and those responsible for implementing them. Highlights of TMDL implementation efforts in this area include:

- ODEQ works in partnership with the Oregon Department of Agriculture (ODA), local Soil & Water Conservation Districts (SWCDs), watershed councils, Tillamook Estuaries Partnership (TEP), Tillamook County Creamery Association (TCCA), the Oregon Watershed Enhancement Board (OWEB) and others on an aggressive riparian restoration program on agricultural lands that includes livestock exclusion, off-channel watering facilities, riparian planting, and barb placement to narrow and deepen river channels. As of November 2004, the effort has resulted in approximately 200 miles of riparian fencing, 250 miles of riparian plantings, and 6 channel barbs to narrow river channels.

- ODEQ works in partnership with watershed councils, TEP, Tillamook County SWCD and others to restore riparian areas on non-agricultural rural residential lands. As of November 2004, approximately 50 miles of streams and rivers have had riparian planting treatments.

- ODEQ works with watershed councils, the Oregon Department of Forestry (ODF), US Forest Service (USFS), Bureau of Land Management (BLM), private timber companies, and small woodlot owners to develop, implement and/or monitor water quality protection projects on forest lands.

- ODEQ has worked together with SWCDs, watershed councils and private landowners to replace 20 culverts and 10 tidegates. Through the TEP, the partnership also successfully negotiated and purchased 350 acres of wetlands in the lower Wilson/Kilchis Rivers area. The wetland will, when restored, filter bacteria, sediment, and nutrients now entering Tillamook Bay from agriculture and urban areas.

- ODEQ has joined with ODA, TEP, TCCA, Oregon State University Extension Service and others to establish a two year buffer strip effectiveness study to determine the most effective buffer width and type needed to abate runoff from agriculture lands.

- ODEQ coordinated efforts by the TEP and Tillamook County to inform and educate private landowners about on-site septic system maintenance and replacement. Efforts to date have included an information mailing to all on-site septic users and a non-regulatory program to inspect systems that may be failing. To date, approximately 8% of the systems have been inspected.

- North Coast TMDLs have identified urban stormwater runoff as a major area of concern. ODEQ worked in conjunction with the Oregon Economic and Community Development Department (OECDD) to inform local jurisdictions about stormwater concerns and form partnerships to address the problems. As of November 2004 the cities of Bay City and Tillamook have completed Stormwater Master Plans and the City of Wheeler has begun a study. It is anticipated that all cities and municipalities in the North Coast and Lower Columbia basins will have completed these plans within five years.

- ODEQ worked with and provided grant funds to the Port of Garibaldi to contain all of their surface runoff from the main port area, including a small hardwood processing plant. ODEQ is currently working with local governments, the OSU Coastal Rainstorming Project and other local partners to fund and implement BMPs necessary to abate the problems identified.

Water Quality Improvements in TMDL Basins

ODEQ used water quality information from the Oregon Water Quality Index (see Section B.1 of ODEQ's report for a description of this index) to look at water quality trends in basins where TMDLs have been developed and implemented. In general, water quality has improved across the state since the late 1980s. Nine out of ten OWQI sites with the greatest improvements in water quality from 1990 to 2003 are in watersheds where TMDLs have been implemented. While it is not possible to definitively determine the causes of the improvements, the information suggests that TMDLs are a contributor to this trend.

Implementation of Agricultural Water Quality Management Plans in the Oregon Coast coho ESU

ODA has adopted plans and rules for the basins associated with the Oregon Coast coho ESU. These are the North Coast, Mid Coast, Umpqua, the Coos and Coquille, and Curry County Agricultural Water Quality Management Areas. The plans and rules for these areas were adopted between 1999 and June 2004. All of these areas are subject to a waste management rule reflecting existing statute (Oregon Revised Statute 468B.025) that went into effect upon adoption and a riparian rule that is presently in effect for the Umpqua and North Coast planning areas, and will go into effect in 2005 for the Coos/Coquille and Mid Coast planning areas, and in 2007 for the Curry planning area.

The waste management rule prohibits the discharge of any wastes into waters of the state that causes a water quality violation or is in violation of any waste discharge permit. This rule is designed to ensure that concentrated nutrients, pathogens associated with high animal density areas, high sediment concentrations in run-off, toxics, or other potential pollutants are not readily transported to waters of the state. Wastes associated with livestock operations can include manure from seasonal feeding and birthing areas, gathering areas and corrals, rangelands and pasture, and any other situations not already covered by Oregon's Confined Animal Feeding Operation laws. Fecal coliform counts in field runoff that exceed state water quality criteria indicate noncompliance with the Waste Management Rule. Livestock grazing is allowed to the extent it complies with the area rules and does not lead to conditions that cause a water quality violation. Compliance with the Streamside Riparian Area Management Rule will help keep wastes from being carried into waters of the state. Wastes may also include excess sediment discharges. Landowners who are actively discharging significant quantities of sediment may be in violation of the Waste Management Rule.

The riparian rules vary marginally from basin to basin in the Oregon Coast coho ESU. The rules are designed to provide management direction to private landowners as they work to implement practices to meet the area rule in the respective basin and protect water quality. Specific emphasis is placed on the establishment and maintenance of vegetation that provides for streambank stability and shade consistent with site capability. Excerpts of the rules are found in Part 4 (A) ODA Agriculture Report and a complete listing of all of the rules and plans associated with each basin can be viewed at www.oda.state.or.us.

Since adoption of these plans and rules, ODA continues to work with the Local Management Agency to help the local agricultural community address agricultural water quality issues through technical assistance, incentives, and education. ODA and LMA implementation activities include education programs on successful agricultural conservation practices, assisting landowners with addressing water quality concerns, helping landowners' access programs to share the cost of water quality improvements, and monitoring the effectiveness of the area plan and rules. ODA's goal is to have 100% compliance by landowners with the Agricultural Water Quality Management program rules. While this expectation is high, the reality is that compliance with water quality laws is good conservation and good for the resource. Since land ownership is in a

constant flux, there will always be a need for an outreach and education and periodic compliance action.

On a biennial basis, ODA has been and continues to review the implementation progress of the Area Plan and Rules to determine whether the plan is sufficient to meet and address water quality standards. Biennial reviews include review of compliance actions, outreach activities, on-the-ground projects that have been reported to the Local Management Agency (typically an SWCD), and any monitoring results that are available to evaluate the effect of the program. To date, biennial reviews for the Coho ESU planning areas have documented a large amount of relevant activity and indicated that no changes are needed to address rule or implementation deficiencies. For additional details on implementation of Area Plans and Rules, see Part 4(A) ODA Agriculture Report.

Agricultural water quality management plans have only recently been completed in the coho ESU and implementation is just getting started. As a result there has not been enough time to assess effectiveness. As Part 4 (A) indicates, the programs to address issues related to agricultural lands contain the structure and resources to conduct outreach to inform landowners of conservation and fish needs, to implement a regulatory compliance program for those instances where an enforceable backstop is needed, to establish a solid description of the conditions expected that is the foundation of the compliance program, and to provide for a review and monitoring program to determine program effectiveness and provide for modification in a timely manner when needed. Thus, even though it is a performance-based rather than a practices-based program, the framework and resources to effectively address issues is established and being implemented and is described in the existing report. Establishing rules to ensure riparian conditions that provide for streambank stability and shade is expected to result in substantial benefits (e.g., improved water quality and habitat complexity) to fisheries as conditions improve and water quality standards are met.

Summary

Oregon has both regulatory and non-regulatory programs in place to address point source and nonpoint source pollution in order to restore and maintain water quality. The State's goals over the near-term are to see improving trends in water quality conditions while longer time spans will be needed to achieve and maintain full compliance with water quality standards. Programs discussed in this report have been developed and implemented to assist the State in meeting water quality standards as required by the federal Clean Water Act, not to meet the specific needs of coho salmon. The direct linkage to salmonids and ultimately coho is that the State's water quality standards are designed to protect the needs of the most sensitive "beneficial uses". In many cases (i.e., stream temperature), the most sensitive beneficial use is salmonids.

The State has committed to monitoring the effectiveness of existing programs and seeking appropriate modifications through the conservation planning process when necessary. Monitoring information will inform these decisions, however, our current monitoring programs are either limited by the scale (both time and space) of inference or

in proof of concept (aerial photography and site capability), and some monitoring programs recently experienced reductions (see Part 4(B) Water Quality).

In summary, there are regulatory and non-regulatory water quality programs in place that require actions that are protective of water quality and have monitoring and periodic review elements that should identify when and where adjustments to programs may be needed. Threats from water quality remain a secondary consideration when considering freshwater habitat needs to meet viability criteria for the Oregon Coast coho ESU (for more details, see the discussion of current threats to ESU viability in Part 1). Where significant issues have been identified (Umpqua populations), management strategies to address these threats will be refined in the conservation plan under development for the ESU. In addition, while water quality is not a significant constraint to the viability of the ESU, water quality does have the potential to limit coho survival at local scales. Where local constraints to coho survival are identified, the State will work to focus regulatory and non-regulatory programs on theses issues.

Conservation Efforts Directed at Water Quantity

This discussion of water quantity programs in the Oregon Coast coho ESU is based on supporting documentation found in Part 4(I) Water Quantity of the Oregon Coastal Coho Assessment.

Overall, Oregon concluded that water quantity, in the form of low summer flows, was a low threat to ESU viability (see Part 1 (A) Synthesis Report). Water quantity was identified as a primary population bottleneck for 2 of the 21 populations (Middle and South Umpqua) and a secondary population bottleneck for no populations. The Oregon Department of Water Resources (WRD) regulatory and restoration programs are aimed at providing sufficient quantity of water for coho salmon. Overarching biological objectives are to 1) protect and maintain existing streamflows in areas providing significant salmon habitat value and 2) restore streamflows in areas providing significant salmon habitat value.

Maintaining streamflows occurs through the following regulatory programs:

a) Establishment of instream water rights;
b) Water distribution and regulation by priority date of water rights of record, including instream water rights;
c) Protection of instream water rights from injury during review of water right transfers; and
d) Public interest review, water right conditions, and water allocation policy in considering new out of stream water uses.

Restoring streamflows occurs through the following conservation programs:

a) Voluntary instream lease agreements;
b) Voluntary instream transfers; and
c) Allocations of conserved water.

WRD partnered with ODFW to combine assessments of streamflow needs for fish with streamflow restoration potential—to produce priorities for streamflow restoration in river basins. This joint prioritization effort was completed in 1998 for the Oregon Coast coho ESU. Priority flow restoration areas and the methods used to prioritize watersheds are provided at http://www.wrd.state.or.us/programs/salmon/priority.shtml.

Watershed councils, soil and water conservation districts, conservation groups and others are encouraged to use these priorities to guide their flow restoration efforts. WRD watermasters also focus their flow restoration efforts and other Oregon Plan activities in these high priority areas.

Effectiveness of Streamflow Protection and Restoration Programs That Address Threats to the Oregon Coast coho ESU

Based on the existing regulatory programs to manage and restore streamflow, along with supporting monitoring programs, the State concludes there is a low risk that summer streamflows in the Oregon Coast coho ESU are likely to deteriorate in the foreseeable future.

With respect to foreseeable increases in consumptive use, this determination is supported by the following findings:

- Based on consumptive use estimates and modeled streamflow, consumptive use of water is not a widespread issue in the ESU. Overall, 70% of the ESU area exhibited August consumptive use that was less than 10% of the 80% exceedance flow (for discussion on how exceedance flows are determined, see Part 4 (I) Water Quantity Report.
- While municipalities may continue to grow into their permitted water rights, the consumptive use estimates used in this analysis relies on the consumptive use of the full face value of active municipal rights. In this sense, the consumptive use estimates are highly conservative because they assume that the municipality is currently using the full amount of their active water rights. Our estimates did not include consumptive use for "non-active" municipal rights that are typically held for emergency and redundancy purposes.
- Consumptive use has not substantially increased since 1997. Overall, 93% of the total area of the Oregon Coastal coho ESU had no change in estimated August CU between 1997 and 2004. This demonstrates the effectiveness of existing regulations to protect streamflows during low flow months.
- New water rights are subject to water availability standards pursuant to the Oregon Water Resources Commission's (WRC) Water Allocation Policy under OAR Chapter 690, Division 410. For the purposes of this assessment, water availability at the 80% exceedance natural flow is used as proxy for the likelihood that new water uses would be permitted. At an 80% exceedance flow, water is not available for new water appropriations in August in 94% of the total ESU area. In addition to water availability, the water use must be consistent with administrative rules adopted by the Water Resources Commission that prescribe future allowable uses of water, must not

result in injury to existing water rights, and must be consistent with other rules of the Water Resources Commission. So, while future demand for water will likely grow, it is highly probable that these demands will have to be met from sources other than summer-time streamflows.

With respect to maintaining instream flows and flow restoration, this determination is supported by the following findings:

- Approximately 800 instream water rights, covering over 3,700 miles of streams, exist in coastal Oregon basins. When streamflow measurements indicate that the quantity of water in a stream is less than the instream water right, WRD requires junior water right holders to stop or curtail their use. Depending on the priority date of the instream water right, flows are either stabilized or may improve where instream water rights are in place.
- Since 1997, streamflow restoration activities coincide with areas of highest consumptive use. Streamflow restoration efforts since 1997 have been focused in the Umpqua and Mid-South monitoring areas with 66 projects and 25 cfs of water placed instream.

While it is conceivable that existing statutes and administrative rules regarding the issuance of new water rights and instream flow protection could be changed, there are no current efforts to do so. Based on data collected since 1997, we assume a high degree of certainty in our ability to implement/enforce existing regulatory and conservation plans and policies.

Actions by WRD Watermasters are the core mechanism for implementing these regulatory and conservation programs. Watermasters are funded through General Funds so there is a high level of certainty that these positions will continue to be funded. WRD ranks its field operations as a high priority and directly related to core program functions and WRD's mission so the certainty of continued funding is high.

Habitat Restoration Programs to Address Threats to Viability

This discussion of habitat restoration programs in the Oregon Coast coho ESU is based on supporting documentation found in Part 4(H) Restoration of the Oregon Coastal Coho Assessment.

Restoration work on private, state, and federal lands addresses the following limiting factors for the Oregon Coast coho ESU:

- Stream complexity (increasing wood, decreasing fine sediment, increasing off-channel rearing and shelter opportunity, increasing pool depth, etc.);
- Riparian condition (providing shade, lowering summer stream temperature, providing opportunity for future wood recruitment);
- Fish passage (allowing access to streams by adults and juveniles at a greater range of stream flows);

- Water quality (reducing fine sediment, lowering summer water temperature);
- Water quantity (providing additional flow in summer); and
- Nutrients.

Restoration programs are organized and conducted through many entities in Oregon. The following programs or independent actions apply specifically to the Oregon Coast coho ESU:

1. Watershed Councils;
2. Soil and Water Conservation Districts (SWCDs);
3. Oregon Department of Fish and Wildlife Western Oregon Stream Restoration Program;
4. Federal Lands Restoration (USFS and BLM);
5. State Lands Restoration (Oregon Department of Forestry);
6. State Roads Fish Passage Restoration (Oregon Department of Transportation); and
7. Private Landowner Initiative.

We define restoration actions as the variety of on-the-ground work that result in preservation, conservation, or restoration of watershed function that will support sustainability of native fish species, water quality, and watershed health. This category of action may occur on private, state, tribal, county, or federal land. Non-regulatory action on private lands is especially significant to efforts to restore the Oregon Coast coho ESU because the species is primarily distributed on private rather than public lands in the ESU. Restoration work is ultimately useful by improving the quality and quantity of habitat to support the needs for spawning, rearing and migration of the listed coho ESU. In this report, the term *restoration* refers to actions that will actively or passively result in conservation or re-establishment of watershed function that is consistent with sustaining native species (including the Oregon Coast coho ESU) and water quality.

Restoration Effectiveness

Assessing the overall impact of restoration activities on the condition of coho habitat is difficult, since most of the monitoring programs provide information on habitat status and trend but not on causality. Available information suggests that while many of the restoration activities have the potential to improve the condition of targeted habitats, the total miles of stream treated generally represent a small proportion of the total accessible to coho in the ESU. Specific goals and targets for restoration will be developed in the conservation plan being developed by NOAA Fisheries and the State of Oregon.

Monitoring and research of instream habitat restoration has shown that projects are generally successful at replicating levels found at less disturbed reference reaches and can result in increased overwinter survival of juvenile coho. A 2002 OWEB study (Bishaw et al., 2002) found that 45% of all riparian planting projects had a high survival rate. However, they suggested that the use of site preparation, post-planting maintenance, and tree protection increased the survival rates dramatically (to roughly 80% with high

survival rate). The same study evaluated fencing projects and determined that 83% of fences were intact. Of those sites with failing fences, 80% had low tree survival.

Since 1997, instream habitat restoration has been conducted in about 7% of the 6,575 stream miles accessible to coho in the ESU. Thus, broad-scale monitoring cannot yet detect an improving trend in the quality of instream habitat in the ESU. For some activities (e.g. riparian restoration) it may take years before the overall benefit of the restoration work is realized. At the current rate of restoration work (1%/year) it will require another 93 years to address the remaining coho streams. From an operational perspective, for many private lands the economic opportunity to conduct restoration occurs when other activities such as timber harvest are planned (logging equipment is on site that can deliver logs to streams that are otherwise inaccessible). For private forestlands, assuming a timber harvest entry every 50 years, it is feasible to double the restoration rate. Work by NOAA Fisheries evaluating restoration work done in Washington and Oregon concluded that work in Oregon appeared to have a moderate to high likelihood of effectiveness. Research by NOAA and others indicates that large wood placement can lead to higher densities of juvenile coho during summer and winter and cutthroat and steelhead during winter. While considerable resources have been expended to improve and restore coho habitat in the ESU, the effects of the restoration work cannot yet be detected, and it is too early for all the potential benefits to be realized.

Restoration investments to date: (1) have primarily addressed sediment delivery to streams (roads), fish passage, and habitat complexity (riparian and instream), (2) and have been well distributed across the ESU throughout the post-1997 Oregon Plan era. Oregon's broad-based restoration program can be an effective tool to address the primary risk factors identified by this assessment. Stream complexity was identified as the primary risk factor bottleneck for 13 of the 21 populations in the ESU. Oregon will need to consider whether or not to prioritize restoration investments in basins where populations did not pass criteria over restoration in basins where populations did pass viability criteria. On one hand, restoration to bring populations from failing to passing status would seem to be the most direct approach to strengthening ESU viability. On the other hand, restoration in populations that currently pass criteria, if directed to primary bottlenecks would also strengthen ESU viability. Oregon now has new tool to improve restoration investment decisions.

Effectiveness of Restoration Programs That Address Threats to the Oregon Coast coho ESU

Oregon retains solid, grassroots-based support for restoration activities in the ESU. In addition, the current program retains funding for program through 2014 from Measure 66. The program, in its many forms, continues to evolve in response to new information, such as watershed assessments, to take actions that will respond to watershed health and fish needs. Demands for funds from worthy projects continue to outpace available funds. A challenge to the various programs is to respond to findings in work like the Coastal Coho Assessment while balancing the needs of other species and other directives (water quality). Significant hurdles remain in evaluating the effectiveness of individual projects

as well as the overall program. Oregon has embarked on a path to implement an effectiveness-monitoring program and feedback from this program will be critical to the long-term support and effectiveness of restoration programs. Our expectation for the program is a strong commitment to funding while bringing more focused and structured efforts on the ground, targeted at the areas that most impair fish and watersheds.

2. Explicit incremental objectives for the conservation effort and dates for achieving them.

Objectives and timelines for the conservation efforts described in this report are provided in the supporting technical reports developed by the Oregon Department of Forestry (ODF), Oregon Department of Water Quality (ODEQ), Oregon Department of Agriculture (ODA), Oregon Water Resources Department (OWRD), and Oregon Watershed Enhancement Board (OWEB) in support of this document.

3. The steps necessary to implement the conservation effort are identified in detail.

The steps necessary to implement the conservation efforts described in this report are provided in the supporting technical reports developed by the Oregon Department of Forestry (ODF), Oregon Department of Water Quality (ODEQ), Oregon Department of Agriculture (ODA), Oregon Water Resources Department (OWRD), and Oregon Watershed Enhancement Board (OWEB) in support of this document.

4. Quantifiable, scientifically valid parameters that will demonstrate achievement of objectives, standards for these parameters by which progress will be measured, are identified.

Descriptions of parameters that demonstrate achievement for the conservation efforts described in this report are provided in the supporting technical reports developed by the Oregon Department of Forestry (ODF), Oregon Department of Water Quality (ODEQ), Oregon Department of Agriculture (ODA), Oregon Water Resources Department (OWRD), and Oregon Watershed Enhancement Board (OWEB) in support of this document.

5. Provisions for monitoring and reporting progress on implementation (based on compliance with the implementation schedule) and effectiveness (based on evaluation of quantifiable parameters) of the conservation effort provided.

Descriptions of monitoring and reporting progress on implementation and effectiveness of the conservation effort described in this report are provided in the supporting technical reports developed by the Oregon Department of Forestry (ODF), Oregon Department of Water Quality (ODEQ), Oregon Department of Agriculture (ODA), Oregon Water Resources Department (OWRD), Oregon Watershed Enhancement Board (OWEB), and the Oregon Department of Fish and Wildlife in support of this document. In addition, Oregon developed a strategy to develop and implement a statewide Monitoring Program in coordination with state natural resource agencies for activities conducted under the

Oregon Plan for Salmon and Watersheds in 2003. This Strategy describes an overall framework for structuring this cooperative effort and provides direction to help integrate Oregon Plan programs and monitoring with region-wide watershed enhancement and salmon recovery efforts (http://oregon.gov/OWEB/docs/pubs/MonitoringStrategy.pdf)

The Ability of Oregon's Monitoring Programs to Detect Change

Oregon's investment in a rigorous and well-defined monitoring program over the last 7 to 14 years now provides the State with a baseline to assess future changes in fish populations, aquatic and riparian habitats and water quality. With each year of additional data, our ability to detect smaller changes increases significantly. At the ESU-scale, we can detect small annual changes (10%) for the majority of variables. At the monitoring area scale, our capacity is to detect change varies by individual monitoring areas. At the coho populations scale, we currently lack any capacity to detect changes in aquatic and riparian habitats and water quality and limited capacity to detect trends in adult spawners. A more thorough discussion of these results can be found in Parts 4 (B) ODEQ Water Quality Report and 4 (C) ODFW (3) Habitat Report.

To assess the ability of Oregon Plan monitoring programs to detect change over time, we used the computer program TREND (Gerrodette 1993) to calculate the amount of change in coho spawners, instream habitat, riparian conditions, and water quality that Oregon Plan monitoring programs can detect with 10 or 15 years of sampling. For coho spawners, instream habitat, riparian conditions, and water temperature, this equates to an additional three to eight years of monitoring for on-going programs. For the remaining water quality variables, the current monitoring design began in 1994, meaning that the 10 year monitoring milestone has already been achieved and the 15 year monitoring milestone will be achieved in 5 years.

Instream and Riparian Habitat Monitoring Trend Detection Sensitivity

At the ESU scale, the current instream habitat and riparian monitoring design will be able to detect relatively small annual changes for all but two variables; % slackwater pools and conifers > 90cm DBH in the next 3 to 8 years (Table 2). The low occurrence of these two variables across the ESU leads to high variability in our annual estimates for these variables, an issue that will be difficult to address with our current sample design. With three more years of data we will be able to detect an annual change of 10% or less for 8 of the 14 variables. In eight years, we will be able to detect an annual change of 10% or less for 10 of the 14 variables (5% or less for 8/14). Overall, we submit that our monitoring program demonstrates significant capacity to detect meaningful changes in instream habitat and riparian conditions at the ESU scale.

The current monitoring program varies in its capacity to detect change in instream habitat and riparian conditions at the Monitoring Area scale. For the North Coast and Mid-Coast Monitoring Areas (Tables 3 and 4), the State will have the capacity to detect annual changes of 10% or less for the majority of the variables in 8 years. However, for the Umpqua and to a lesser extent the Mid-South Coast monitoring areas, our current

Table 2. The minimum detectable change in instream habitat and riparian variables based on monitoring conducted over the range of coho in the Oregon Coast coho ESU. Change detection was based on the variation observed in parameters collected from 1998-2003. Minimum rates of change were determined with a 5% probability of a Type 1 error (alpha = 0.05) and an 80% probability of trend detection (power = 0.8). Sample intervals of 10 and 15 years will be achieved by OPSW monitoring in 2008 and 2013.

Variable	1998 value	Minimum annual change detectable after 10 years of monitoring	Minimum annual change detectable after 15 years of monitoring
% Bedrock	2.3%[a]	0.4%	0.2%
% Fine Sediment in Riffles	20.3%[a]	1.8%	0.8%
% Gravel in Riffles	32.1%[a]	1.9%	1.0%
% Pools	32.8%[a]	3.0%	1.3%
% Shade	79.0%[a]	2.4%	0.8%
% Side Channel	1.3%[a]	1.2%	0.3%
% Slackwater Pools	4.8%[b]	-[d]	892%
Conifers > 50cm dbh	104.8/mile[b]	14.7/mile	6.3/mile
Conifers > 90cm dbh	80.8/mile[c]	-[d]	-[d]
Deep Pools	6.1/mile[b]	0.24/mile	0.12/mile
Key Pieces Large Wood	2.3/mile[a]	1.1/mile	0.4/mile
Large Wood Volume	155 m^3/mile[a]	6.2m^3/mile	3.1m^3/mile
Number Pieces Large Wood	168.6/mile[a]	10.1/mile	5.1/mile
Total Conifers	858.9/mile[a]	85.9/mile	42.9/mile

[a]Median value, [b]75th percentile value, [c]75th percentile - 1999 data, [d]Annual variability too high for sensitivity analysis

Table 3. The minimum detectable change in instream habitat and riparian variables based on monitoring conducted over the range of coho in the North Coast Monitoring Area. Change detection was based on the variation observed in parameters collected from 1998-2003. Minimum rates of change were determined with a 5% probability of a Type 1 error (alpha = 0.05) and an 80% probability of trend detection (power = 0.8). Sample intervals of 10 and 15 years will be achieved in 2008 and 2013.

Variable	1998 value	Minimum annual change detectable after 10 years of monitoring	Minimum annual change detectable after 15 years of monitoring
% Bedrock	0.4%[a]	0.3%	0.1%
% Fine Sediment in Riffles	29.3%[a]	11.5%	4.1%
% Gravel in Riffles	29.5%[a]	1.8%	0.9%
% Pools	24.1%[a]	1.4%	0.7%
% Shade	77.7%[a]	1.6%	0.8%
% Side Channel	4.3%[a]	0.8%	0.3%
% Slackwater Pools	3.1%[b]	-[c]	-[c]
Conifers > 50cm dbh	263.3/mile[b]	39.5/mile	18.4/mile
Conifers > 90cm dbh	0/mile[b]	-[d]	-[d]
Deep Pools	6.1/mile[b]	0.7/mile	0.3/mile
Key Pieces Large Wood	5.6/mile[a]	3.6/mile	1.1/mile
Large Wood Volume	254.1 m^3/mile[a]	50.8 m^3/mile	20.3 m^3/mile
Number Pieces Large Wood	208.9/mile[a]	14.6/mile	6.3/mile
Total Conifers	666.1/mile[a]	206.5/mile	79.9/mile

[a]Median value, [b]75th percentile value, [c]Annual variability too high for sensitivity analysis,
[d]Sensitivity analysis not possible due to zero estimates for each sample year

Table 4. The minimum detectable change in instream habitat and riparian variables based on monitoring conducted over the range of coho in the Mid-Coast Monitoring Area. Change detection was based on the variation observed in parameters collected from 1998-2003. Minimum rates of change were determined with a 5% probability of a Type 1 error (alpha = 0.05) and an 80% probability of trend detection (power = 0.8). Sample intervals of 10 and 15 years will be achieved by OPSW monitoring in 2008 and 2013.

Variable	1998 value	Minimum annual change detectable after 10 years of monitoring	Minimum annual change detectable after 15 years of monitoring
% Bedrock	9.1%[a]	0.9%	0.5%
% Fine Sediment in Riffles	19.5%[a]	8.6%	2.9%
% Gravel in Riffles	39.1%[a]	2.3%	1.2%
% Pools	35.5%[a]	4.3%	2.1%
% Shade	79.7%[a]	3.2%	1.6%
% Side Channel	2.5%[a]	-[d]	-[d]
% Slackwater Pools	7.2%[b]	-[d]	14.8%
Conifers > 50cm dbh	96.5/mile[b]	25.1/mile	9.6/mile
Conifers > 90cm dbh	47.4/mile[c]	-[d]	-[d]
Deep Pools	5.4/mile[b]	0.2/mile	0.1/mile
Key Pieces Large Wood	2.1/mile[a]	16.7/mile	0.8/mile
Large Wood Volume	130.9 m^3/mile[a]	19.6 m^3/mile	9.2 m^3/mile
Number Pieces Large Wood	136.6/mile[a]	24.6/mile	10.9/mile
Total Conifers	764.9/mile[a]	252.4/mile	91.8/mile

[a]Median value, [b]75th percentile value, [c]75th percentile - 1999 data, [d]Annual variability too high for sensitivity analysis

monitoring does not appear adequate to allow us to detect significant changes for many of the instream habitat and riparian parameters.

At the scale of individual population units, the current monitoring program for instream habitat and riparian monitoring program is not adequate to detect meaningful changes. Based on the results brought forward by the Coastal Coho ESU Assessment, the State of Oregon is in the process of reviewing the instream habitat and riparian monitoring program to improve the change detection ability for the Umpqua and Mid-South Coast monitoring areas as well as the individual coho population units within the ESU.

Water Quality Monitoring Trend Detection Sensitivity

For most water quality parameters, the current monitoring program can detect relatively small annual changes at the ESU scale (See Table 9, Part 4(B) Water Quality Report). In three years, ODEQ will be able to detect a 10% or smaller annual change for 7 of the 10 water quality parameters. However, lack of adequate sample sizes precludes the ability to detect changes at finer spatial scales. The information provided by this assessment will help guide the State of Oregon in improving the spatial resolution of the OPSW water quality monitoring program.

Adult Spawner Monitoring Sensitivity

Due to the large influence of ocean conditions on coastal coho smolt to adult survival, temporal data on the abundance of coho spawners can naturally fluctuate widely regardless of our freshwater sampling design. We believe that a more meaningful characterization of current monitoring for coho spawner abundance is obtained by evaluating the average precision of the population estimates (Table 5). In 1998, ODFW set target goals for the precision of its coastal coho spawner monitoring program at + 20% at the ESU scale, 30% at the Monitoring Area scale, and 60% at the basin scale (Jacobs and Nickelson 1998). Based on these criteria, current sampling for adult coho spawners is meeting the precision goals for the ESU and Monitoring Areas and at half of the Population Units. The lack of adequate precision for some Population Units is primarily due to a lack of adequate sample sizes, an issue that ODFW is currently working on rectifying.

Table 5. Precision of adult coho spawner surveys. Precision is calculated by dividing the 95% confidence interval for an estimate by the estimate.

Spatial Scale	Average Precision (% of Estimate)	Average Sample Size
ESU	16%	412
North Coast	28%	120
Necanicum	52%	10
Nehalem	32%	58
Tillamook	54%	31
Nestucca	89%	18
Mid-Coast	24%	101
Salmon	70%	5
Siletz	50%	14
Beaver	97%	4
Yaquina	59%	11
Alsea	53%	18
Siuslaw	34%	41
Mid-South Coast	27%	85
Coos	44%	36
Coquille	29%	44
Floras	138%	3
Sixes	NA[1]	NA[1]
Siltcoos	NA[1]	NA[1]
Tahkenitch	NA[1]	NA[1]
Tenmile	NA[1]	NA[1]
Umpqua	25%	107
Lower Umpqua	29%	45
Midddle Umpqua	60%	21
South Umpqua	45%	41
North Umpqua	NA[1]	NA[1]

[1]No estimate of precision is available due to inadequate sample sizes.

Monitoring Needs

Although there is a considerable amount of effort and resources dedicated to monitoring in the ESU, there are three significant shortcomings. First, although monitoring is in place that enables statistically rigorous evaluation of the status and trend of coho populations, water quality, and habitat conditions, very little monitoring is in place that enables an assessment of the effectiveness of regulatory and restoration programs. Effectiveness monitoring has the potential to quantify the effects of specific practices or policies. In an effort to improve effectiveness monitoring in Oregon, OWEB is in the process of developing an effectiveness monitoring plan. Monitoring implemented as a result of this plan will be funded from a combination of sources including OWEB, NOAA Fisheries, BLM, and USFS.

Spatial resolution is the second shortcoming of existing monitoring programs. When the OPSW was implemented in 1997, most monitoring was designed to provide information at the ESU or monitoring area scale (previously gene conservation areas). For this assessment, the NOAA Fisheries TRT developed finer scale coho population units for which analyses would ideally be conducted. As evidenced by the information in this report, Oregon currently lacks adequate information at the coho population scale for several habitat parameters. In addition, funding for many of the monitoring programs have not kept pace with rising costs, resulting in cutbacks in some program sampling efforts. As a result, fewer sites are sampled each year by some programs, further diminishing the programs that have not kept pace with rising costs, resulting in cutbacks in some program sampling efforts. Continued funding and more efficient use of current resources will be a major agenda item for the Oregon Plan Interagency Monitoring team in the coming months.

Finally, in the process of conducting this assessment it became abundantly clear that an improved system is needed for information archiving and retrieval. The team members working on this assessment spent considerable time tracking down and formatting information at the expense of time spent analyzing the information. We need to be able to access and understand data being collected by a variety of entities at multiple-scales in order to take full advantage of our collective efforts. This is particularly true of data collected at finer scales. Two actions are being undertaken to address these issues. First, OWEB has contracted with ODFW's Natural Resource Information Program (NRIMP) to develop and maintain an Internet based data library. The goal is to have all entities conducting monitoring for the OPSW regularly post information to this site. Second, ODFW, ODEQ, and statisticians at Oregon State and Colorado State University have partnered to conduct a review of the statistical needs of the OPSW. The results of this review, which will include a development of needed statistical tools, will be published in a special issue of the journal Environmetrics.

6. Principles of Adaptive Management are Incorporated.

Adaptive management is a central element of numerous Oregon Plan programs and activities. Significant changes to a variety of State programs prior to and subsequent to

Oregon Plan implementation have occurred. For example, dramatic changes in harvest and hatchery management occurred in direct response to declining coho numbers. New fish management policies, hatchery management policies, continual examination of Forest Practices rules, revision of water quality standards, development of TMDL's and AWQMP, revised harvest management, revised monitoring programs are all examples of adaptive management in action. Finally, this assessment is probably the best example of adaptive management. State agencies and other Oregon Plan partners will use this assessment to make better decisions about how we implement the Oregon Plan in the future. In Part 1: Synthesis, the section on "Lessons Learned and Adaptive Management" discusses Oregon's approach to adaptive management and specific actions the State proposes to take in relationship to the Oregon Coast coho ESU. In addition, Part 3(B) Appendix A provides a detailed discussion of the statutory and programmatic requirements to conduct adaptive management.

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APPENDIX A

Adaptive Management and Continuous Improvement

Adaptive management is a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs. Its most effective form–"active" adaptive management–employs management programs that are designed to experimentally compare selected policies or practices, by evaluating alternative hypotheses about the system being managed. At its simplest, adaptive management can be described as a repeated cycle of "plan, do, report, and evaluate." This basic cycle is in place at all levels of the Oregon Plan, including at the grassroots level through for example, watershed councils and their action plans, at the ESU level through the Oregon Plan monitoring plan, and at the state budget/policy levels through a number of processes.

Specifically under the Oregon Plan, a set of systems are in place to provide for adaptive management within the scope of watersheds, the ESU and statewide. However, as discussed more fully below, the Oregon Plan does not operate its adaptive management systems in isolation, but rather as part of the state's overall strategic planning and budgeting processes supported by the Oregon Benchmarks and the Sustainability Act. Its adaptive management process is also connected to federal adaptive management efforts and to active research being undertaken related to hatcheries and habitat. Ensuring that the Oregon Plan functions in this broader adaptive management context is an important strength in promoting budgetary and other investments by Oregon's Legislature.

Adaptive Management at Work

The Oregon Plan Coastal Coho Assessment Project is clearly adaptive management at work. The purpose of the Oregon Plan Assessment is to document and evaluate the implementation of the Oregon Plan in meeting its purposes within the Oregon Coast ESU and to make recommendations for changes as may be needed.

This assessment has identified a number of possible improvements to the adaptive management process and our work has led to a number of new commitments and recommendations related to adaptive management, including;

1. Oregon through OWEB will produce a report of comprehensive monitoring efforts in the coastal Coho ESU at 5 year intervals. The first report would be produced in 2010 and contain data collected though 2007. The report will update information on Coho, habitat, water quality, and stream flow, recently completed research results and effectiveness monitoring.
2. Oregon will establish an Adaptive Management Work Group (AMWG) by the end of 2005. The AMWG will be responsible for identifying key issues and analyses that should be addressed by monitoring and reported in the periodic monitoring report.
3. Oregon through the Governor's Office will seek to enhance existing state agency staffing levels dedicated to monitoring and that will specifically support data analysis and reporting.
4. Oregon through the Oregon Plan Monitoring Team will complete a review of monitoring in relation to findings of this Assessment and propose refinement or alteration of monitoring designs by the 2006 field season. This review will work to enhance and demonstrate the Oregon Plan's capacity to detect and respond to changes in Coho viability or habitat.
5. OWEB will maintain and upgrade the data library website to provide access to data used in the Assessment
6. Oregon through the Governor's Office will continue work with Stakeholder/NOAA work group to complete a draft conservation plan by December 2005. The Conservation Plan will attempt to identify potential harvest/habitat/hatchery thresholds for considering management or status changes.

The above recommendations will strengthen an adaptive management program that is already strong. The information below provides a further overview of Oregon's Oregon Plan adaptive management program, including how the program is interrelated with other state and federal agency efforts, and the connections to Oregon's policy and budget processes.

1. 0 Overview of Oregon Plan Adaptive Management Processes

ORS 541.351 to 541.415 establishes the Oregon Plan, Oregon Watershed Enhancement Board, the IMST and agency responsibilities under the Oregon Plan for Salmon and Watersheds. Within this framework are a set of adaptive management requirements for monitoring, research, reporting, collaborating and improving agency actions. An Oregon Plan Monitoring Team works to connect statewide interagency and agency actions into a cohesive and comprehensive monitoring strategy.

ORS 541.351 defines "adaptive management" under the Oregon Plan as applying management or practices over time and across the landscape to achieve site specific resource goals using an integrated and science based approach that results in changes over time in response to feedback or monitoring. ORS 541.353(e) requires that agencies under the Oregon Plan monitor and ensure

implementation of the integrated watershed action plans using adaptive management to make appropriate changes in action plans and goals as needed.

ORS 541.365 Requires the Oregon Watershed Enhancement Board to coordinate information, data and data retrieval needs of the natural resource agencies of the state with the State Service Center for Geographic Information Systems and to develop and implement a statewide monitoring program for activities conducted under the Oregon Plan.

ORS 541.371 requires the Oregon Watershed Enhancement Board to establish a framework for a locally based integrated watershed planning and management process designed to assist watershed councils and soil and water conservation districts and to support the efforts of watershed councils and soil and water conservation districts to work within the requirements of state and federal laws without duplication of planning effort.

The framework must include guidance and protocols for watershed assessments to encourage consistent assessment methods across all watersheds and agencies, including assessment of cumulative effects and guidance on how to prepare watershed action plans. OWEB is required to support development and implementation of a system that enables standardized collection, management and reporting of natural resources information in Oregon, including water data, geographic information system data and information on native fish and wildlife and habitat.

ORS 541.378 creates in the General Fund of the State Treasury the Restoration and Protection Research Fund. Moneys credited to the fund are continuously appropriated to the Oregon Watershed Enhancement Board for the purpose of funding research and other activities related to the restoration and protection of native salmonid populations, watersheds, fish and wildlife habitats and water quality, including but not limited to research, monitoring, evaluation and assessment related to the Oregon Plan.

ORS 541.395 requires the Department of Environmental Quality, Department of Fish and Wildlife, Water Resources Department, State Forestry Department, State Department of Agriculture, and agricultural extension service of Oregon State University to provide the OWEB with a copy of any report produced by the agency that is related to enhancement or restoration of riparian areas or associated uplands.

ORS 541.409 creates an Independent Multidisciplinary Science Team consisting of seven scientists with recognized expertise in fisheries, artificial propagation, stream ecology, forestry,

range, watershed and agricultural management. The Independent Multidisciplinary Science Team reviews implementation of the Oregon Plan and other programs for achieving healthy streams as described in ORS 541.405. They are to prepare and submit to the Governor, the Legislative Assembly and the public an annual report on the implementation of the Oregon Plan, including any recommendations for changes or adjustments to the initiative. They serve as an independent scientific peer review panel to the state agencies responsible for developing and implementing the Oregon Plan and other salmon or stream enhancement programs throughout this state. Finally, they report regularly to the joint legislative committee created pursuant to ORS 171.551 concerning the duties described under this subsection and other requests by that joint legislative committee.

OWEB is specifically required to biennially report to Legislative Assembly on the implementation of the management program under ORS 541.384 and grants awarded under ORS 541.399. ORS 541.420 require the Oregon Watershed Enhancement Board shall, by January 15 of each odd-numbered year, to submit a report to the Governor and to the appropriate committee or committees of the Legislative Assembly that assesses the implementation and effectiveness of the Oregon Plan in the state. The report is required to address each drainage basin in the state and includes.

1. A status report on watershed and key habitat conditions in the drainage basin based on available information;
2. An assessment of data and information needs deemed critical to monitoring and evaluating watershed and habitat enhancement programs and efforts;
3. An overview of state agency programs addressing watershed conditions;
4. An overview of voluntary restoration activities addressing watershed conditions;
5. A summary of investments made by the board from funds received under section 4b, Article XV of the Oregon Constitution, and all other sources; and
6. The recommendations of the board for enhancing the effectiveness of Oregon Plan implementation in each drainage basin.

In addition to the biennial report, Oregon Watershed Enhancement Board is required to report regularly during the interim on the implementation of the Oregon Plan to the joint legislative committee created under ORS 171.551. Each natural resources agency is to provide information requested by OWEB in the format and at the times determined by them.

The State has adopted a monitoring framework that is based upon several key hypotheses that will be tested through various adaptive management processes. The first set of these hypotheses are that our programs are effective in maintaining the resources they are designed to protect. These hypotheses are being tested programmatically by the agencies charged to implement the program

and through some key landscape modeling efforts as described in the tables below.

The second set of hypotheses is that the key initiatives under the Oregon Plan related to harvest, hatcheries and habitat are effective at restoring populations and habitat. ESU scale monitoring is underway to track coho population, and aquatic and riparian habitat trends. Monitoring of fish populations occurs at all life stages and should be highly sensitive to trends. Data collected for habitat parameters is currently less sensitive to trends, but when tied to fish population trends should provide critical information necessary to appropriately react.

A third set of hypotheses relate to the implementation and effectiveness of the Oregon Plan, which is periodically assessed to identify programmatic improvements. As noted elsewhere in this assessment report, a number of changes are being proposed related to the Plan under the current assessment of the north Coast ESU. The biennial reports discussed earlier are also a key element in this effort.

1.1 Oregon Benchmarks

Oregon somewhat uniquely ties all the adaptive management efforts together through the Oregon Benchmarks. The Oregon Benchmarks represent among the most sophisticated approaches taken by state government to track progress in achieving economic, social and environmental goals.

The Benchmarks measure progress towards Oregon's overall strategic vision, *Oregon Shines*. Its goals are three-fold: 1) quality jobs for all Oregonians, 2) safe, caring and engaged communities, and 3) healthy, sustainable surroundings. Benchmarks are organized into seven categories: economy, education, civic engagement, social support, public safety, community development and environment. These benchmarks help to provide the long view perspective in solving economic, social and environmental problems. In addition, Oregon Benchmarks are used for a broad array of policymaking and budget-related activities. Oregon state agencies are required to link key performance measures to them for budget reporting and development purposes.

In the late nineties, The Oregon Progress Board facilitated a process to update and revise the state's environmental benchmarks. The process involved several committees of scientists, stakeholders, and agency personnel. A group of scientists, chaired by Oregon State University President Paul Risser, ultimately proposed 18 new or modified indicators to the Board. These indicators were described in the Oregon State of the Environment Report 2000.

The Progress Board evaluated the indicators submitted by the scientists and, after extensive discussion with agency personnel, adopted and/or modified most of them. For some benchmarks,

the Board also set targets or performance goals. The Progress Board released its report called Achieving the Oregon Shines Vision: the 2001 Benchmark Performance Report, in March 2001. The Board adopted additional changes to the environmental benchmarks during the May 2002 meeting.

The following are general topic descriptors of the key environmental Oregon Benchmarks that are currently being used by Oregon:
BM 75 Air quality; BM 76 CO2 emissions; BM 77 Wetlands; BM 78 Water quality; BM 79 Water rights; BM 80 Agricultural land; BM 81 Forest land; BM 82 Timber harvest; BM 83 Solid waste; BM 84 Hazardous waste; BM 85 Freshwater species; BM 86 Marine species; BM 87 Terrestrial species; BM 88 Species in conservation areas; BM 89 Invasive species; and BM 90 State park land. Detail on the specific elements of these indicators can be found at http://egov.oregon.gov/DAS/OPB/obm.shtml

1.2 Sustainability Act

Sustainability Act of 2001and the Governor's Executive Order 2003-03 direct state government to define sustainability, produce goals within state government to achieve sustainability, identify challenges to achieving sustainability and measure our performance based on sustainability. The intent is to use this act for to further the adaptive management and continuous improvement process in state government. To institutionally support this effort, the Act created the Institute for Natural Resources (INR) at Oregon State University. The purpose of the Institute is to provide reliable, objective relevant and science-based interdisciplinary natural resource expertise, information, research and assistance to facilitate adaptive management and long-term stewardship of Oregon's resources. With adequate support and resources, the Institute will be able to help state agencies fully implement and adaptively manage the benchmark process. To date the INR has supported a number of agency efforts related to adaptive management under the Oregon Plan. These have included a review of "salmon anchor habitat" and a forest fire program review.

2.0 Overview of Federal Efforts

Eight Federal agencies have developed an implementation and effectiveness monitoring program encompassing Federal lands managed by the Forest Service, Bureau of Land Management, and Park Service under the Northwest Forest Plan (NWFP) (this includes all federal lands in the ESU). This effort focuses on important regional scale questions about older forests, listed species (northern spotted owls, marbled murrelets), watershed health, federal agency relationships with Tribes, and changing socio-economic conditions in communities closely tied to federal lands. The

Regional Monitoring program receives its own funding and is a separately managed interagency program.

The federal monitoring program is charged with producing annual summaries and reports. Periodic interpretive reports present the analysis and results of cumulative monitoring data and other information important to evaluating the effectiveness of the Northwest Forest Plan. The interpretive reports are critical to the Northwest Forest Plan adaptive management process, used to make adjustments to the NWFP as necessary for achieving plan objectives. The first comprehensive interpretive report was recently presented at a large public meeting in Portland. The first report is important in establishing baseline information and in describing any status and trends that can be detected in monitored resources since the plan was signed in 1994. This includes information on northern spotted owls, marbled murrelets, older forests, watershed condition, rural communities and tribes, and compliance with the standards and guides of the Northwest Forest Plan. Recommendations will be made based on analysis of key components of the NWFP. Subsequent interpretive reports will be published every five years.

3.0 Overview of Grassroots Efforts

Watershed Councils are a key element in the adaptive management process. At the grassroots level they conduct watershed assessments, gather other information and prepare watershed action plans. They sponsor and/or conduct restoration projects and report accomplishments to OWEB. Data and information reported by Watershed Councils are used to document the planned implementation of the Oregon Plan restoration efforts and the success of the local watershed action plan. Based upon their local experience, OWEB and state agencies assist Councils review their plans and make appropriate periodic modifications.

Private Oregon Plan partners such as forest, farm and fish producers that have become "certified," usually have adopted and implemented environmental management systems and an adaptive management processes as a condition of their certification. For example, the Sustainable Forestry Initiative (SFI) program includes a system of performance measures and the requirement to promote continual improvement by monitoring, measuring and reporting performance in achieving their commitments under SFI. Most industrial forestland within the ESU is certified under one of the existing systems.

4.0 Key Monitoring and Research Actions under the Oregon Plan Adaptive Management Program

As discussed earlier, several sets of hypotheses are being tested under the Oregon Plan process. The tables below describe **key** policy/programs/practices and the Oregon Plan or agency

programmatic and monitoring or research adaptive management systems that are in place for them. The tables also provide information of the certainty and effectiveness of these systems. These tables do not include any compliance or enforcement monitoring programs. Compliance/enforcement monitoring are used as adaptive management elements for regulatory programs, especially to determine root causes of compliance problems and to determine whether rule changes, training or other actions are needed to improve compliance. Compliance/enforcement monitoring is described elsewhere in Oregon's Coastal Coho Assessment report.

Policy/Program/ Practice	Scope	Certainty	Frequency	Decision-making body(ies)	Coordination required	Effectiveness
Hatchery Management Policy	Statewide. The purpose of the Hatchery Management Policy is to describe the hatchery tool and its range of applications. The Hatchery Management Policy also provides general fish culture and facility guidelines and measures to maintain genetic resources of native fish populations spawned or reared in captivity. This policy applies to all Department hatchery operations and programs including Salmon and Trout Enhancement Program (STEP) fish propagation projects (OAR 635-009-0090 through 635-009-0240) and Cooperative Salmon Hatchery Programs (OAR 635-009-0400 through 635-009-0455).	Required by rule. This policy describes best management practices that are intended to help ensure the conservation of both naturally produced native fish and hatchery produced fish in Oregon through the responsible use of hatcheries. The Hatchery Management Policy complements and supports the Native Fish Conservation Policy OAR 635-007-0502 through 635-007-0506 and will be implemented through conservation plans developed for individual species management units, hatchery program management plans, or other formal agreements with management partners. The Hatchery Management Policy provides a foundation for the management and reform of hatcheries in Oregon, whereas the Native Fish Conservation Policy establishes the process for defining the specific use of the hatchery tool in specific watersheds.	Annual reports to establish conformity of individual hatcheries with policy. BMPs reviewed as needed based upon new research.	Fish and Wildlife Commission		
Harvest Management Policy	Statewide and Regional	Federal and state statutory requirements	Annual reports	Pacific States Marine Fisheries Commission; Fish and Wildlife	Member states of PSMFC	PSMFC facilitates interjurisdictional fishery agreements and coordinates information.

				Commission		PSMFC coordinated the signing of a Memorandum of Understanding between the states of Washington, Oregon and California regarding season
Native Fish Policy	Statewide	The Native Fish Conservation Policy was adopted in Nov. 2002 with interim criteria added in Sept. 2003. The purpose of the Policy is to ensure the conservation and recovery of native fish. The Policy is implemented through the development of conservation plans adopted by the OFW Commission. The Policy identifies three goals: Prevent the serious depletion of native fish. Maintain & restore naturally produced fish in order to provide substantial ecological, economic and cultural benefits to the citizens of Oregon. Foster & sustain opportunities for fisheries consistent with the conservation of naturally produced fish & responsible use of hatcheries.	Annual and long-term reporting requirements to document data, departures from plan & evaluations necessary for adaptive management – in a format available to the public.	Fish and Wildlife Commission	USFWS; NMFS	Conservation plans shall illustrate a range of options for recovery strategies, fisheries and the responsible use of hatchery produced fish. Conservation plans will address the following elements: Management Identification of the SMU & the constituent populations. Description of the desired biological status. Description of the current status. Assessment of the primary factors causing the gap between current & desired status and identify those that can be managed. Description of short - and long-term management strategies to address the limiting factors. Description of monitoring, evaluation & research necessary to gauge the success of strategies & resolve uncertainties. A process for modifying strategies based on

						monitoring, evaluation and research results. Measurable criteria indicating significant deterioration in status, triggering plan modification. Annual & long-term reporting requirements to document data, departures from plan & evaluations necessary for adaptive management– in a format available to the public. Description of potential impacts to other native fish species
Northwest Forest Plan for Oregon State Forests	State-owned forestlands in Tillamook, Clatsop, Washington, Columbia, Benton, Yamhill, and Lance Counties	Required by rule	Maximum ten years	Oregon Board of Forestry	With ODFW	Monitoring Plan is in place. Budgeted resources include
State Forests Watershed Analysis Projects	The Oregon Department of Forestry (ODF) conducts watershed analysis projects in basins containing State Forest land. These projects evaluate the interactions between ODF management and a watershed's physical and biological processes. And lead to forest management plan implementation decisions.	Required by rule. ODF watershed analyses are designed to be performed in several steps. The analyst compiles available information to describe current watershed condition. Based on this description, factors limiting important watershed functions are identified and assessed. The analysts and ODF resource specialists determine whether riparian and aquatic strategies are addressing the appropriate process and function concerns within the	Ongoing	Department of Forestry/Board of Forestry	With ODFW	As watershed analysis projects are completed, the project reports, with selected supporting materials, will be posted at the ODF's website site.

		watershed. Information provided by watershed analysis will be used to refine district implementation plans and, as necessary, contribute to a comprehensive review of forest management plan goals and strategies.				
Northwest Forest Plan for Federal forests	All Federal lands managed by USDA Forest Service and BLM under the NFP	Federal forests are monitoring the effectiveness of the North West Forest Plan through a program titled: "Aquatic and Riparian Effectiveness Monitoring Program". The program is being implemented West of the Cascades in Washington, Oregon, and Northwest California.				The goal is to evaluate the effectiveness of forest plan aquatic conservation strategy to maintain key aquatic and riparian processes that create and maintain habitat conditions. The sample design is based on randomly sample and survey of 250 watersheds over 5 years (10% of watersheds). The data will be analyzed using a decision support model based on shifting frequency distributions (Fuzzy Logic)
Oregon Forest Practices Act	All private and state-owned forestlands	OAR 629-635-0110 Applicability and Monitoring (3)(a) Monitoring and evaluation of the water protection rules are necessary … (b) In cooperation with state and federal agencies, landowners and other interested parties, the department shall conduct monitoring on a continuing basis….. The monitoring shall determine the	Annual reports required by OAR 629-635-0110 Applicability and Monitoring ….(d) The department shall report to the Board of Forestry annually about current monitoring efforts and, in a timely manner, present findings and recommendations for	Oregon Board of Forestry	OAR 629-605-0110 Annual Review The State Forester shall, at least once each year, meet with other state agencies concerned with the forest environment to review the Forest	Monitoring Plan is in place. Budgeted resources include $368,000 per year based for the 03-05. FPMP. Roughly $47,500 per year of harvest tax dollars are used to fund cooperative monitoring and research projects. The goals of the FPMP are to: Evaluate the effectiveness,

		effectiveness of the rules to meet the goals of the Forest Practices Act and the purposes stated in the rules, as well as their workability and operability.	changes to practices. The Board of Forestry shall consider the findings and recommendations and take appropriate action.		Practice Rules relative to sufficiency. The State Forester shall then report to the Board of Forestry a summary of such meeting or meetings together with recommendations for amendments to rules, new rules, or repeal of rules.	implementation and assumptions of the forest practices act Coordinate with other monitoring and research efforts Investigate the cumulative effects of forest practices on forest resources. Support efforts to establish benchmarks/criterion used to define the range of desired conditions/regional goals. Monitor the implementation and effectiveness of the Oregon Plan. Monitor temporal and spatial trends in forest and stream conditions.
Clean Water Act - State Water Quality Standards	Periodic assessment of water quality (i.e., 303(d) list) and review of water quality improvements plans (i.e., TMDLS)	To ensure water quality improvements occur, DEQ has adopted rules enabling the agency to enforce TMDL implementation requirements. These rules also incorporate principles of adaptive management. The rules require federal land managers and municipalities to develop, implement, monitor and revise TMDL implementation plans as necessary to reduce pollutant loading. The rules also describe how pollution controls on state and private forest land will be addressed under the Oregon Forest Practices Act and controls related to agricultural	DEQ plans to revisit the TMDLs every 5-10 years when new information suggests changes may be needed	Environmental Quality Commission	With Board of Forestry and Department of Agriculture as noted. EPA	

		activities will be addressed per the requirements of Senate Bill 1010 and associated rules.				
DEQ Water Quality Management (WQM) Program	Statewide In support of restoring and protecting Oregon's water, air and land, the WQM Program: Collects representative, valid environmental data through physical, chemical, and biological sampling and assessment. Manages environmental data to ensure availability of accurate and complete data from agency programs and the general public. Analyzes and interprets water quality related data to produce reports which identify water quality conditions, identify threats to water quality, evaluate trends, and model proposed actions.	See above. Resources are in place to conduct annual monitoring. Protocols are in place. Part of this effort is specifically encompassed in the Oregon Plan Monitoring Program described below.	Annual monitoring and reports	Environmental Quality Commission	With other Oregon Plan agencies, EPA	Protocols developed with assistance from EPA. Sites adequate do describe statewide trends.
Oregon Plan Monitoring Program and Plan	Statewide with emphasis in coastal Coho watersheds The Oregon Plan Monitoring Projects are designed to work together to give basic information on salmon populations and conditions across large geographic areas. The major elements are: **Adult Salmon Spawning Surveys** Counts of spawning adult salmon are a key indicator of abundance. **Juvenile Salmon Population Census** Snorkel pool habitats to count juvenile salmon. **Stream Habitat Assessment** Information on channel size, flow, substrate composition, large wood, habitat complexity, and riparian characteristics.	Required by statute	Biennial Reports	OWEB and joint interim legislative committee	All state natural resource agencies	Monitoring plan and protocols are in place and annual data collection is occurring. Oregon Plan assessment will be used to evaluate efficacy and effectiveness of the monitoring efforts. Oregon plans to increase the statistical power of the different projects to improve predictive strength.

	Salmonid Life Cycle Monitoring Project: Smolt Trapping A program to monitor survival and downstream migration of salmonid fishes (*Oncorhynchus spp*.) with three objectives; 1) estimate abundance of adult salmonids and downstream migrating juvenile salmonids, 2) estimate the marine and freshwater survival rates for Coho salmon (*Oncorhynchus kisutch)* and 3) evaluate the effects of habitat modification on the abundance of juvenile salmonids in Cummins and Tenmile Creeks. **Stream Health – Biotic Index Measurement** Measurements of aquatic insects, aquatic plants, water quality, fish communities, and habitat are combined to create an integrated assessment of stream condition.					
Forestry Program for Oregon Assessment	All private and public forestlands	Assessment of Forest Conditions based upon a developing set of criteria and indicators adopted by Board of Forestry	Every 7-10 years	Oregon Board of Forestry		Periodic report using Criteria and Indicators based on the Conservation and Sustainable Management of Temperate and Boreal Forests developed through the Montreal Process. The Montreal Process is an internationally sponsored initiative that identified seven criteria as essential components of sustainable forest management. Sixty-seven indicators are used to describe these seven criteria.
Timber Growth and Harvest	All private and public forestlands	Required for statewide benchmarks "Timber Harvest - Public Lands Actual public timber harvest	Annual	Oregon Board of Forestry	USDA Forest Service	Uses FIA data

		as a % of potential harvest levels under current plans & policies" and "Timber Harvest - Private Lands Actual private timber harvest as a % of potential harvest levels under current plans & policies"				
The Fish Passage Program.	Statewide implementing state fish passage laws, providing resources and information for those affected by the laws or seeking to improve passage, working with the Fish Passage Task Force advisory group, and working with local ODFW staff and others to improve fish passage throughout the state	required by statute and rule		DSL, ODF, and ODFW		Requires an inventory of barriers to be maintained so progress in restoration can be tracked. Mechanisms are in place to adopt and disseminate technical information about the success of various approaches for ensuring fish passage. Oregon maintains a manual describing the technical elements of fish passage.

This section describes some of the key Adaptive management research underway that is integrated into state or federal programs as part of the Oregon Plan.

Research Program	Current Geographic Focus	Research Goal	Cooperators	Research Focus	Website
Watershed Research Cooperative	Hinkle Creek Paired Watershed Study in the Cascade Range. Two additional installations are planned, one in the north Coast Range.	To evaluate on a watershed scale how well current forest practices protect water quality, aquatic habitat, and fish—particularly salmonids.	OSU College of Forestry, FRESC, OSU College of Agriculture the Fisheries and Wildlife Department, ODFW, BLM, Roseburg Forest Products, OFIC, OFRI, Douglas County and ODF	Studies will focus on the cumulative affects of harvesting in upstream, nonfish-bearing headwaters and the linkages to any to fish-bearing streams. This issue has been addressed conceptually for years and this project will be one of the first efforts to address it quantitatively	
Hatchery Research Center (HRC)		The goal of the Hatchery Research Center (HRC) is to answer questions related to fish recovery and hatchery programs, including the differences between wild and hatchery fish, and how to better manage those	Oregon Department of Fish and Wildlife and the Oregon State University Department of Fisheries and Wildlife.		http://www.dfw.state.or.us/HRC

		differences.			
Cooperative Forest Ecosystem Research (CFER)	Western Oregon	To study the effects of natural disturbance, forest management, and their interactions on ecosystem function and development. Ecology of individual species within a general framework of understanding community and ecosystem-level relationships. To study the biotic and abiotic patterns, processes, and linkages at multiple levels of time and space	USGS Forest and Rangeland Ecosystem Science Center (FRESC), Oregon State University (OSU), the Bureau of Land Management (BLM), and the Oregon Department of Forestry (ODF)	Currently, there are four research themes that focus CFER research activities. These themes address: (1) Stand structure and biotic responses to changes in structure of young forests of western Oregon; (2) Large woody debris in the terrestrial and aquatic riparian zone: production, recruitment and function; (3) Influence of Landscape pattern and composition on species in forested ecosystems of western Oregon; and (4) Influences of riparian vegetative community composition on animal community response	http://www.fsl.orst.edu/cfer/overview/integtn.html
Coastal Landscape Analysis and Modeling Study (CLAMS)	The study area is the Oregon Coast Range Physiographic Province, which contains all of the Coast Range hydrological province and part of the Willamette hydrological province.	To develop and evaluate concepts and tools to understand pattern and dynamics of provincial ecosystems such as the Coast Range and to analyze the aggregate ecological and socio-economic consequences of different forest policies and strategies across multiple ownerships of the province.	OSU College of Forestry, the US Forest Service Pacific Northwest Research Station, and the Oregon Department of Forestry.	Build high resolution spatial models (grain size of 0.1 to 10 ha) of current biophysical conditions (e.g. veget ation, ownership patterns, topography, streams) across all ownerships using Landsat TM satellite imagery, forest inventory plots, and other GIS layers. Conduct surveys and interviews of forest landowners to determine their expected management intentions (e.g. rotation ages, thinning regimes, riparian management intensity) under current policies and develop spatial land use change models based on retrospective studies. Simulate expected successional changes in forest structure and composition under differe nt management regimes using ORGANON and ZELIG stand dynamics models. Build a landscape change simulation system based on forest management intentions and forest stand models to project future landscape structure for 100-200 years. Develop habitat suitability models for selected terrestrial and aquatic vertebrate species, coarse filter measures of community and landscape conditions, historical range of natural variation of forest successional	http://www.fsl.orst.edu/clams/overview.html

				stages, and landslide and debris flow potential, and geomorphic dynamics. Develop socio-economic response models for measures of employment and income by economic sector, timber value and production using IMPLAN; develop recreational opportunity spectrum models, and contingent value of biological diversity to the public. Build landuse change models that are based on historical FIA data and driven by estimates of population change. Estimate ecological and socio-economic consequences of current forest policies using the landscape simulator and the various response models. Include outside influences such as effects of population growth on land use change. Evaluate, test, and revise overall simulator system and sub-models. Provide policy makers, landowners, and the public with results of spatial projections of consequences and interact with them to help inform debate and facilitate collaborative learning.	

5.0 Certainty and Effectiveness

This assessment itself is a partial demonstration of adaptive management being implemented under the Oregon Plan. However, an individual assessment or evaluation, does not lead to a conclusion that there is a certainty of ongoing adaptive management through a series of continuous improvement cycles and that the cycles will be effective. Breaking adaptive management into components of "plan," "do," "report" and "evaluate" is useful in considering both certainty and effectiveness of our efforts.

With regard to "plan," planning occurs at a number of levels and through a number of processes. Some of these have been described earlier, with the most obvious "plan" being the Oregon Plan

for Salmon and Watersheds itself. The Oregon Plan includes a substantial number of written documents that include commitments and planned actions, and a body of supporting frameworks, institutions and processes. Other plans of importance include the monitoring plan and watershed action plans. Specific to these plans, Oregon does not yet have a comprehensive means of tracking changes to the plans that occur not as a result of adaptive management, but rather as a result of external factors such as budget problems. Despite this weakness, specific plans are required, resources are in place to support development of required plans, and each plan by policy is to include adaptive management principles for ongoing improvement.

"Do" is the implementation part of the Oregon Plan. In the context of adaptive management, it is important that systems are in place to document barriers that are preventing the implementation of planned actions. The formal process that is in place to complete this documentation is through the Oregon Plan Core Team, which has as one of their charges to address barriers to plan implementation. However, this approach probably has not yet been developed to the point that all barriers would be documented. Nonetheless key barriers, particularly those related to restoration practices, generally are documented. For example, the Core Team has documented and worked to address barriers to instream restoration work through the use of the Regional General Permit.

To the extent that adaptive management keys on the adaptive management component of "report," it is apparent that reporting processes are in place for many key parts of the Oregon Plan, especially operational elements such as reporting of restoration projects. Conditions are placed on grant recipients requiring reporting. As described in the table above, reporting relative to key policies and programs are also in place. For most of the key policies and programs under the Oregon Plan, law or rule requires periodic reporting to the policy Board or Commission responsible for the program.

"Evaluation" under the Oregon Plan occurs through a number of agency policy and programmatic processes discussed in the tables above. At the Oregon Plan scale, evaluation is also formalized through the role of the IMST. The Independent Multidisciplinary Science Team (IMST) is a scientific review panel charged with advising the State of Oregon on matters of science related to the Oregon Plan for Salmon and Watersheds. These matters include fish recovery, water quality improvements, and enhancing watershed health. IMST evaluation of the scientific basis for programs provides the public, the Governor, and the Oregon Legislature with a frame of reference when struggling with policy decisions affecting Oregon Plan implementation.

The primary means of communicating results of the IMST's work to Oregon's Governor, Legislature, state agencies, and the public is through written technical reports and reviews. In

technical reports, the IMST assesses the best available science as it pertains to salmonids and watershed recovery and the management of natural resources. IMST reports are addressed to Oregon's Governor, Senate President, and Speaker of the House. Reviews are addressed to the requesting agency or authority.

IMST recommendations are directed to State agencies or entities that have the ability to implement or to affect changes in management or regulation that are needed for implementation. State agencies are expected to respond to IMST recommendations within six months after a report is issued.

Once agency responses are received, the IMST reviews the scientific adequacy of each response and if further action or consideration by the agency is warranted. The IMST's review of responses is forwarded to the Governor and the State Legislature.

To date the IMST has prepared reports evaluating the following topics: Agriculture, Forestry, Water Temperature, Instream Gravel Mining, Klamath Basin, Predation on Salmonids, and Riparian Area Management.

In an example of how these evaluations have been used, in its Forestry Report, the IMST made a total of 19 recommendations in its forestry project report of September 14, 1999. These recommendations along with the Department of Forestry actions/responses to address the recommendations are described in the table below.

In addition to the IMST, the INR has increasing played a role in facilitating program management reviews of different components of the Oregon Plan. Through their help, science and other information are systematic used to consider program effectiveness and options for improvement.

Certainty and effectiveness are also impacted by budget and resource constraints. During the 2001-2003 biennium, reductions in General Funds precipitated in large part by the economic downturn reduced some monitoring and adaptive management investments These reductions have limited the number and/or frequency of stream sites being monitored by DEQ (both ambient and Oregon Plan monitoring sites). Under the reduced budget levels, water quality monitoring in the Coastal Coho ESU includes only large river ambient sites. Surveys of small wadeable streams have been reduced from 55 to 6 sites per year. It will be difficult for DEQ to continue to assess water quality status and trends in the ESU with this reduced monitoring network. Further limited reductions are possible to monitoring resources under the 2005-07 budget cycle. Oregon will seek to address resource limits as improvements in the economy and budget take place.

IMST Recommendation	ODF Action Completed	ODF Action Pending
1. Explicitly incorporate the policy objectives of the Oregon Plan and Executive Order 99-01 into OFPA.	The 2003 Forestry Plan for Oregon makes explicit that "*The Board will support and contribute to continuing statewide efforts under the OPSW to protect and enhance Oregon's native fish populations and water quality, while sustaining a healthy economy.*"	July 2004 draft FPA riparian rules also make explicit the policy objectives of the Oregon Plan in several rules (OAR 629-635-0100 and 629-605-0103) to encourage continued voluntary participation in the OPSW. Note: Draft riparian rules are being deliberated by the Board of Forestry. The official public comment period has not been initiated by the Board, but should proceed in 2005. Rules which have been ***adopted*** have been finalized; rules which are described as ***approved draft rules*** continue to be deliberated.
2. ODF should develop a policy framework to encompass landscape (large watershed) level planning and operations on forests within the range of wild salmonids in Oregon.	The 2003 FPFO provides a policy framework that will foster landscape level planning and operations on forests statewide. Much new information useful for implementing effective economic and social forest policies has been jointly developed by the Department of Forestry, Oregon State University College of Forestry, the USDA Forest Service Pacific Northwest Research Station, and others. However, more information is needed about conditions and trends of Oregon's forests to better craft coordinated approaches and to understand the implications of changes in forest policy and management at the landscape level and across ownerships. Once this information is available, the Board and ODF will be better able to implement a more coordinated management approach that is needed to promote the desired balance of forest value production.	ODF believes we should work with OSU College of Forestry and others to create and implement a process to build the scientific foundation necessary to support policy and technical changes that improve consistency of forest practices and forest management with the concepts of dynamic forest ecosystems and "primary purpose". Tools are also needed to: (a) better analyze short- and long-term risks; and (b) better analyze, at different scales, how well the different forest ownerships integrate to provide necessary resource protection. The Coastal Coho ESU assessment, currently underway, is an example of how natural resource agencies are beginning to conduct landscape scale evaluations of the OPSW. Lessons learned from the study will help us to improve our ability to conduct these types of assessments at various scales, and to move toward seamless communication between implementing agencies and local conservation groups.
3. Treat non-fish-bearing streams the same as small, medium, and large fish-bearing streams when determining buffer-width protection.	The Board of Forestry approved a draft rule in March 2004 that Type F prescriptions for large and medium Type N streams will be addressed through a voluntary pathway. The Board concluded that there was insufficient monitoring or scientific	The July 2004 draft rules propose that: ➢ ODF will continue to prioritize monitoring small Type N streams as budget and resources are available. ➢ The Oregon Headwaters Research Consortium, formed in 2001, continues to address headwater

	evidence that documents that degradation of resources is likely if forest practices continue to be conducted under existing regulations.	stream research questions. ➢ Hinkle Creek is the site of a new, state-of-the-art paired watershed study to investigate the effects of contemporary forest practices on water quality, fisheries and aquatic habitat. It is the first ever paired watershed study located completely on private forestland. ➢ Increased protection for small Type N streams is continuing to be deliberated by the Board of Forestry.
4. Provide increased riparian protection for the 100-year floodplains and islands	The Board of Forestry approved a draft rule in September 2003 that additional protection for channel migration zones would be addressed through voluntary measures. The Board concluded that there was insufficient monitoring or scientific evidence that documents that degradation of resources is likely if forest practices continue to be conducted under existing regulations.	ODF will address development of an Oregon Plan measure through an advisory committee process in 2005. Monitoring necessary to determine whether existing riparian rules are effective in protecting channel migration zones will be included in the department's monitoring strategy. Landowners choosing this voluntary option provide the opportunity for us to test our assumptions.
5. Increase the conifer basal-area requirement and the number-of-trees requirement for RMAs, with increases in these requirements for medium and small streams regardless of fish presence.	The Board of Forestry approved a draft rule in July 2004 draft rule language for an increase in basal area retention on medium and small Type F streams in western Oregon subject to the outcome of the analysis required by ORS 527.714. The Board rejected in March 2004 any basal area retention increase to medium and small Type F streams in eastern Oregon until there is sufficient monitoring or scientific evidence that documents that degradation of resources is likely if forest practices continue to be conducted under existing regulations.	**Related Rule Proposals** Draft riparian rules propose an increase in basal area for small and medium fish bearing streams in western Oregon. A physical habitat approach for classifying streams will be used for fish presence, including where field surveys show no fish use above artificial fish passage barriers. **Monitoring & Research Necessary** Insufficient information exists to expand the basal area increase to all other streams regardless of fish presence. Monitoring of small non-fish bearing streams is proposed to be a monitoring priority. **Interim Voluntary Pathway** Until better information can inform our rule making process, a number of voluntary Oregon Plan measures

		may be developed including measures to: ➢ Use Type F prescriptions for large and medium Type N streams. ➢ 60% Basal Area Cap. ➢ No harvest within ½ RMA ➢ Retain largest trees within RMA
6. Complete the study of the effectiveness of the OFPA Rules in providing large wood for the short and long term.	The study was completed and a report entitled "Harvest Effects on Riparian Function and Structure Under Current Oregon Forest Practice Rules" (Dent 2001) was released in July 2001. Based on data from this study, the Board of Forestry approved in July 2004 draft rule language for an increase in basal area retention on medium and small Type F streams in western Oregon subject to the outcome of the analysis required by ORS 527.714. The Board rejected in March 2004 any basal area retention increase to medium and small Type F streams in eastern Oregon until there is sufficient monitoring or scientific evidence that documents that degradation of resources is	A rule is proposed to improve incentives for the active placement of large wood during harvest operations. The change will allow operators to harvest more trees from the riparian management areas in exchange for placing large wood in streams or doing other acceptable fish habitat improvement work. The increased incentive ratio is offset by an increase in the active management target for small and medium Type F streams in western Oregon.
7. Provide enhanced levels of certainty of protection for "core areas".	likely if forest practices continue to be conducted under existing regulations.	The FPA provides for the use of site specific plans and alternate practices, and encourages management such that the desired outcomes are provided. Proposed riparian rules, the 2003 FPFO, and the Private and Community Forest Program strategic plan encourage active management within the RMA to provide for enhanced riparian function. Providing flexibility for alternate practices fits nicely with the concept of ***"core areas"*** as originally intended in the OPSW. That is, when landowners are informed about the habitat and life stage needs of species dependent upon "biological hotspots" either located on the landowner's property or downstream, management decisions can be made to maximize a return on their

		investments to enhance or restore habitat. We recognize that the landscape from the headwaters to the estuary is comprised of multiple ownerships, and all have a part to play in conducting management to conserve and restore watershed functions that are suitable to salmonids life cycle needs An example of how the FPA is evolving to recognize the importance of knowledge to inform landowners' management decisions is the proposed rule to strategically leave trees in debris prone locations where large wood can be delivered to downstream fish bearing reaches. Assisted by the ODFW field biologist and ODF stewardship forester, the landowner can determine whether this management strategy is the best to provide for a particular species or life stage.
8. Develop and implement standards or guidelines that reduce the length of roadside drainage ditches that discharge into channels.	The Board of Forestry adopted rules, effective January 1, 2003. Guidance has been developed. **629-625-0330 Drainage**: The purpose of this rule is to provide a drainage system on new and reconstructed roads that minimizes alteration of stream channels and the risk of sediment delivery to waters of the state. The rule provides a list of priorities to assist operators in achieving the intended purpose.	
9. Implement the standards and guidelines for the length of roadside drainage ditch between cross-drainage structures, especially on steep-gradient roads.	The Board of Forestry adopted rules, effective January 1, 2003. Guidance has been developed. **Drainage** (1) The purpose of this rule is to provide a drainage system on new and reconstructed roads that minimizes alteration of stream channels and the risk of sediment delivery to waters of the state. Drainage structures should be located based on the priority listed below. When there is a conflict between the requirements of sections (2)	

	through (6) of this rule, the lowest numbered section takes precedence, and the later-numbered and conflicting section shall not be implemented. (2) Operators shall not concentrate road drainage water into headwalls, slide areas, high landslide hazard locations, or steep erodible fillslopes. (3) Operators shall not divert water from stream channels into roadside ditches. (4) Operators shall install dips, water bars, or cross drainage culverts above and away from stream crossings so that road drainage water may be filtered before entering waters of the state. (5) Operators shall provide drainage when roads cross or expose springs, seeps, or wet areas. (6) Operators shall provide a drainage system using grade reversals, surface sloping, ditches, culverts and/or waterbars as necessary to minimize development of gully erosion of the road prism or slopes below the road.	
10. Require the flow capacity of cross-drainage structures and stream crossing structures and culverts to meet current design standards.	The Board of Forestry adopted rules effective January 1, 2003. Guidance has been developed. Technology transfer, often through Associated Oregon Logger workshops, ODF monitoring, and other media have communicated what we have learned. **629-625-0320** **Stream Crossing Structures** (2) Operators shall design and construct stream crossings (culverts, bridges, and fords) to: (a) Pass a peak flow that at least corresponds to the 50-year return interval. When determining the size of culvert	Roads built before the FPA are addressed through a voluntary Oregon Plan pathway. Discussion about the topic is provided in the next section.

	needed to pass a peak flow corresponding to the 50-year return interval, operators shall select a size that is adequate to preclude ponding of water higher than the top of the culvert; and (b) Allow migration of adult and juvenile fish upstream and downstream during conditions when fish movement in that stream normally occurs.	
11. Provide for the stabilization of roads not constructed to current standards (including "old roads and railroad grades") in critical locations.	**Critical Locations Policy - For Roads Subject To The FPA** 629-625-0100 and 0200, before roads are constructed or reconstructed, the Department will work with operators and landowners to locate these roads away from critical locations to the extent possible. Critical locations include high landslide hazard locations, slopes over 60 percent with decomposed granite-type soils, within RMAs or within 50 feet of stream channels or lakes, or within wetlands.	**Incentives before Mandates** The BOF cannot mandate that roads built before the FPA be brought up to current standards. Furthermore, the 2003 Forestry Plan for Oregon supports cooperation and incentives as the preferred tools for promoting desired public benefits on private lands. Oregon Forest Industries Council members are recognized for their voluntary actions to address work needed on roads built prior to the FPA. OWEB biennial reports document their contribution. We believe that a voluntary pathway to bring 'legacy' roads up to current standards has been a sound policy choice. **More work needed** The Coastal Coho Assessment Habitat Team is evaluating success of an Oregon Plan voluntary pathway to make legacy road improvements. We know that industrial forest landowners have completed many projects. We have monitored these projects for conformance with current standards and have shared information on what works best. Still, we cannot say how much work remains to be completed. Better ways of gathering and sharing information is needed to help us understand how far we have come and how far we have left to go. Numbers of reported projects have decreased recently. We would like to know whether the decrease is due to work having been completed, or whether other issues are involved. If work is nearing completion, how can we document that? If the latter, how can agencies

		better serve the process to provide meaningful incentives? Improvements are needed to better serve non-industrial landowners, who through conversation, have told us that they would like to improve legacy roads but need financial assistance and/or assistance in reporting what they have already accomplished.
12. Require durable surfacing on wet-season haul roads and require that hauling cease before surfaces become soft or "pump" sediment to the surface.	The Department completed a Wet Weather Hauling study in June 2003. Based on this data, the Board of Forestry adopted rules effective January 1, 2003. Guidance has been developed and training implemented. **629-625-0700: Wet Weather Road Use** (1) The purpose of this rule is to reduce delivery of fine sediment to streams caused by the use of forest roads during wet periods that may adversely affect downstream water quality in Type F or Type D streams. (2) Operators shall use durable surfacing or other effective measures that resist deep rutting or development of a layer of mud on top of the road surface on road segments that drain directly to streams on active roads that will be used for log hauling during wet periods. (3) Operators shall cease active road use where the surface is deeply rutted or covered by a layer of mud and where runoff from that road segment is causing a visible increase in the turbidity of Type F or Type D streams as measured above and below the effects of the road.	
13. Retain trees on "high risk slopes" and in likely debris torrent tracks to increase the likelihood that large wood will be transported to streams when landslides and	The Board of Forestry approved draft rule language in July 2004 subject to outcome of the analysis required by ORS 527.714.	**Wood from Debris Flows Proposed Rule:** Provides a menu of methods to leave trees or downed wood where the materials can be moved by debris flows into fish-use streams. The proposed rule language recognizes the importance of upland sources of wood and provides a means for wood delivery not identified in current rules. Requiring operators to retain harvest unit leave

debris torrents occur.		trees (already required in harvest Type 2 or Type 3 units) along the lower portions of small Type N streams the Department determines are likely to experience torrents that would move wood into the adjacent Type F stream. The objective is to provide at least a portion of the upland source of large wood for fish streams. The revision would not require retention of any more trees than the current regulations do, but would require operators to leave a portion of those trees in a specific location.
14. Continue to apply the current best management practices (BMP) approach to the management of forest lands with significant landslide potential, and develop a better case history basis for evaluating the effectiveness of BMPs in these areas.	The Board of Forestry adopted rules effective January 1, 2003. Guidance has been developed. Technology transfer has been conducted to train stewardship foresters to implement the rule.	
15. Modify culverts and other structures to permit the passage of juvenile and adult salmonids upstream and downstream at forest roads and ODF bridges.	The Board of Forestry adopted rules effective January 1, 2003. Guidance has been developed. Technology transfer through Associated Oregon Loggers has also occurred and other media, such as the FP monitor, developed to inform operators as we manage differently.	
16. ODFW and ODF should develop a collaborative program of monitoring to quantify the linkages between parameters of ecosystem condition and wild salmonid recovery.	ODFW has developed and implemented a collaborative monitoring program as a member of the Oregon Plan Monitoring Team and have collected some of the parameters that describe ecosystem conditions as part of that effort. Through initiatives like the Coastal Coho Assessment we anticipate the state natural resource agencies will be in a better position to define additional information needs to address this critical question.	**Coastal Coho ESU Assessment** This study, currently underway, is an unprecedented first attempt to conduct landscape scale evaluations of the OPSW. Lessons learned from conducting the assessment will help us to improve our ability to conduct these types of assessments at various scales, and to move toward seamless communication between implementing agencies and local conservation groups. **Riparian Function and Stream Temperature Study (RipStream)** The objective of this study is to provide a coordinated

		monitoring effort with which to evaluate effectiveness of forest practices rules and strategies in protecting stream temperature, and promoting riparian structure that provides necessary functions for the protection of fish and wildlife habitat. The project will evaluate both privately and state-owned forestland. ODF is completing the 2nd year of baseline (i.e. pre-harvest) data for some sites and the first year of post-harvest data for other sites. Some sites have the two-years of pre-harvest data and are pending harvest. Analysis of the pre-harvest data is scheduled to begin in late 2004. The Oregon Headwaters Research Cooperative (OHRC) has formed in Oregon to help address these headwater research needs. The purpose of the cooperative is to investigate local and downstream effects of forest management on the biota and habitat characteristics of headwaters stream systems. The goals of the OHRC are: 1. To gain scientific understanding of the physical and biological processes of headwaters stream systems. 2. To examine the local and downstream responses of headwater streams to a range of forest management prescriptions. Hinkle Creek is the site of a new, state-of-the-art paired watershed study to investigate the effects of contemporary forest practices on water quality, fisheries and aquatic habitat. It is the first ever paired watershed study located completely on private forestland.
17. ODFW should complete "core area" designation for all wild salmonids in Oregon and identify high priority protection/restoration areas that are not covered by current "core area"	ODFW has developed a refined core areas and high priority areas for habitat restoration/protection in coastal watersheds. Analyses completed under the Coastal Coho Assessment will provide additional direction to this task.	

designations.		
18. ODFW should include consideration of practices (forestry, agriculture, urban, other land uses) above and below core areas, as these may affect the conditions and processes critical to maintenance of core area function in forestry areas.	This task is related to #17. Our recent efforts to identify priority areas have focused on 6th field watersheds as the basis for establishing these areas, rather than stream segments (as was done for Core Areas).	
19. The Oregon Forest Research Laboratory (FRL), in collaboration with ODFW, should develop forest road-stream crossing strategies that facilitate the passage of large wood at road-stream crossings.	ODFW has not completed or initiated any action on this recommendation.	ODF is supportive of developing strategies to facilitate passage of large wood at road stream crossings.

CHANGES TO
THE OREGON COASTAL COHO ESU ASSESSMENT
PART 2 VIABILITY CRITERIA AND STATUS ASSESSMENT

A large number of comments, both written and verbal, were received from the IMST, Stakeholder Team, NOAA Fisheries and others on Part 2 of the January 31, 2005 draft of the Oregon Coastal Coho Assessment. Part 2 is the portion of the assessment that describes the viability criteria that were developed for this ESU and reports on the test of current ESU status relative to these criteria.

The revised draft (May 6, 2005) reflects a substantial number of changes to address reviewer comments and suggestions. The primary differences between the original draft and the revised draft are summarized by the following list.

- Clarification that the focus of the assessment was whether or not the ESU met minimum criteria for viability. Some reviewers of the January 31 draft were unclear as to which status threshold the assessment addressed.

- The number of populations used in the assessment increased from 17 to 21. This occurred as a result of subdividing the Upper Umpqua population into three new populations and bringing the Floras and Sixes populations into the assessment as the result of newly available data. These changes are consistent with the revised population structure currently used by the Oregon coastal coho Technical Recovery Team (OTRT).

- Estimates of spawner abundance and associated proportion of wild and hatchery fish from 1958 to 1989 were added to the data set, which in the January draft only covered the period from 1990 to 2003.

- A criterion for spawner abundance was developed and added to the population viability assessment.

- The productivity criterion was changed and the focus narrowed to only those years when the marine survival was at its worst (1990 to 1996 brood years).

- The simulation model used to estimate the metrics for the persistence criterion is based upon recruitment equations for which there is more confidence. This increased confidence occurred because the data series used to estimate these equations for each population is considerably longer (43 brood years versus 11 brood years). In addition, a better method called "bootstrapping" was used to fit these equations to the data.

- An alternate recruitment model was developed to test the sensitivity of the persistence criterion results to the assumption that the number of recruits produced per spawner will increase with decreasing number of spawners.

- The results from new analyses are presented that the overall status determination for the ESU is not different when the assumption of density dependence is removed from the recruitment simulation models.

- The 'what if' modeling exercise in the January draft concerning the effect changing habitat capacity has on population persistence was removed because it was confusing and considered events that were unlikely to occur (e.g., the loss of 80% of the stream mileage utilized by a population for spawning).

- The results from a set of new 'what if' scenarios are presented that examine the relationship between population persistence and the number of additional years a population is subjected (within the simulation model) to the record poor marine survival conditions of the 1990s.

- A new section was added that recommended an approach for an early warning system to detect unexpected deteriorations in the status of the ESU in time for an adaptive response by conservation managers.

Oregon Coastal Coho Assessment

Part 1: Synthesis of the Coastal Coho ESU Assessment – Including:

1. **Viability Analysis**
2. **Population Bottlenecks**
3. **Evaluation of Conservation Efforts**
4. **Monitoring**
5. **Current Threats to ESU Viability**
6. **Adaptive Management Commitments**

State of Oregon[1]

May 6, 2005

[1] For reference purposes, primary authors are Jay Nicholas, Bruce McIntosh and Ed Bowles, Oregon Watershed Enhancement Board and Oregon Department of Fish and Wildlife, Salem, Oregon.

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EXECUTIVE SUMMARY

Background

Populations of coho salmon (*Oncorhynchus kisutch*) that occur in coastal watersheds between Cape Blanco and the mouth of the Columbia River are being evaluated by NOAA Fisheries for listing under the federal Endangered Species Act (ESA). These populations, which have been designated a single Evolutionary Significant Unit (ESU) (Weitkamp et al. 1995), have been the focus of a considerable conservation effort by the State of Oregon, local and private entities, and federal management partners. Much of this conservation effort has been developed and implemented under a planning framework called the Oregon Plan for Salmon and Watersheds (Oregon Plan). The Oregon Plan brings together various governmental and non-governmental entities to implement conservation strategies for fish populations throughout Oregon, including those belonging to the Oregon coastal coho ESU. In this context, the Oregon Plan refers to the broad suite of conservation efforts implemented to improve the status of coho and their watersheds (e.g., harvest, hatcheries, habitat, etc).

The Coastal Coho Project and the Coho Assessment

The State of Oregon, in partnership with the National Marine Fisheries Service (NOAA Fisheries), initiated a collaborative project to address the conservation of coastal coho on the Oregon coast. The primary objectives of the Coastal Coho Project are to:

- Assess Oregon Plan efforts to conserve and rebuild coastal coho populations.
- Use the assessment to inform NOAA Fisheries' status review listing determination.
- Use the assessment as a foundation for developing a conservation or recovery plan for coho.
- In the event that NOAA Fisheries determines to list this ESU as threatened, use the assessment as a basis to seek legal assurances for those carrying out activities that are consistent with the Oregon Plan.

This report addresses objective (2) of the Coastal coho Project by providing a synthesis (Part 1) of the biological analysis of coho status relative to viability criteria (Part 2) and an assessment of conservation efforts to address the factors for decline and threats associated with the coastal coho ESU (Parts 3 and 4). The four parts of this report address ESA listing considerations, including the federal Policy for Evaluation of Conservation Efforts When Making Listing Decisions (PECE) (68CFR15100).

The Coho Assessment Process

The framework for this assessment included developing measurable criteria to define population and ESU viability, utilizing the best available information to evaluate fish status relative to these criteria, identifying key factors likely responsible for the evaluation result, assessing the implementation certainty and effectiveness of conservation efforts to address factors for decline and potential threats to viability, and concluding with Oregon's overall evaluation of what threats to this ESU remain and what the significance of those threats is in terms of risk to viability.

To accomplish this, various types of data were examined, including: fish abundance and distribution, marine survival, fishery harvest, hatchery programs, stream complexity, riparian condition, water quality, streamflow, fish passage (access to spawning and rearing streams), predation, fish disease, and exotic fish species. These data represent available information collected both before and after the formal implementation of the Oregon Plan in 1997.

The State of Oregon has conducted this comprehensive assessment of the status of the fish, the status of habitat that supports the species' life cycle, and the ongoing conservation efforts for this ESU in order to inform the continued management programs and activities. The results of this Assessment are intended also to inform the federal government's listing decision. Oregon's assessment includes:

1. Evaluating the biological viability (sustainability) of the ESU.
2. Identifying key risk factors that contributed to the past decline of coho or potentially threatening coho viability in the foreseeable future.
3. Determining the current levels of risk to ESU viability presented by these key risk factors.
4. Evaluating the status and trends of management programs, restoration work, habitat, and other conditions in place to address these risk factors and maintain or enhance the continued viability of the ESU.

The Coho Assessment will Inform Recovery Planning

The Coastal Coho ESU Assessment is the starting point for more effective future restoration investment, monitoring, and adaptive management action. Regardless of the current ESA listing decision, Oregon, in partnership with NOAA Fisheries and interested stakeholders, will continue the ongoing process of completing a full conservation/recovery plan. This plan builds upon the Assessment to establish goals beyond the threshold of viability, focuses management actions on the primary limiting threats to reaching those goals, and establishes a comprehensive monitoring and evaluation program for adaptive management. The draft conservation/recovery plan is scheduled to be completed by the end of 2005.

Contents of the Part 1 Synthesis Document

This Part 1 Synthesis document provides a complete overview of the Assessment. A reader will be able to review the entire Assessment story here, including the following elements.

1. Viability analysis
2. Population bottlenecks
3. Evaluation of conservation efforts
4. Monitoring
5. Evaluating current threats to ESU viability
6. Oregon's conclusions regarding future ESU viability
7. Lessons learned and adaptive management commitments

Assessment Results Will Also be Displayed Graphically in Storyboards

A series of Storyboards have also been developed that display key elements of data and interpretation developed during the Assessment. Storyboards are developed at three spatial/biological scales: the ESU, the Monitoring Area, and the population. These storyboards are an additional effort to communicate the key elements of a complex story in shorthand. The storyboards may be viewed and printed from the following internet address. The internet address will be active on May 6, 2005. Some of the data displayed in the storyboards will be revised during the month of May, and final versions will be complete by the end of May 2005.
http://mtjune.uoregon.edu/website/OWEB/Assessment

Key Conclusions Regarding ESU Viability

1. The Coastal coho ESU is viable, that is, coho populations generally demonstrate sufficient abundance, productivity, distribution and diversity to be sustained under the current and foreseeable range of environmental conditions. In fact, the ESU retains sufficient productivity and is supported by sufficient habitat to be sustainable through a future period of adverse ocean, drought and flood conditions similar to or somewhat more adverse than the most recent period of poor survival conditions (late 1980s and 1990s).
2. During and after the recent period of poor marine survival, coho populations generally demonstrated adequate resiliency to resist continued downward population trends, and demonstrated the ability to rebound dramatically as marine survival conditions improved.
3. The mechanisms for this response are most likely a combination of inherently strong density-dependent recruitment coupled with sufficient high quality habitats to sustain productivity during periods of adverse environmental conditions. This reasoning does not imply that habitat conditions are optimum for the species nor that habitat is currently sufficient to achieve broader Oregon Plan recovery goals for the ESU.
4. Although the ESU passed viability criteria, 7 of 21 independent coho populations failed at least one of the viability criteria. These populations are distributed across 4 of 5 population strata that comprise the ESU.
5. Hatchery programs were associated with 5 of the 7 populations that did not pass viability criteria, and may have contributed to poor population performance. Significant improvements have already been made in hatchery programs for 3 of these 5 populations; positive gains in the viability of these populations are expected to become evident over the next decade.
6. The possibility that a number of adverse environmental conditions could converge and create a catastrophic threat to ESU viability is real. The convergence of the worst marine survival conditions in the last five decades, drought and extreme floods all occurred in the 1990s. Although the impacts were dramatic the ESU remained viable through this period and rebounded quickly once conditions moderated. Oregon concludes that the life cycle of the species, its population dynamics and structure, and its broad geographic distribution all provide protection and reduce the likelihood that catastrophic events or convergence of multiple adverse environmental conditions would result in this ESU not being viable in the foreseeable future.

7. The assessment that Oregon coastal coho are viable and likely to persist into the foreseeable future is predicated on the assumption that freshwater habitat and marine survival conditions in the future will generally correspond with environmental conditions and variability evident in the past several decades. If survival associated with marine or freshwater conditions trend moderately downward into the future, then the assessment should be revisited and adjusted accordingly.
8. Diligence in ongoing conservation efforts, coupled with an ongoing commitment to monitoring and evaluation for adaptive management, will ensure that viability is maintained. Improving viability to better meet recovery goals and Oregon Plan objectives will likely require additional conservation efforts focused on key limiting factors. Oregon and NOAA Fisheries, in collaboration with stakeholders, are currently developing this expanded conservation plan. A draft is scheduled for completion by the end of 2005.

Key Conclusions Regarding Population Bottlenecks

1. Oregon has identified primary and secondary risk factor bottlenecks for each of the 21 independent populations that comprise the ESU.
2. This work will help prioritize future management and restoration work to further strengthen ESU viability and achieve the intent of the Oregon Plan.
3. Stream complexity and water quality were the two most commonly identified population bottlenecks, regardless of whether populations were or were not classified as viable.
4. Stream complexity was the primary bottleneck for 13 of 21 populations and was a secondary bottleneck for 8 of 21 populations.
5. Water quality was not a primary bottleneck for any populations; however, it is a secondary bottleneck for 15 of 21 populations.
6. Other risk factors that were identified as primary population bottlenecks include: hatchery impacts (2 populations), exotic fish species (3 populations), water quantity (2 populations), and spawning gravel (1 population).
7. Oregon concludes that it will often be more reasonable to simultaneously pursue remediation of both primary and secondary population bottlenecks, using local data to prioritize restoration funding at local spatial scales, rather than to adopt a narrow view of only attempting to remediate the primary risk factor bottleneck.

Key Conclusions Regarding Oregon's Conservation Effort

1. Historical land, water and fish management activities that were the major contributing factors for the legacy of coho declines have been stopped.
2. State and federal laws established during the 1950s through 2004 (Splash damming eliminated, gill-netting eliminated in coastal rivers, federal Clean Water Act, federal Endangered Species Act, Oregon Forest Practices Law, Oregon Fill and Removal Law, PFMC Harvest Matrix Amendment 13, Native Fish Conservation Policy, Salmon and Parks Initiative, etc) establish a far more protective management environment than existed previously.
3. Implementation of the Oregon Plan beginning in 1997 demonstrated a substantial effort by the state to expand and strengthen an already considerable programmatic

conservation and restoration effort – designed to improve the status and prevent any future deterioration of this ESU's viability.

4. Fishery harvest rates over the last decade have been maintained by management action at extremely (unprecedented) low levels compared to the prior four decades.
5. Hatchery programs and impacts are at the lowest levels during the past four decades.
6. Conservative regulation of fishery and hatchery impacts is required by state and federal policies that will continue to protect and strengthen future ESU viability.
7. Reduced adverse impacts from hatchery programs across the ESU in the last two decades may not have been fully reflected in populations that were most adversely affected by historical practices. Such positive expression of current management practices may occur in the next decade or so.
8. New regulatory and programmatic action by DEQ, ODA, and ODF has been implemented; this action should further improve water quality and habitat supporting the ESU.
9. A new analysis of water use in the ESU indicates that permitted water use is not and will not become a primary limiting factor of ESU viability.
10. Restoration work (including fish passage) in the ESU during 1997-2003 exceeded any previous level of effort.
11. Recent analyses of wetlands associated with coastal estuaries indicate that these habitats are being protected by current regulations.
12. Primary habitat-related threats to coho viability are being addressed through ongoing conservation efforts.

Key Findings Regarding Future Conditions in the ESU

1. Watershed councils have been established throughout the ESU; these will complement future conservation and restoration efforts by Soil and Water Conservation Districts, private landowners, and state and federal agencies.
2. State funding to support Oregon Plan work (e.g., restoration, Watershed Council support, Soil and Water conservation District support, monitoring, assessments, etc.) is provided by Oregon Law until at least mid-2014.
3. Substantial new investments in monitoring of coho, habitat, and water quality provided a rich source of data to support Oregon's ESU assessment and adaptive management of conservation efforts.
4. The ocean environment for coho survival improved since mid-to-late 1990s, although current conditions and future trend is uncertain.
5. Abundance and density of coho spawners throughout the ESU increased since 1998 to the highest average level observed in five decades, reflecting a rapid and ESU-wide response of the populations that comprise the ESU. Higher spawner numbers distributed widely across the ESU should have positive impact on the ESU as a consequence of increased input of marine derived nutrients.
6. Analyses by the Coastal Landscape Analysis and Modeling Study (CLAMS) suggest that the future availability of larger riparian trees in forestlands will increase on fish-bearing streams regardless of land ownership. In contrast, the future potential for wood recruitment is likely to vary across forestland ownerships, with the higher potentials on public lands and lower potentials on

private lands. Oregon concludes that these projections suggest that future habitat conditions for coho across the ESU will be at least similar to and perhaps improved over current conditions.

7. CLAMS analyses did not consider what is likely to happen to riparian vegetation on agricultural or urban portions of the landscape. The State concludes that modest improvement in riparian vegetation is likely to accrue on agricultural lands under current rules but acknowledges that considerable uncertainty exists regarding specificity of improvement.
8. Monitoring of habitat and water quality since 1997 provides a baseline to detect future trends (positive or negative) that could affect ESU viability. The sensitivity (ability to detect change) of monitoring will increase substantially in the next 3-8 years as more data become available.

Key Conclusions Regarding Current Threats to ESU Viability

1. Based on Oregon's finding that the Coastal coho ESU is viable – plus evaluation of habitat data, conservation efforts, and monitoring programs – current levels of threat to continued ESU viability were determined.
2. Oregon concluded that two risk factors (ocean conditions and stream complexity) currently present moderate levels of risk to future ESU viability.
3. This finding is in sharp contrast to 1997 when many risk factors (fishery harvest, hatchery programs, stream complexity, fish passage, water quality, water quantity) were thought to present high levels of threat to ESU viability.

Key Conclusions Regarding Adaptive Management

1. Recently available tools (e.g., *High Intrinsic Potential* modeling, fish passage structure mapping at 1:24,000K scale, ESU population structure description) represent tangible opportunities to improve the efficacy of future conservation and restoration investments.
2. Oregon will develop a draft conservation plan for the Oregon Coast coho ESU by December 2005 with participation by NOAA and a stakeholder team. This plan will build on existing adaptive management frameworks (e.g., Oregon Plan, Native Fish Conservation Policy, Hatchery Management Policy, Pacific Fishery Management Council) to identify specific triggers for additional responsive actions to address unanticipated declines in fish numbers or unanticipated threats to viability. Until this comprehensive plan is completed, existing adaptive management triggers remain in place (e.g., Native Fish Conservation Policy interim criteria).
3. Oregon has committed to complete a review of monitoring programs in relation to findings of this Assessment and propose any needed refinement or alteration of monitoring designs by the 2006 field season.
4. Oregon has committed to maintain and upgrade a data library website to provide access to data used in the Assessment
5. Oregon has committed to focus habitat inventories and culvert condition evaluations first on identifying the presence of high quality overwintering habitat above existing fish passage barriers and on clarifying the passage status of structures that would provide access to high intrinsic potential streams.

6. Oregon has committed to building on existing information to ensure that high quality habitats are well defined and mapped.

Key Findings Regarding Future ESU Viability

1. A diverse set of conditions supports the conclusion that this ESU will maintain its viability into the foreseeable future. This set of conditions includes laws, management programs, monitoring, environmental conditions, and societal networks. In concert, these conditions serve to sustain and improve future viability of the ESU by: (1) reversing many of the environmental alterations and fishery impacts caused by historical management practices, (2) conserving existing conditions that support viability of the ESU, (3) creating future environmental conditions, based on an understanding of primary threats to individual populations, that will further improve the viability of the ESU in fulfillment of Oregon Plan objectives; and (4) maintaining a comprehensive monitoring program to allow adaptive management of conservation efforts as new information is gained.
2. It is unlikely that conditions currently supporting viability of the ESU will change so rapidly or dramatically as to preclude future, timely detection and protective action under Oregon management programs or the federal ESA.
3. Ongoing vigilance regarding conservation and restoration programs is necessary to sustain and improve viability of the ESU, most notably the responsiveness of these programs to variation in marine survival.
4. Recognizing that considerable uncertainty does indeed exist in relation to data, modeling, and interpretation of future trends, Oregon concludes that a modest level of optimism is warranted regarding the overall status and management of this ESU. Oregon also concludes that future evaluation of data will be conducted and that this future analysis will provide sufficient accountability to detect any errors that may have been made in interpreting the present status of the ESU.

SUMMARY – VIABILITY ANALYSIS[2]

Prior ESA listing decisions and the current NOAA Fisheries status review for coastal coho did not include an up-to-date and comprehensive analysis of coho viability relative to a suite of fish performance attributes examined at the population and ESU level (50 CFR Part 27). Recent description of the ESU population structure by the NOAA Coastal Coho Technical Recovery Team (TRT) (Lawson et al. 2004), ongoing development of viability criteria by the TRT, plus the availability of extensive data on coho abundance and distribution collected during 1997 – 2004, are new elements that allowed Oregon to complete a more comprehensive and updated analysis of coastal coho viability.

The framework used in the viability analysis included: identifying the ESU population structure; selecting fish performance attributes essential for viability; developing population viability criteria for each attribute and the roll-up to assess ESU viability; and then analyzing the status of coastal coho relative to population and ESU viability criteria.

ESU Population Structure

The NOAA Technical Recovery Team has proposed a population structure (Lawson et al. 2004) for the Coastal coho ESU, slightly modified in recent months, that identifies 57 *populations* comprising five population *strata* within the ESU. Of these 57 populations, only 21 are thought to occur in basins with sufficient historical habitat to have persisted through several hundred years of normal variations in marine and freshwater conditions (Figure 1). These have been classified as "potentially independent" and "functionally independent" populations[3] and are grouped into five strata (Table 1). The vast majority (~ 95%) of the coho historically produced in this ESU probably originated from these independent populations. The remaining 36 populations, which Lawson et al. (2004) classifies as "dependent populations," are generally thought to be dependent on the periodic reproductive contribution of strays from adjacent larger populations in order to naturally persist for periods longer than 100 years. Populations are the basic elements of the ESU and population strata are used to represent clusters of populations that share ecological or geographic similarities. The 21 independent populations were the focus of the viability assessment because the fate of the ESU is largely driven by their condition.

[2] See Part 2 of report for detailed description and discussion of the coho viability analysis.

[3] Potentially independent populations were historically self-sustaining but also likely were demographically influenced by neighboring independent populations. Functionally independent populations were historically self-sustaining and likely had relatively little demographic influence from neighboring populations (Lawson et al. 2004).

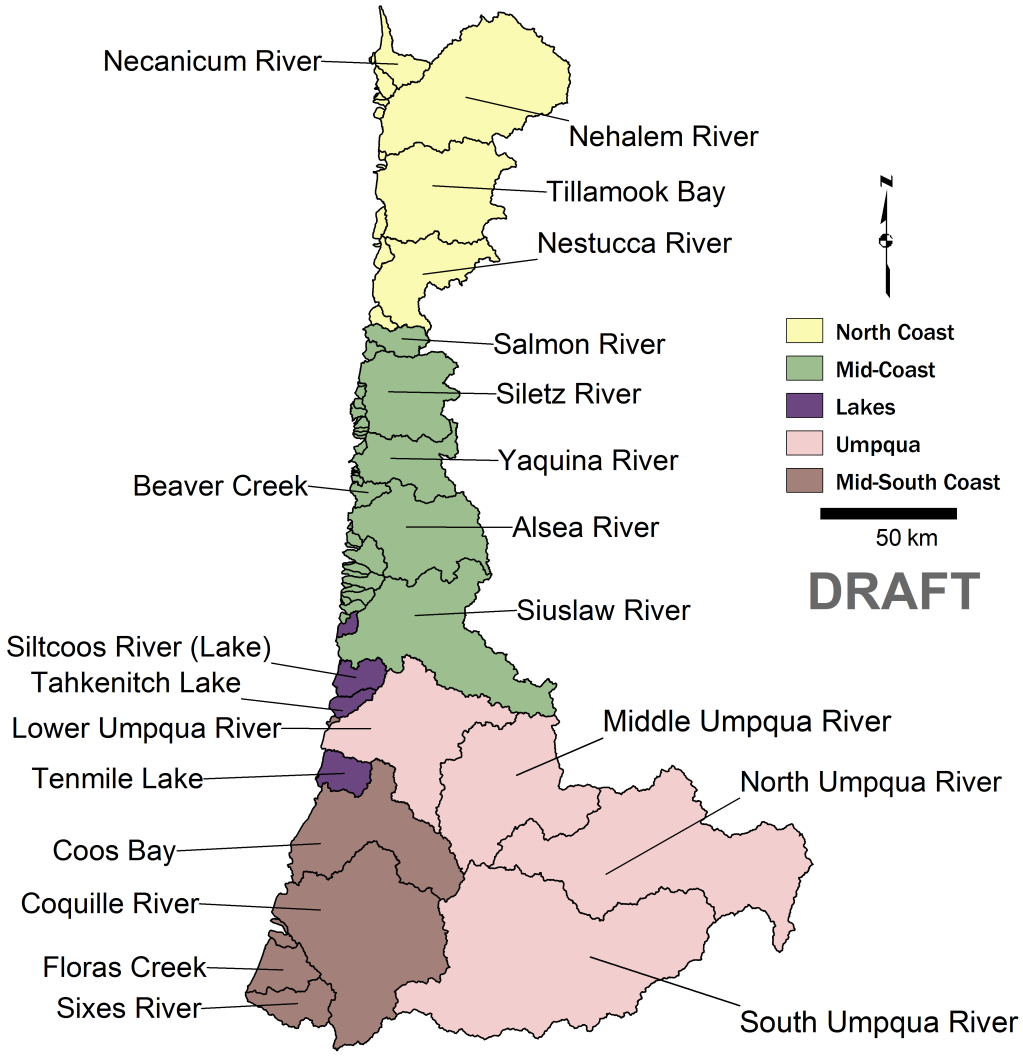

Figure 1. Independent populations and geographic strata of the coastal coho ESU.

Table 1. Geographic strata and independent populations for the Coastal coho ESU.

Geographic Stratum	Population	Population Type
Northern	Necanicum	Potentially Independent
	Nehalem	Functionally Independent
	Tillamook	Functionally Independent
	Nestucca	Functionally Independent
North-Central	Salmon	Potentially Independent
	Siletz	Functionally Independent
	Yaquina	Functionally Independent
	Beaver	Potentially Independent
	Alsea	Functionally Independent
	Siuslaw	Functionally Independent
Umpqua	Lower Umpqua	Functionally Independent
	Mid Umpqua	Potentially Independent
	North Umpqua	Potentially Independent
	South Umpqua	Functionally Independent
Lakes	Siltcoos	Potentially Independent
	Tahkenitch	Potentially Independent
	Tenmile	Potentially Independent
South-Central	Coos	Potentially Independent
	Coquille	Functionally Independent
	Floras	Potentially Independent
	Sixes	Potentially Independent

Fish Performance Attributes

Multiple, mostly independent criteria were used to evaluate whether populations within the ESU are viable based on abundance, productivity, persistence, distribution and diversity attributes of coho performance.

Abundance was evaluated by determining if populations averaged above five spawners per mile associated with the seven worst years of poor marine survival conditions in the 1990s. Productivity was evaluated by determining if populations averaged at or above replacement when spawner densities were relatively low during the record downturn of the 1990s. Persistence was evaluated by a modeling exercise that forecast spawner abundance levels over a period of 100 years incorporating 3 randomly fluctuating variables: habitat capacity, intrinsic productivity and marine survival conditions. The probability of persistence was one minus the proportion of the model simulations that adult abundance was forecast to be less than an effective extinction level. Distribution was evaluated by examining whether reasonable numbers of coho where observed in a majority of stream reaches most years. Diversity was evaluated by estimating the potential loss of genetic variation over the next 100 years.

Abundance, productivity and distribution criteria were evaluated based on a retrospective evaluation of population performance including the most recent period of adverse ocean conditions. Persistence and diversity criteria were based on a prospective forecast of

future population abundance based on coho recruitment data from the 1950s through 2003. All attributes were evaluated at the population level, and then rolled up for strata and ESU evaluation.

Population Viability Criteria

The following criteria were assigned to each attribute to represent viable populations. If a population failed one or more of the criteria, it was not considered viable. Part 2 of this report provides a more thorough description of criteria.

Abundance: (1) During a recent period of very poor ocean survival conditions (1993-1999), the average spawning abundance met or exceeded levels equivalent to five fish per mile.

Productivity: (2) During a recent period of very poor ocean survival conditions, the recruits per spawner (R/S) averaged at or above replacement when spawner density was less than 10 fish per mile.

Persistence: (3) The probability of averaging only one fish per mile for any three-year period over the next 100 years is no more than 5%.

Distribution: (4) Based on pooled spawner data for the recent 12-year period of poor marine survival (1989-2000), at least half of the sampling sites within a population's spawning area have at least four fish per mile for at least half of the 6th field Hydrologic Unit subbasins.

Diversity: (5) The harmonic mean of annual forecasted spawner abundance exceeds 600 spawners to avoid loss of 5% genetic variation over the next 100 years.

ESU Viability Criteria

Population viability results were rolled up to evaluate the status of the ESU. The ESU was considered viable if all of the following conditions were met: (1) at least half of the independent ESU populations passed all population viability criteria; (2) at least two populations per strata passed all population viability criteria; and (3) all strata passed (i.e., met conditions 2 and 3).

Assessment of Coho Status Relative to Criteria

Based on our assessment of the status of coastal coho relative to viability criteria, the ESU is viable (Table 2). All strata passed their criteria; 14 populations passed all the population criteria, and seven populations failed at least one criterion.

Table 2. Conclusions from the viability analysis for Oregon coastal coho at the population, strata and ESU level. Distinction between pass and pass+ designations was not quantified and is only provided to identify those populations that passed one or all criteria by relatively narrow margins.

ESU criteria conclusion	Geographic stratum	Stratum criteria conclusion	Population	Population criteria conclusion
Pass	Northern	***Pass***	Necanicum	Pass
			Nehalem	**Fail**
			Tillamook	**Fail**
			Nestucca	Pass
	North-Central	***Pass***	Salmon	**Fail**
			Siletz	**Fail**
			Yaquina	Pass +
			Beaver	Pass +
			Alsea	**Fail**
			Siuslaw	Pass +
	Umpqua	***Pass***	Lower Umpqua	Pass +
			Mid Umpqua	Pass +
			North Umpqua	**Fail**
			South Umpqua	Pass +
	Lakes	***Pass +***	Siltcoos	Pass +
			Tahkenitch	Pass +
			Tenmile	Pass +
	South-Central	***Pass***	Coos	Pass +
			Coquille	Pass
			Floras	Pass
			Sixes	**Fail**

In general, the results from application of these criteria to populations comprising the ESU produced consistent results. For example, populations in the northerly portion of the ESU were less resilient than populations in the south, and the Lakes stratum contained the most robust populations in the entire ESU.

Our analysis indicates the ESU is viable assuming that environmental and habitat conditions in the future are no more than moderately worse than those that have been experienced during the last five decades (Table 3 and see Part 2 of this report). Moderate to severe declines in the condition of the marine and freshwater habitats would put populations at greater risk. However, several populations most vulnerable to this additional stress are also expected to benefit from recent reduction in the number of hatchery coho released (see Part 2 of this report).

Table 3. Sensitivity of failing the persistence criterion (p>0.05; shaded cells) based on positive and negative changes to the current life cycle survival of independent coastal coho populations. Changes in life cycle survival are relative to the base period 1958 – 2000; identified as 1.00 in Table Heading.

	Life Cycle Survival Relative to 1958 – 2000 Average											
Population	**0.10**	**0.20**	**0.30**	**0.40**	**0.50**	**0.60**	**0.70**	**0.80**	**0.90**	**1.00**	**1.50**	**2.00**
Necanicum	1.00	1.00	1.00	0.98	0.80	0.40	0.14	0.03	0.00	0.00	0.00	0.00
Nehalem	1.00	1.00	1.00	1.00	0.99	0.89	0.65	0.42	0.19	0.10	0.00	0.00
Tillamook	1.00	1.00	1.00	1.00	0.99	0.89	0.72	0.47	0.25	0.15	0.00	0.00
Nestucca	1.00	1.00	0.98	0.76	0.37	0.15	0.04	0.00	0.00	0.00	0.00	0.00
Salmon	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Siletz	1.00	1.00	1.00	1.00	1.00	0.98	0.86	0.63	0.43	0.23	0.00	0.00
Yaquina	1.00	1.00	0.98	0.79	0.47	0.25	0.10	0.04	0.02	0.01	0.00	0.00
Beaver	1.00	1.00	0.73	0.09	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Alsea	1.00	1.00	1.00	1.00	0.98	0.82	0.58	0.28	0.11	0.03	0.00	0.00
Siuslaw	1.00	1.00	0.93	0.53	0.19	0.05	0.02	0.00	0.00	0.00	0.00	0.00
LoUmpqua	1.00	1.00	0.66	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MidUmpqua	1.00	0.97	0.16	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NUmpqua	1.00	1.00	1.00	1.00	0.99	0.92	0.73	0.48	0.26	0.11	0.00	0.00
SUmpqua	1.00	1.00	0.85	0.23	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Siltcoos	1.00	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tahkenitch	1.00	0.73	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tenmile	1.00	1.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coos	1.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coquille	1.00	1.00	0.92	0.27	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Floras	1.00	1.00	1.00	0.64	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sixes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.24	0.01

Persistence modeling predicted that several additional populations would be at risk in the northern and middle portions of the ESU if overall survival declined moderately (e.g., 15-50%) from what was experienced over the last five decades, which included the dramatic downturn of the 1990s. Changes of this magnitude are unlikely to occur so quickly as to preclude detection and adaptive response from state and federal managers.

Observed productivity indicates the ESU would remain viable if the adverse conditions of the 1990s are repeated. Risk of catastrophic events further compounding the effects of a return to poor ocean conditions is low. This is because the assessment of viability is based on data reflecting the adverse conditions of the 1990s, which already included poor ocean conditions, several years of drought, and extreme winter flood events (50-year event).

Potential sources of error in this evaluation relate to five general topics: 1) basic data measurement error, 2) the span of years with data was shorter than optimal for a highly reliable evaluation, 3) uncertainty with respect to the impact and trends in future habitat conditions, marine survival, and hatchery programs, and 4) validity of assumptions that formed the basis for criteria test metrics. Part 2 of this report discusses these potential sources of error in more detail.

There are numerous strengths of the viability analysis. It is based on an exceptionally comprehensive and long-term fish abundance and distribution data series. This comprehensive monitoring coincided with a previously unrecorded period of adverse environmental conditions that tested coho viability. The wealth of data that recorded the performance of coastal coho populations during this test period, and their subsequent rebound when environmental conditions moderated, allowed an empirical approach to assessing viability rather than just hypothetical. Finally, for the persistence criterion metric, a sensitivity analyses was performed to assess the implication of errors in measurement of population abundance, the implication of these errors on the model used to forecast coho recruitment, and the effect of different assumptions concerning future freshwater and marine conditions.

In addition, several areas of the analysis are risk averse resulting in a precautionary approach to assessing viability. Some examples include:

- if four out of five population viability criteria are met, the population is still considered not viable; if four out of five strata pass, the ESU is still considered not viable;
- persistence modeling dampened productivity at low fish densities even though the opposite was observed empirically;
- persistence modeling defined an extinction event as abundance equivalent to a density of one fish mile or 50 spawners, which ever was larger. A less precautionary approach to modeling persistence would have defined an extinction event as zero fish; and
- the expected positive impact of recent reductions in the number of hatchery smolts on the overall productivity of naturally reproducing populations was not included when testing to see if the population passed the persistence criterion.

In summary, the ESU is judged to be viable, that is, it retains sufficient productivity and is supported by sufficient quantity and quality of habitat to be sustainable through a future period of adverse conditions similar to or slightly more adverse than the most recent period of poor ocean survival (late 1980s and 1990s).

SYNTHESIS – BOTTLENECKS FOR POPULATIONS THAT COMPRISE THE ESU

The intent of this section is to report Oregon's determination of population bottlenecks for the 21 coho populations that comprise the ESU. This analysis is an important new element of Oregon's effort to create future conditions that will strengthen ESU viability. Whereas conservation and restoration efforts during 1997 -2004 were conducted in an attempt to address all factors for decline, the results of a risk factor (Table 4) analysis has the potential of providing more effective focus to conservation and restoration work.

Table 4. Definition of terms related to risk factors.

Risk Factor: management or environmental condition that has the potential of affecting ESU viability. Risk factors may be discussed in past, present, and future tense. ***Factor for Decline***: Risk factors that significantly contributed to a previous decline in the viability of the ESU. Factors for decline are typically discussed in past tense. ***Threat to Viability***: Threats to viability are only discussed in present or future tense. Threats to ESU viability were ranked as high, moderate, or low.

Population Bottleneck Defined

Oregon's intent was to identify the *primary* risk factor that limits production for each population in the ESU, regardless of whether or not the population passed viability criteria. This risk factor is referred to as a population *bottleneck:* the risk factor that most limits the population. In theory, then, efforts to improve viability or production of the population would address the population bottleneck first. The State recognizes that the risk factor *ocean conditions* exerts crucial influence on life-cycle survival. However, this risk factor was excluded from the bottleneck deliberation, because it is not possible to directly influence this environmental condition through management action.

Oregon believes that it is most useful to identify bottlenecks at the scale where restoration or management action could affect a positive response to improve ESU viability. In most instances, this means the population. However, some management actions are implemented so broadly that they affect the ESU. The following two examples illustrate these contrasting situations.

1. Management action to reduce impacts of fishery mortality in the ocean would affect many populations across the ESU.
2. A restoration project designed to improve fish passage at a culvert would affect productivity of an individual population.

Regardless of whether a specific population currently *does or does not* meet biological criteria, restoration work designed to address a population bottleneck should serve to strengthen the population and, thus, strengthen the existing viability of the ESU.

Stream Complexity Defined

Considerable research has suggested that the availability of overwinter rearing habitat is a critical life-cycle bottleneck for the Oregon Coast coho ESU; however, no previous effort

identified population-scale bottlenecks. Oregon's use of the term *stream complexity* refers to any multivariate set of habitat conditions that create shelter for rearing juvenile coho salmon, especially habitat conditions that create shelter during the overwinter rearing period. The State is particularly concerned with habitat of such quality that it provides overwinter survival at rates high enough to produce a positive recruits-per-spawner relationship during periods of extremely adverse ocean conditions. Habitat conditions that create sufficient shelter for overwintering juveniles may be characterized by the presence of one or more features including the following: large wood, a lot of wood, pools, connected off-channel alcoves, beaver ponds, pasture trenches, lakes, reservoirs, connected wetlands, and other conditions.

The State has decided to use the term *stream complexity* to refer to any of the various combinations of conditions that result in overwinter shelter conditions sufficient to support sustainable populations through especially adverse periods of ocean survival. This decision is based on observations that habitats with higher levels of complexity (more wood, more large wood, more braided channels, etc) are more likely to provide sufficient levels of overwinter survival, although coho may be experiencing sufficient overwinter survival in some relatively less complex habitats like pools, pasture trenches, etc. Oregon notes that stream habitats with higher levels of complexity also tend to provide benefits to all coho life stages.

Expert Panel Composition

Primary and secondary risk factor bottlenecks were identified for all independent coho populations in the Coastal ESU through a multi-stage process of discussions with State of Oregon fish biologists. Seventeen individuals participated in this expert panel deliberation and included District Fish Biologists, Watershed District Managers, researchers, and a variety of project and staff personnel with significant career expertise applicable to the issue. Oregon's process employed several basic aspects of consensus decision-making processes that are often referred to as a Delphi Process.

General Process of Delphi-Like Deliberation

Identification of life cycle bottlenecks evolved over a period of more than a year and included 5 work sessions of as few as 2 to over 10 individuals in any single work session. Initial risk factor rankings were developed by headquarters and research staff. District Fish Biologists were brought into the process to provide review and additional perspective based on extensive field experience in each of the basins in the ESU. The experts participating at each stage of the deliberation process listened to each other and presented the group with alternate rationale for identifying a primary bottleneck for each population. In most populations, a secondary bottleneck was also identified. In a handful of populations, however, either no secondary bottle neck was identified, or two secondary bottlenecks were identified. Fish experts who participated in the process had from 15 to over 25 years professional experience in the Pacific Northwest as fish biologists, fish researchers, and fish managers. Experts met, discussed likely population bottlenecks through an iterative, interactive discussion process and reached consensus decisions. Discussions included the expert's broad view of published research, data on fish and habitat, and personal field observations and experience in specific watersheds. In

addition, new analyses developed for the Coastal Coho Project were considered in the group's deliberations.

Stages in the Deliberation

1. An initial work session was held in late 2003 where headquarters and research fish biologists met and identified primary risk factor bottlenecks for each of the 19 independent coho populations. Results from this meeting were tabulated and distributed among the group for consideration and feedback
2. Some of the group's initial decisions were modified after additional discussion and review of the entire context of decisions at the first meeting.
3. At the conclusion of each work session, the group agreed on determinations for each of the 19 independent populations.
4. A smaller group of 3 experts (Nicholas, Rodgers, and McIntosh) discussed the bottleneck determinations agreed to by the first two working groups and made some changes based on data analyses that were not initially available. Final determinations were made in a work session that included, for the first time, Watershed District Managers and District Fish Biologists with extensive local field experience in the ESU. Previous bottleneck determinations were discussed to determine whether local field experience suggested revisions, and the group deferred to local expertise by modifying bottleneck determinations for several populations.

Outcome is Consensus opinion

Oregon recognizes that the outcome of this process is a consensus opinion of experts rather than an objective fact. Oregon recognizes that the population bottlenecks identified through this consensus process are, in effect, working hypotheses, and that different risk factors could be bottlenecks at spatial scales smaller than the population. Future monitoring, research and analysis should be devoted to ground-truth these bottleneck determinations.

The State also recognizes that Delphi-like processes have strengths and weaknesses. The benefit of developing a consensus opinion regarding coho population bottlenecks is that it will provide general guidance to a broad range of activities including management, restoration, research, and monitoring efforts. Actions on-the-ground should be based on site-specific information and needs. An alternative restoration approach would be to reduce mortality at all life-cycle stages through management actions (fishery and hatchery management) and restoration of all aspects of watershed function. Common sense suggests that the *fix-everything-randomly-in-equal-measure* will not produce the most prompt improvements in the ESU viability – unless all risk factors equally and independently impair viability of all populations.

Cross-Checking the Findings of the Expert Panel

Subsequent to determining population scale bottlenecks using the Delphi-like process outlined above, Oregon conducted an analysis to estimate the smolt production capacities of summer and winter habitat in each coho population unit (Part 4 (C) ODFW (3) Habitat Report). Summer habitat smolt potential was calculated for all available habitat and then reduced proportionally to reflect potential summer water temperature limitations identified at the Monitoring Area scale by ODEQ (Part 4(B) DEQ Water Quality Report).

Winter habitat smolt potential was calculated for all available habitat and for high quality habitat only. Calculation of the smolt potential from high quality habitat was conducted because modeling conducted by Nickelson and Lawson (1998) demonstrates that during periods of prolonged poor ocean survival (i.e., $\leq$ 3 %), coho populations will tend to persist only in areas with high quality winter habitat.

During periods of good ocean survival rates (i.e., >3%), the temperature-limited summer smolt capacity for the ESU as a whole is approximately 1.7 times higher than total winter smolt capacity (Table 5). When only the smolt production capacity of high quality winter habitat is considered (i.e. those areas where populations will persist during poor ocean conditions) the temperature-limited summer smolt capacity is over 6 times higher than winter capacity.

Table 5. Estimated seasonal smolt capacity of independent and potentially independent population units in the ESU.

Population Unit	Temperature Limited Summer Smolt Potential	Winter Smolt Potential (all habitat)	Winter Smolt Potential (HQ habitat)	Total Winter/Summer	High Quality Winter/Summer
Necanicum	145,191	65,498	12,844	2.2	11.3
Nehalem	2,272,785	1,043,877	244,570	2.2	9.3
Nestucca	508,587	231,173	22,070	2.2	23.0
Tillamook	1,168,435	525,830	45,741	2.2	25.5
Alsea	859,331	535,474	108,784	1.6	7.9
Beaver	79,380	54,654	40,604	1.5	2.0
Salmon	96,496	68,580	9,068	1.4	10.6
Siletz	409,958	285,257	89,182	1.4	4.6
Siuslaw	1,560,483	1,013,033	327,643	1.5	4.8
Yaquina	732,571	477,688	225,182	1.5	3.3
Coos	1,138,597	815,422	467,636	1.4	2.4
Coquille	1,166,392	617,918	129,569	1.9	9.0
Floras	166,772	82,346	0	2.0	-[1]
Siltcoos	NA[2]	NA[2]	NA[2]	NA[2]	NA[2]
Sixes	190,258	99,277	0	1.9	-[1]
Tahkenitch	NA[2]	NA[2]	NA[2]	NA[2]	NA[2]
Tenmile	NA[2]	NA[2]	NA[2]	NA[2]	NA[2]
Lower Umpqua	546,504	722,006	137,878	0.8	4.0
Midddle Umpqua	291,515	399,169	105,591	0.7	2.8
North Umpqua	81,578	113,824	16,131	0.7	5.1
South Umpqua	243,539	410,717	50,051	0.6	4.9
ESU	13,138,682	7,710,675	2,032,543	1.7	6.5

[1]No high quality habitat available

[2]Estimates for lake population units are not available.

This, preliminary analysis, suggests that winter habitat (i.e. stream complexity) is a higher priority for restoring coho populations across the ESU than water quality. The

analysis also suggests that during periods of good ocean conditions, the Umpqua populations are limited by summer rearing capacity. This finding is consistent a determination that water quantity and water quality were primary or secondary risk factors in the Umpqua. Further analysis demonstrated that for summer rearing to become the life cycle bottleneck at any time in all populations except the Umpqua, the proportion of stream miles that exceed the temperature standard would have to reach 68% on average (range among populations 60 to 72%). This translates into a 26% increase in the miles of streams that would have to exceed the temperature standard relative to current conditions.

Conclusions of Oregon's Delphi-Like Process

Population bottlenecks identified via Oregon's Delphi-like process are displayed in Table 6. A scarcity of stream complexity (crucial to over-winter survival of juvenile coho) was the most common primary risk factor bottleneck and water quality was the most common secondary bottleneck in these populations. Identification of these population bottlenecks provides a useful context for work to both conserve present conditions and to create improved future conditions for the ESU that should strengthen viability beyond its present condition.

Bottleneck Determinations will inform Conservation Planning

Oregon's ongoing effort to develop a conservation/recovery plan, consistent with the requirements of the Native Fish Conservation Policy, the Oregon Plan, and federal conservation/recovery guidelines, will provide a coordinated approach for maintaining and enhancing the status of the coastal coho ESU. Oregon's conservation planning effort currently involves a Stakeholder Team, NOAA Fisheries staff, and other fish, water and land managers. The conservation planning team will help develop and review various management scenarios for the ESU and will describe quantifiable attributes that will define a socially agreed-on condition for the ESU that is compatible with the broad Oregon Plan Mission. Any recommended changes to existing conservation efforts will include a thorough public review process. The current schedule for completing a draft conservation/recovery plan is December 2005.

Table 6. Primary and secondary life cycle bottlenecks for independent populations in the Oregon Coastal coho ESU. (*Source*: ODFW unpublished data)

Population	Primary Bottleneck	Secondary Bottleneck	Viability Status
Necanicum	Stream Complexity	--	Pass
Nehalem	Stream Complexity	Water Quality	**Fail**
Tillamook	Stream Complexity	Water Quality	**Fail**
Nestucca	Stream Complexity	--	Pass
Salmon	Hatchery Impacts	Stream Complexity	**Fail**
Siletz	Stream Complexity	--	**Fail**
Yaquina	Stream Complexity	Water Quality	Pass+
Beaver	Spawning Gravel	Stream Complexity	Pass+
Alsea	Stream Complexity	Water Quality	**Fail**
Siuslaw	Stream Complexity	Water Quality	Pass+
Lower Umpqua	Stream Complexity	Water Quality	Pass+
Middle Umpqua	Water Quantity	Stream Complexity Water Quality	Pass+
North Umpqua	Hatchery Impacts	Stream Complexity	**Fail**
South Umpqua	Water Quantity	Stream Complexity Water Quality	Pass+
Siltcoos	Exotic Fish Species	Stream Complexity Water Quality	Pass+
Tahkenitch	Exotic Fish Species	Stream Complexity Water Quality	Pass+
Tenmile	Exotic Fish Species	Stream Complexity Water Quality	Pass+
Coos	Stream Complexity	Water Quality	Pass+
Coquille	Stream Complexity	Water Quality	Pass
Floras	Stream Complexity	Water Quality	Pass
Sixes	Stream Complexity	Water Quality	**Fail**

Applying Bottleneck Determinations to Restoration Prioritization

Theoretically, future restoration work will be most effective if work is directed first at the primary bottleneck in each population. This course of action would be suitable if it was certain that the coho population bottleneck was accurately identified, and if the only objective of restoration was improvement in the coho population (i.e., as opposed to considering related Oregon Plan objectives of improving water quality or restoring watershed function).

As previously noted, however, Oregon recognizes that the Bottleneck determinations represent consensus expert opinions and should be viewed as working hypotheses rather than cast-in-stone certainties. The reality is that there may indeed be many local circumstances where the distinction between primary and secondary bottlenecks is slight. Also, actions that might be taken to improve water quality should contribute to stream

complexity. Finally, the broad mission of the Oregon Plan does include water quality and watershed function as well as listed species restoration.

Oregon therefore concludes that it will often be more reasonable to simultaneously pursue remediation of both primary and secondary population bottlenecks, using local data to prioritize restoration funding at local spatial scales, rather than to adopt a narrow view of only attempting to remediate the primary risk factor bottleneck.

SYNTHESIS OF CONSERVATION EFFORTS: ADDRESSING THE FACTORS FOR DECLINE

The intent of this section is to report Oregon's evaluation of prominent management actions that address the factors for decline (Table 4) identified by NOAA. The State evaluated data and actions related to the following factors for decline: ocean conditions, fishery harvest, hatchery impacts, stream complexity, fish passage, water quality, and water quantity.

Addressing Factors for Decline by Changing Historical Management Practices

The current status of the Coastal coho ESU is a product of historical management practices, variable regional climatic and ocean conditions, contemporary management programs, and recently completed restoration work. The Oregon Plan effort – restoring water quality, watershed health and listed salmonids statewide – represents a recent programmatic strengthening of conservation commitment that has been growing since the 1950s. Oregon Plan work includes contributions from a broad range of participants and programs: e.g., federal and state environmental laws; participation by citizens via SWCDs and watershed councils; restoration work on private lands; ongoing management by state and federal agencies; active and passive restoration work on public and private lands; and an effective monitoring system capable of detecting changes in resource status and advising future management needs.

Oregon has reviewed conservation efforts in context with the analysis of ESU viability (Part 2). The term *conservation effort* is used broadly to indicate management practices, policies or programs that address factors for decline or risk factors (Table 4) that may potentially affect future ESU viability. A detailed description of conservation efforts may be found in Part 3A and Part 3B of this report, as well as the agency reports contained in Part 4.

The remainder of this section summarizes Oregon's evaluation of prominent actions that address the key factors for decline.

Ocean Conditions

This risk factor exerts strong influence on life-cycle survival; however, Oregon is unable to directly alter this environmental condition through management action. The State's management response to this risk factor consists of implementing conservative management that directly affects all other risk factors (e.g., fishery harvest, hatchery impacts, stream complexity, fish passage, etc.).

Fishery Harvest *(See also Part 4(C) ODFW (2) Harvest Report)*

Historical Context

Harvest management (regulating the number of coho salmon killed directly or indirectly in fisheries) has improved dramatically in the last 10 years. The fishery harvest rate for

coastal coho was often greater than 70%, and was almost always over 50% during more than 4 decades prior to restrictions in 1994. Since 1997, harvest rates are defined in a regulatory *matrix* that was developed concurrently with The Oregon Plan. This harvest matrix was developed in recognition of the conservation needs of the species and was designed to impose appropriate limits on direct and indirect fishery mortality of coho salmon in context with ocean environment and the biological status of naturally produced coho throughout the range of the Oregon Coastal coho ESU.

Recent Management Action Related to Fishery Harvest

Oregon, as a member of the Pacific Fisheries Management Council (PFMC), now operates under the technical guidance of the *harvest matrix* that was developed concurrently with development of The Oregon Plan and refined through the PFMC process in 2000. The revised *matrix* stipulated more conservative exploitation rates (0-8%) at critically low parent spawner abundance and increased the maximum exploitation rate to 45% under high survival and abundance conditions. Oregon will seek formal adoption of the revised harvest matrix under the PFMC Amendment 15 process in 2005. Mortality of Oregon coastal coho has been maintained below 15% (Figure 2) since adoption of the harvest matrix preceding implementation of The Oregon Plan. Incorporation of the revised matrix under Amendment 15 in 2005 will strengthen future protection to the Coastal coho ESU.

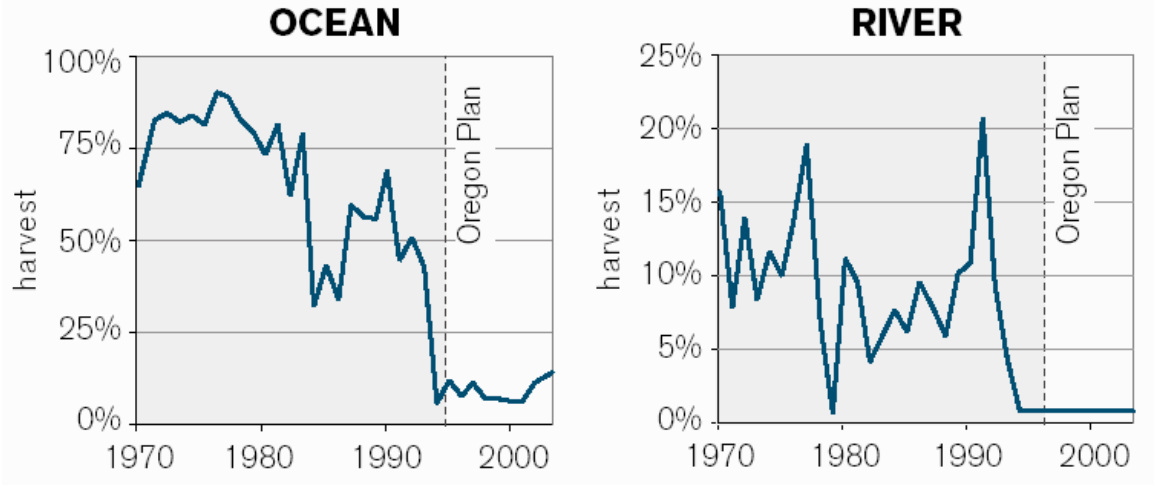

Figure 2. Estimated fishery mortality (harvest rate) of naturally produced coho salmon, (direct take plus indirect mortality). The graph at left presents estimates of fishery mortality in ocean fisheries; the graph at right presents estimates of mortality rate in river-based (terminal) recreational fisheries. Year indicates year of fishery. (*Source*: Part 4(C) ODFW (2) Harvest Report)

Conclusion: Fishery Harvest

On the basis of these changes in fishery harvest management policy and a decade-long track record of maintaining the conservative policy, Oregon concludes that *fishery harvest*, as a factor for decline, has been sufficiently addressed.

Hatchery Impacts *(See also Part 4(C) ODFW (1) Hatchery Management Report)*

Historical Context

During the 1960s through the early 1990s, the coho hatchery program in the Coastal coho ESU was characterized by the following conditions.

- High numbers of hatchery coho were released.
- Coho juveniles were released in most of the basins in the ESU.
- Adult coho were often out-planted from hatcheries to natural spawning streams.
- Hatchery broodstocks were often combined from returns to several hatcheries and non-native broodstocks were the norm.
- Releases of hatchery juveniles into streams in the ESU usually included fry, pre-smolts, and smolts.
- Hatchery–origin (stray) coho were common in natural spawning areas.

Recent Management Action Related to Hatchery Impacts

Many aspects of hatchery management have been improved in ways that are expected to reduce or eliminate potential risk from hatcheries to the viability of the Coastal coho ESU. Key elements of these changes are summarized following.

- *Reduction in Magnitude of Hatchery Fish Releases – R*eleases of hatchery coho in the Oregon Coastal coho ESU declined from a peak of ~35 million in 1981 to ~0.8 million in 2005 (Figure 3). As recently as the early1990s, hatchery coho juveniles were released in 17 of 19 ESU populations; in 2004, hatchery coho were released in 7 of 19 populations. Current hatchery programs are constrained to release no more than 200,000 smolts in any basin.

- *Reduction of Interactions in Spawning Areas* – The proportion of (stray) hatchery fish found in natural spawning streams in the Coastal coho ESU declined from levels of 15-25% during 1990-1998 to within established policy guidelines (about 9%) during 1999-2003 (Figure 3). Currently, only Salmon River and Upper Umpqua populations still average over 10% hatchery fish on the spawning grounds. Reduced proportions of hatchery coho in natural spawning areas are a product of reduced release numbers, reduced release locations, and increased returns of wild coho.

- *Reduction in Off- Station Releases* – Most hatchery coho smolts are either released from the hatchery or at acclimations sites; except in very limited circumstances (e.g., volunteer-based efforts involving small numbers of fish) or experimental circumstances hatchery coho fry or fingerlings have not been released into ESU streams since 1998.

- *Marking all Hatchery coho* – Since 1997, virtually all ODFW hatchery coho smolts released in the Coastal coho ESU were marked, facilitating accurate enumeration of wild coho in natural spawning areas.

- *Use of Native versus non-native Broodstocks* – in contrast with the historic practice of routinely releasing mixed-origin and non-native coho hatchery

broodstocks, mixed-origin hatchery stocks are only released in 3 and non-native hatchery stock is only released in 1 of 19 populations in the ESU.

- *Water Withdrawals* – Water diversions at ODFW facilities are permitted under existing water rights. The amounts of water used are reported annually to the Oregon Water Resources Department.

- *Hatchery Effluent Discharge into Streams* – Effluent water quality from ODFW hatchery facilities is regulated under a general 330J NPDES permit as required by the Oregon Department of Environmental Quality. Improvements in hatchery programs and operations and improved training of hatchery personnel has resulted meeting permit requirements for at least the last 4 quarterly reporting periods.

- *Adult Passage at Hatchery Barriers – A*pproximately 155 miles of coho spawning habitat (roughly 3% of the coho spawning distribution) in the Oregon Coastal coho ESU is above some sort of barrier associated with an ODFW hatchery. Recent work planned or accomplished at Alsea, Fall Creek and Rock Creek hatcheries has reduced the impact of passage above hatchery barriers by converting complete barriers to selective barriers. These selective barriers will be operated to remove hatchery fish and pass wild fish to natural spawning areas.

- *Hatchery Programs in Areas Outside the ESU* – A reduction in OPI area (Oregon coast and Columbia River) hatchery coho smolt releases from over 60 million in 1982 to 26 million significantly reduces the potential for adverse impact to the Coastal coho ESU.

- *Coastal Hatchery Releases of Other Species* –ODFW hatcheries also release chinook and steelhead into streams across this ESU. Hatchery programs for these species have generally been changed over the past decade in the same ways that the coho hatchery programs have been changed (i.e., lower release number, fewer off-station releases, more native broodstocks, improved hatchery operation and maintenance, etc.). These changes are consistent with reducing potential for adverse impact on the coho ESU.

- *Hatchery Policy Guidance* – Three new policies effectively reduce the potential for adverse interactions between hatchery and wild fish throughout the ESU: (1) Native Fish Conservation Policy (2002), (2) Fish Hatchery Management Policy (2003), and (3) Fish Health Management Policy (2003). These three policies establish a conservative framework for hatchery management that requires reducing or eliminating adverse impacts on wild populations.

Summary: Hatchery Management

During the 1980s, hatchery coho releases in the Coastal coho ESU often exceeded 20 million smolts annually (Figure 3); stock transfers, out-planting of adult and juvenile coho were common practice. Private hatcheries virtually ceased operation in the early 1990s and a variety of changes were implemented in Oregon's fish management program. As a result, releases of hatchery coho in the ESU have declined to just fewer

than 1 million fish per year; broodstock selection and other aspects of hatchery management have been modified to minimize the potential for adverse impact on the Coastal coho ESU. The net result is that modest numbers of hatchery coho are now released in only seven of the nineteen populations and stray hatchery spawners now constitute <10% of coho in streams throughout the ESU.

Management of hatcheries across the Coastal coho ESU has changed dramatically since the mid 1990s, particularly the number of hatchery fish released. These changes now establish a strong risk-averse environment across the Coastal coho ESU. Collectively, current management practices have reduced the potential for hatchery programs to adversely affect the Coastal coho ESU via genetic interactions, competition, or predation.

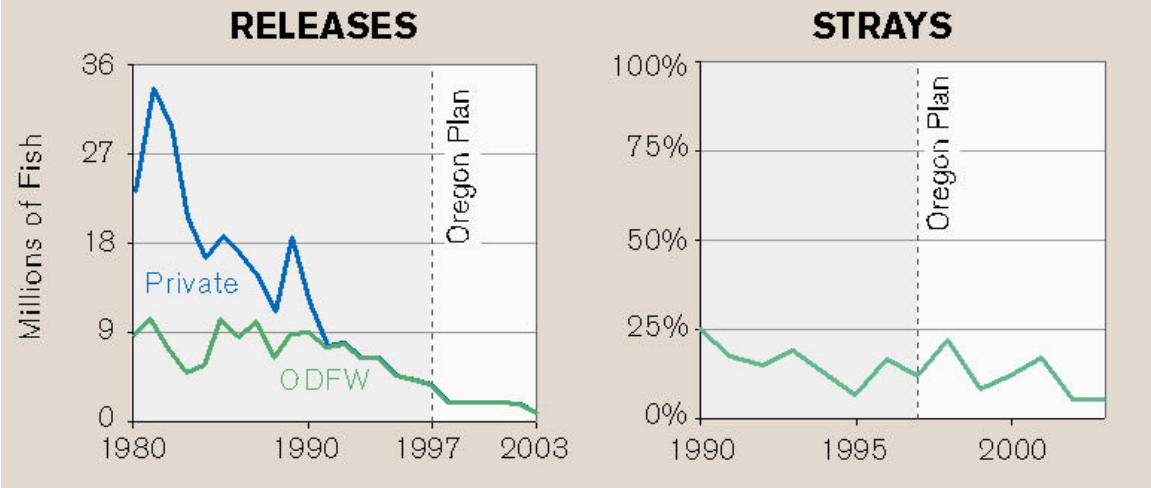

Figure 3. Estimated releases of hatchery coho salmon juveniles, and occurrence of stray hatchery coho adults in natural spawning streams, for the Coastal coho ESU. The graph at left represents estimated releases of hatchery coho juveniles by private and ODFW hatcheries; the graph at right represents estimated percent of coho observed in spawning areas that were stray hatchery fish. Year indicates year of release or return. (*Source*: Part 4(C) ODFW (1) Hatchery Management Report)

Conclusion: Hatchery Management

On the basis of these changes in fishery harvest management policy and a decade-long track record of maintaining the conservative policy, Oregon concludes that *hatchery impacts*, as a factor for decline, has been sufficiently addressed.

Stream complexity (*See also* Part 4(C) ODFW (3) Habitat Report)

This sub-section reports Oregon's evaluation of the historical context and Oregon's extensive management actions related to the risk factor *stream complexity.* The term *stream complexity* refers to any multivariate set of habitat conditions that create shelter for rearing juvenile coho salmon, especially habitat conditions that create shelter during the overwinter rearing period.

Historical Context

The regulatory regime and management practices that caused an alteration of habitat from conditions that were especially favorable to coho – to conditions that are less favorable to coho – were very different historically than what has evolved since the 1950s. State and federal laws including the National Forest Management Act, National Environmental Policy Act, Oregon Fill and Removal Law, Oregon Forest Practices Law, Oregon Land Use Law, Instream Water Rights Act, federal Coastal Zone Management Act, and federal Clean Water Act, for example, initiated protections to end or reverse the impact of historical land and water management practices. The positive impacts of these programs are expected to continue to accrue over time, but these and other laws and recent refinements to management practices certainly have established a different habitat management climate than was in effect for over a century in the ESU.

Examples of the historic habitat management practices illustrate the extent to which current practices have improved environmental trajectories for the Coastal coho ESU.

- *Splash Damming* – Splash dams were outlawed in 1956. Prior to that time, portions of many river basins in the Coastal coho ESU were severely altered by splash damming, and the practice of using small tributaries as logging roads continued until at least the late 1950s. Splash dams often scoured streams to bedrock and moved wood outside the normal active channel.

- *Riparian Protection* – Until the early 1960s it was rare for riparian buffers to be retained along streams on forestland. Beginning in 1963, the first riparian buffer strips were left on one side of the stream in state-owned timber harvest areas. In 1968, buffer strips were left on both sides of fish streams in some state-owned timber sales. A similar pattern occurred on federal lands. Oregon Forest Practices Act Rules (1972) required limited buffers along streams on private forestlands with "significant" fish use. Revisions in these rules in 1994 required riparian buffers and conifer retention that prevented a shift of stands from conifer to hardwood composition. These new rules also required buffers for all fish-bearing and some non fish-bearing streams. A management emphasis on conserving or establishing riparian buffers along streams in agricultural and urban settings only dates to the mid 1990s. The relatively simple process of riparian reestablishment and addition of large wood is relatively new and will yield more significant results in the next ten decades. Oregon expects that riparian areas will be protected in the future by relevant protections including a combination of existing state and federal programs, both regulatory and nonregulatory, that lead

to protection or restoration of riparian vegetation for stream bank stability, shade, and physical habitat. This will lead to controlling degradation and improvement of conditions that affect water quality to meet state water quality standards in the future. The rate of improvement will be dependent on the watershed-specific impediments to meeting water quality standards and the mechanisms to reverse these impediments (growing large trees vs. forbs/shrubs, etc.). The completion of TMDL's for the coastal ESU will also bring more specificity to recovery processes.

- *Stream Cleaning* – Damage caused to streams and rivers by early logging operations (splash dams, slash disposal in streams, log drives, etc.) often created huge logjams and undoubtedly prevented or impeded anadromous fish passage in some areas. These spectacular cases prompted The Oregon Game Commission (in the 1930s) to require loggers to remove woody debris from streams. This effort gained more emphasis after WW II when caterpillar tractors became available for use in logging. Stream cleaning on state-owned forests began in the 1950s, and probably continued into the mid-1970s. The Oregon Game Commission conducted a stream improvement (cleaning) program throughout the ESU from about 1956-1976. It is difficult or impossible to comprehend the magnitude of these stream cleaning efforts on the productive capacity of coho streams. Current management programs recognize the role of large wood in creating stream complexity, thus providing a fundamentally different perspective on habitat management.

- *Reduction in Beaver Populations* – Because of their ability to create dam pools which are refugia from high winter water velocities, beavers have the potential of creating high quality habitat for juvenile coho. Historical trapping combined with land management practices reduced beaver populations, potentially minimizing an important influence that formerly shaped the riparian and physical habitat of coastal streams. More recently, harvest of beaver has declined significantly and programs have been put in place to avoid harvest in areas critical to coho rearing. Evidence suggests that beaver pond habitat may still be well below historic levels. Monitoring data at the ESU scale are currently capable of detecting a 5% annual rate of change in beaver pond habitat – and the data do not detect any recent trend in this parameter (See Part 4(C) ODFW (7) Beaver Report). Any future increases in beaver pond habitat that might occur would be expected to benefit by creating high quality overwintering habitat for juvenile coho.

- *Tidelands Diking* – Alteration of coastal tidelands through diking has been extensive (~40%) and occurred as early as the 1880s; however, the majority of the existing dikes were constructed between 1930 and 1960 under the federal Flood Control Act authorities. Federal polices and programs that were active until the 1970's supported stream diking and drainage of coastal wetlands. With the change in federal and state policy from a position of encouraging and funding wetland drainage – to a position of severely limiting wetland alteration plus

funding wetland restoration – the likelihood that there will be further loss or degradation of these habitats in the foreseeable future is low.

- *Channelization* – Extensive alterations of rivers, tidelands, and wetlands were implemented under a range of federal programs and authorities up through late 1960s. These efforts, usually characterized as stream *improvements*, included construction of dikes, placement of riprap to armor streambanks, and dredging river channels. For example Flood Control Acts in the 1940s authorized projects on the Nehalem, Yaquina, and Umpqua rivers and tributaries. These historical channelization efforts probably reduced access by juvenile coho to many suitable overwintering areas. Although the legacy of these practices largely remains, the practices themselves have been stopped.

- *Roads* – Roads were historically constructed without regard to any possible adverse impact to watershed function, fish, or water quality. Historic settlement patterns and relative ease-of-construction led to preferential location of roads in valley bottoms near streams. These roads often parallel low gradient streams (historically the most productive coho habitat) and cross many tributaries. Standards for design of roads and stream crossing structures have been gradually established and strengthened since the 1970s. Design and construction standards established in the mid 1990s require designs to accommodate 50-year flood events on private forest lands and 100-year flood events on federal forestlands. Current standards for road location and construction are based on best management practices and seasonal restrictions that are designed to protect fish habitat, provide fish passage at stream crossings, and reduce sediment inputs to streams. Considerable restoration investments have recently been made related to upgrading roads and stream crossings to current standards.

Recent Management Action Related to Stream Complexity

The contemporary regulatory climate (1997 – 2005) has been constructive with respect to watershed and fisheries concerns, providing additional state and federal tools and management practices designed to conserve and restore the productive capacity of habitats that support the Coastal Coho ESU. Key elements of these changes are summarized following.

- *Programmatic improvements* – include the Northwest (Federal) Forest Management Plan, Northwest Oregon (State) Forest Management Plan, Elliot State Forest Management Plan, Agricultural Water Quality Management Area Plans, Total Maximum Daily Load Plans, revisions to Oregon Forest Practices Rules, Confined Animal Feeding Operation Program, Pesticide Program, and Weed Control and Invasive Species Program. Intensively managed forestlands now must be reforested with species suitable for the site. Incentives are available to promote continued conversion of agricultural lands to forest.

- *State and federal forestland management* -- substantial portions of forestlands across the ESU (~9% are in State management and ~38% are in federal management) are now managed under some combination of forest reserves,

structure based management, or multi-resource management emphasis (*See also* Part 4(J) OP TR 3. Environmental, Land Use and Land Cover Characteristics in the Coastal Coho ESU). This diverse and geographically dispersed combination of forest management strategies is expected to yield an array of stand types, adequately arranged on the landscape that will contribute to the habitat needs of all native species including coho salmon. For example, a large portion of the State forested landscape across the ESU (perhaps 40-60%) is expected to be comprised of medium and large diameter trees found in layered and older forest structure indicative of 175-250 year old forests. A similar or greater portion of the federal forested landscape is expected to be comprised of medium to larger diameter trees and older forest structure. These estimates do not include the substantial contribution of riparian areas to the land base which is managed for mature forest condition.

- *Future condition modeling* – Analyses by the Coastal Landscape Analysis and Modeling Study (CLAMS) suggest that the future availability of larger riparian trees in forestlands will increase on fish-bearing streams regardless of land ownership. In contrast, the future potential for wood recruitment is likely to vary across forestland ownerships, with the higher potentials on public lands and lower potentials on private lands. Oregon concludes that these projections suggest that future habitat conditions for coho across the ESU will be at least similar to and perhaps improved over current conditions. CLAMS analyses did not consider what is likely to happen to riparian vegetation on agricultural or urban portions of the landscape. The State concludes that modest improvement in riparian vegetation is likely to accrue on agricultural lands under current rules but acknowledges that considerable uncertainty exists regarding specificity of improvement.

- *Land Use Change* – Oregon's 1973 land use law (Land Conservation and Development Act) was established in large part to protect productive forest and farmland from conversion to nonresource uses. An analysis of land use changes in Western Oregon from 1973 to 2000 suggests the law has significantly slowed conversion of farm and forestland to residential and urban uses. A separate study focused on the Oregon coast demonstrated that from 1973 to 2000 there was no loss in forestland, a 1% loss in agricultural lands and a 7% loss in mixed forest-agricultural lands.

- *Estuarine and Wetland Habitat* (*See also* Part 4(G) DSL Wetlands, Estuaries, Dredge, Fill and Inwater Construction Report) – Although the historical (1850-1970) loss of estuarine tidelands and wetland habitat in the ESU is significant (~40% and ~70%, respectively), recent analysis indicates that estuary and wetland loss has been negligible during the most recent 3 decades. The State of Oregon is currently contracting with the U.S. Fish and Wildlife Service, National Wetland Inventory (NWI) to conduct a wetland change study along the Oregon Coast. Analyses have been completed for the Tillamook and Nestucca watersheds that may serve as indicators of conditions in other coastal areas. Results in these two estuaries indicate that ~3% of wetland area has been converted from one wetland

type to another and that net loss of wetland area was ~0.1 to 0.3%. These results, if representative of other estuaries, are an encouraging indication that regulatory and restoration efforts are effectively conserving wetland habitat. Also, Oregon has recently assisted in the conservation acquisition of more than 1,500 acres of coastal wetlands and lowland streams in the ESU.

- *Current Conditions* (*See also* Part 4(C) ODFW (3) Habitat Report) – Coho streams in this ESU (compared to conditions in reference – *relatively undisturbed* – streams) are characterized by a scarcity of large wood instream, lack of large conifers in riparian areas, reduced interactions with off-channel alcoves and flood plains, and accumulations of fine sediment in gravels. These habitat components are critical for stream complexity to shelter and support juvenile coho during harsh winter conditions. Even considering that the ESU is currently viable, a contemporary scarcity of high quality rearing habitat (compared to what is believed to have existed historically in the ESU) is of concern. Nothing in this Assessment is intended to imply that current management or habitat conditions are optimum for coho salmon. Current habitat and fishery management conditions and programs, however, are adequate to avoid any foreseeable adverse change in ESU viability.

Conclusion: Stream Complexity

A wide variety of laws and conservative management practices related to habitat have been implemented from the 1950s through the present. Taken as a whole, these laws and policies represent a huge improvement over legal protections and management practices that were historically common in the ESU. On the basis of these changes in habitat management policies, a several decade track record of implementing progressively more conservative habitat management practices, and recent data from the monitoring program that do not note declines in habitat over the most recent decade, Oregon concludes that loss of *stream complexity*, as a factor for decline, has been sufficiently addressed. The legacy effects of past management practices that reduced stream complexity and that could potentially affect the future viability of the ESU are being addressed by existing conservation efforts (*See also SYNTHESIS* – CONSERVING EXISTING CONDITIONS THAT SUPPORT VIABILITY OF THE ESU BY ADDRESSING CURRENT AND FUTURE THREATS TO ESU VIABILITY in this document). This conclusion includes an acknowledgment that the State must remain diligent in conducting future monitoring because the ability to detect changes in habitat will improve considerably within the next 3-8 years, as more data are available.

Fish Passage (*See also* Part 4(J) OP TR 2 A Spatial Evaluation of Habitat Access Conditions and Oregon Plan Fish Passage Improvement Projects in the Coastal Coho ESU

Historical Context and Recent Management Action Related to Fish Passage

Historical road construction practices led to very adverse conditions for fish passage. Many roads were constructed adjacent to lowland river reaches; these roads crossed many tributaries used by spawning and rearing coho and a large number of the crossing structures (typically culverts) did not provide adequate passage for juvenile and adult fish. Construction design standards have been gradually improving since the 1970s and

were considerably improved in the late 1990s. Considerable recent work has been done by federal, state, county, and private parties to provide improved fish passage throughout the ESU by replacing deficient culverts with structures designed to meet current standards.

Current Fish Passage Conditions in the ESU
During 1997-2003, $25M was invested in this ESU to improve fish passage (*See also* http://mtjune.uoregon.edu/website/OWEB/Assessment). As a result, coho now have improved access within 16% of their distribution in the ESU. Currently, it appears that access by coho may be impaired to some extent over ~10% of the species distribution within the ESU. Access to about 10% of coho streams remains impaired to some extent and the status of access to about 30% of coho streams remains poorly documented. Oregon's identification of population bottlenecks and these recent analyses of fish passage will allow future restoration and inventory efforts to focus on providing passage to high quality overwintering habitat.

Conclusion: Fish Passage
On the basis of restoration work accomplished to date, the population bottleneck determinations, the recent analysis of fish passage conditions in the ESU, and a commitment by the State to focus future fish passage remediation and inventory work on areas of high quality overwintering habitat, Oregon concludes that *fish passage*, as a factor for decline, has been sufficiently addressed.

Water Quality (*See also* Part 4(B) DEQ Water Quality Report)

Oregon's Regulatory Responsibilities
The Oregon Department of Environmental Quality has responsibilities for protecting Oregon's waters from point source and non-point source pollution and restoring Oregon's waters when water quality standards are not being met. The general framework for this program is (1) identify water quality goals (standards), (2) prevent pollution and protect water quality by administering permits and various technical and financial assistance programs, (3) monitor and assess water quality, and (4) implement and oversee efforts needed to restore water quality when standards are not being met. This comprehensive approach ensures that water quality factors for decline will be addressed when they present a threat to listed species. DEQ carries out its responsibilities through a variety of programs and activities that are briefly described below.

- *Water Quality Standards*: DEQ establishes water quality standards to protect beneficial uses of the State's waters, such as fish and aquatic life, recreation, irrigation and domestic water supply. The standards are established at the levels needed to protect the most sensitive beneficial uses. For example, cold water species such as salmonids are generally the most sensitive to water temperature, so the temperature standard is established based upon the need to protect salmonid spawning, rearing and migration. Several water quality standards have been approved by EPA following consultation with NMFS, including temperature, dissolved oxygen and intergravel dissolved oxygen. EPA is currently working

with NMFS in reviewing DEQ's submission of revisions to over 250 water quality criteria for toxics.

- *Point Source Permits:* DEQ issues and enforces point source permits under its delegated Clean Water Act authorities to ensure that the discharge of wastewaters into waters of the state does not cause a violation of water quality standards. The permits set limits for the discharge of pollutants from each source. DEQ also implements state laws that protect groundwater quality by requiring permits for installing subsurface sewage disposal systems (septic systems) and for the application of wastewaters to land. DEQ periodically inspects permitted facilities to ensure compliance and responds promptly to incidents of non-compliance. DEQ recently completed an in-depth review of its wastewater permitting program by an external review committee and is currently implementing a number of the group's recommendations aimed at strengthening compliance efforts and reducing the backlog of permit applications.

- *Non-point Sources:* DEQ protects Oregon's waters from nonpoint source pollution by providing technical assistance and financial incentives for nonpoint source pollution control activities. The program is guided by a 5-year plan that DEQ develops and EPA approves.

- *Water Quality Monitoring*: DEQ implements two primary monitoring programs that assess the status and trends of the water quality: a statewide ambient monitoring program focused on large rivers and a network of randomly selected sites on wadeable streams (1st through 3rd order). DEQ also collects water quality data through a variety of special studies, such as those needed for developing TMDL and permits. Every two years (as required by EPA under Section 303(d) of the Clean Water Act), DEQ prepares a report of statewide water quality conditions and identifies water bodies that are not meeting water quality standards.

- *Development of Total Maximum Daily Loads*: Waterbodies that are identified as being impaired 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. The TMDL then allocates the pollutant load among point sources, non-point sources, background levels, reserve capacity and a margin of safety.

Current Water Quality Conditions in the ESU

Two contrasting views of current water quality conditions are offered by probabilistic and Ambient Site monitoring in the ESU. Based on probabilistic sampling, significant reaches (~50%). of coastal rivers did not meet water quality standards, especially for temperature However, nearly half of the large river water quality monitoring sites recorded slightly improving water quality over the past 10 years, and none demonstrated a declining trend. Sampling at large river sites (Ambient Site sampling) is not designed to account for variation in water quality over the course of a day (e.g., water temperature may only be in violation of numeric criteria in the afternoon in some streams).

Monitoring data also indicate that water quality in coho streams in this ESU is not significantly different from water quality in relatively undisturbed (reference) streams.

Oregon recognizes that water quality remains a legitimate concern as an aspect of watershed function and Clean Water Act compliance throughout much of the ESU, the role of water quality is thought to be secondary to the role of stream complexity with respect to the viability of coho populations. In other words, immediate improvements in the availability of complex habitat must occur *first or concurrently*, before improvements in water quality could strengthen population viability.

Summary: Water Quality

Oregon DEQ programs have a clearly defined framework to establish water quality standards, prevent pollution through permitting, provide technical and financial assistance, and conduct monitoring. Once water quality problems are documented, TMDL development and implementation is the primary mechanism Oregon uses to address problems. Four TMDL's have been developed in the ESU and approved by EPA since the Oregon Plan was implemented. The remaining TMDLs for the ESU are scheduled to be completed by 2008.

TMDLs are implemented and water quality problems are addressed in a variety of ways, including Agricultural Water Quality Management Area Plans (AWQMP), Forest Practices Act implementation, permitting, and storm water management. AWQMPs have been completed for the entire ESU and are in the early phases of implementation. These plans are designed to meet water quality standards on agricultural and rural lands through tools including riparian management.

Oregon believes that, for federal lands, the Northwest Forest Plan makes significant positive contribution toward meeting ESA and Clean Water Act needs. Oregon recognizes, however, that NOAA/NMFS consulted with federal land managers on amendments to land management plans and concluded that on a programmatic level these plans, which incorporate the aquatic conservation strategy of the NWFP, did not jeopardize ESA listed species or destroy critical habitat. Oregon also notes that NMFS concluded that the amount and extent of incidental take of ESA-listed species could not be determined at the plan level and subsequent consultations would be needed on certain land management actions at finer scales than the plans. Finally, Oregon recognizes that NMFS is not responsible for determining whether the NWFP meets the requirements of the Clean Water Act and has made no such determination.

Private and state forest lands rely on forest practices rules to meet water quality standards. Oregon DEQ and ODF are working to constructively engage with USEPA and NOAA to resolve technical issues and advise proposed changes to forest practices by ODF. Oregon has continued to demonstrate a willingness and capacity to modify management programs in response to new information and changing needs.

Conclusion: Water Quality

On the basis of a broad range of existing Oregon and federal programs to address water quality, the population bottleneck determinations, the recent analysis of water quality

conditions in the ESU, and a commitment by the State complete and implement Agricultural Water Quality Area Management Plans and TMDLs, Oregon concludes that *water quality,* as a factor for decline, has been sufficiently addressed.

Water Quantity (*See also* Part 4(I) OWRD Water Quantity Report)

Oregon's Regulatory Responsibilities

The Oregon Department of Water Resources (WRD) regulatory and restoration programs are administered to achieve the following overarching biological objectives : 1) protect and maintain existing streamflows in areas providing significant salmon habitat value and 2) restore streamflows in areas providing significant salmon habitat value. Maintaining streamflows occurs through the following regulatory programs.

- Establishment of instream water rights
- Water distribution and regulation by priority date of water rights of record, including instream water rights
- Protection of instream water rights from injury during review of water right transfers
- Public interest review, water right conditions, and water allocation policy in considering new out of stream water uses

Restoring streamflows occurs through the following conservation programs.

- Voluntary instream lease agreements
- Voluntary instream transfers
- Allocations of conserved water

Current Water Quantity Conditions in the ESU

Instream water rights were established by Oregon statute in 1987. The Instream Water Right law allows the Oregon Departments of Fish and Wildlife (ODFW), Environmental Quality (DEQ), and the Parks and Recreation (OPRD) to apply for instream water rights for the purpose of fish protection, minimizing the effects of pollution, or maintaining recreational uses. The law gives instream water rights the same status as other water rights. Once issued, these instream water rights are held by WRD as trustee for the people of the State of Oregon. Approximately 800 ISWRs exist in the coastal Oregon basins. Key findings of a recent analysis by WRD yielded the following conclusions.

- Within the ESU, over 3,700 miles of stream are protected by an ISWR.

- At an 80% exceedance flow (the amount of flow that exists at 80 percent of the time, on average), water is not available for new appropriations during August in 94% of the ESU area.

- 70% of the ESU had an August consumptive use of water that was less than 10% of the 80% exceedance flow.

- Over 90% of the ESU had no change in August consumptive use between 1997 and 2004

Summary: Water Quantity

Within the constraints of the prior appropriation doctrine, the Oregon Water Resources Department's current program is protective of instream uses and prevents additional consumptive uses of water when water availability becomes limited. Flow protection and restoration programs are currently directed at the areas of greatest need (Umpqua and Mid-South Coast). Future demands for water as the human population grow in the ESU will continue, but Oregon predicts that this water will have to come from sources other than summer flows.

Conclusion: Water Quantity

On the basis of existing Oregon programs to address water quantity, the population bottleneck determinations, the recent analysis of water use and availability conditions in the ESU, and a commitment by the State to focus streamflow conservation and restoration efforts in targeted areas within the ESU, Oregon concludes that *water quantity*, as a factor for decline, has been sufficiently addressed.

SYNTHESIS – CONSERVING EXISTING CONDITIONS THAT SUPPORT VIABILITY OF THE ESU BY ADDRESSING CURRENT AND FUTURE THREATS TO ESU VIABILITY

The intent of this section is to report Oregon's evaluation of management actions in relation to conserving the *existing* viability of the ESU. As noted in the previous section of this document, Oregon concludes that historical land, water and fish management activities (i.e., *factors for decline*) that contributed most to the legacy of coho declines have been sufficiently addressed by a broad-based set of regulatory and programmatic work that has been strengthening and evolving since the 1950s. Whereas the historical factors for decline have been extensively addressed by these regulatory and programmatic changes, risk factors still present a potential future threat to ESU viability.

The remainder of this section summarizes prominent protective and restoration mechanisms in place that address future threats to the viability of the Coastal coho ESU including Oregon's evaluation regarding the sufficiency of these protective mechanisms to conserve the *existing* viability of the Coastal coho ESU. This evaluation is organized by the following risk factors: ocean conditions, fishery harvest, hatchery impacts, stream complexity, fish passage, water quality, and water quantity.

Ocean Conditions

This risk factor exerts strong influence on life-cycle survival; however, Oregon is unable to directly alter this environmental condition through management action. The State's management response to this risk factor consists of implementing conservative management that directly affects all other risk factors (e.g., fishery harvest, hatchery impacts, stream complexity, etc.).

Fishery Harvest

Oregon, as a member of the Pacific Fisheries Management Council (PFMC), manages under the technical guidance of the *harvest matrix* that was developed concurrently with development of The Oregon Plan and refined through the PFMC process in 2000. The revised *matrix* stipulated more conservative exploitation rates (0-8%) at critically low parent spawner abundance and increased the maximum exploitation rate to 45% under high survival and abundance conditions. Incorporation of the revised matrix under Amendment 15 in 2005 will strengthen future protection to the Coastal coho ESU.

Oregon concludes that the *fishery harvest* management frameworks and policies currently in effect are sufficient to conserve the existing viability of the Coastal coho ESU in the foreseeable future.

Hatchery Management

Management of hatcheries across the Coastal coho ESU has changed dramatically since the mid 1990s; these changes now establish a strong risk-averse environment across the Coastal coho ESU. Collectively, current management practices have reduced the

potential for hatchery programs to adversely affect the Coastal coho ESU via genetic interactions, competition, or predation. Continued implementation of Oregon policies including Native Fish Conservation Policy, Hatchery Management Policy, and Genetic Management Policy will continue to support the viability of the ESU.

Key aspects of Oregon's conservative hatchery management program are listed following.

- Numbers of hatchery coho are constrained in basins consistent with minimizing adverse impacts on wild fish.
- Hatchery programs are managed to limit the proportion of strays in natural spawning streams to within policy guidelines (<10%).
- Hatchery fish are released at hatcheries or at acclimation sites in order to reduce straying to natural spawning areas.
- All hatchery coho are marked, facilitating accurate determination of rearing origin of spawners in streams.
- Hatcheries are developing native-origin or local broodstocks.
- Water withdrawals for hatcheries are complying with applicable legal requirements.
- Hatchery effluent discharged into streams meets permit requirements.
- Improved design of barriers at several hatcheries is providing access by wild fish to spawning areas.
- Hatchery policy guidance is requiring monitoring, public involvement in planning, documentation of objectives and criteria, and periodic review to determine of future changes are warranted.

Oregon concludes that the *hatchery management* frameworks and policies currently in effect are sufficient to conserve the existing viability of the Coastal coho ESU in the foreseeable future.

Stream complexity

Oregon's viability analysis (Part 2) indicates that the ESU is viable. This conclusion, alone, is in fact the basis for asserting that current habitat conditions must therefore be sufficient (in quantity and quality) to support the ESU through a future period of adverse ocean, drought and flood conditions similar or slightly more adverse than the most recent period of poor survival conditions (most of the 1980s and 1990s). Oregon is not asserting that contemporary habitat is necessarily sufficient to achieve viability for every population within the ESU, because several populations failed to meet viability criteria.

Further, Oregon is not asserting that habitat supporting ESU viability is *optimum*. Oregon recognizes that contemporary habitats across the ESU reflect substantial loss of estuarine and wetland habitats, reduction in channel complexity, loss of large wood, degradation of riparian habitats and the like. The conservation and recovery planning process that is currently underway with Oregon, NOAA and stakeholder participation will explore the desirability of improving habitat conditions in specific geographic areas to increase population and ESU viability and production potential.

Management of habitat across Oregon has changed dramatically since the 1950s; these changes now establish a more risk-averse environment across the Coastal coho ESU. Key elements of a broad-based, protective habitat management program are listed following.

- The Northwest (Federal) Forest Management Plan
- Oregon's land use law
- Fill and Removal law
- Northwest Oregon Forest Management Plan
- Elliot State Forest Management Plan
- Agricultural Water Quality Management Area Plans
- Total Maximum Daily Load Plans
- Recent revisions to Oregon Forest Practices Rules
- Confined Animal Feeding Operation Program
- Pesticide Program
- Weed Control and Invasive Species Program
- Restoration efforts on state, federal, and private lands

Oregon concludes that the *habitat* management frameworks and policies currently in effect are sufficient to conserve the existing viability of the Coastal coho ESU in the foreseeable future. With only six years of data available for this assessment, the current ability to detect trends in habitat conditions is limited. However, the ability to detect changes in habitat will improve considerably within the next 3-8 years, as more data are available. The State must remain diligent in conducting future monitoring to detect any possible trends in stream complexity that may occur.

Fish passage (*See also* Part 4(J) OP TR 2. A Spatial Evaluation of Habitat Access Conditions and Oregon Plan Fish Passage Improvement Projects in the Coastal Coho ESU)

Fish passage inventory and restoration work has been extensive across the Coastal coho ESU since 1997 (as previously noted in this document). The analysis of fish passage data done as part of this Assessment will help the State focus future effective action regarding this risk factor. Collectively, actions to date plus the State's commitment to focus future fish passage restoration and inventory establish a strong risk-averse environment with regard to this risk factor. Collectively, management practices have reduced the potential for impaired fish passage to adversely affect viability of the Coastal coho ESU.

Oregon concludes that the *fish passage* management and restoration frameworks and policies currently in effect are sufficient to conserve the existing viability of the Coastal coho ESU in the foreseeable future.

Water Quality *(See also* Part 4(B) DEQ Water Quality Report)

Key elements of a broad-based, protective water quality management program are listed following. These programs, plus ongoing voluntary work to address legacy water quality

problems on state, federal, and private lands, should tend to conserve existing ecological conditions to conserve the existing viability of the Coastal coho ESU.

- Water Quality Standards
- Point Source Permits
- Non-point Sources
- Water Quality Monitoring
- Development of Total Maximum Daily Loads
- Implementation of Total Maximum Daily Loads
- Confined Animal Feeding Program rules
- Pesticides rules
- Agricultural Water Quality Area management Plans
- Soil and Water Conservation Districts
- Watershed Councils

Oregon concludes that the *water quality* management frameworks and policies currently in effect are sufficient to conserve the existing viability of the Coastal coho ESU in the foreseeable future.

Water Quantity (*See also* Part 4(I) OWRD Water Quantity Report)
Given that the ESU is currently judged to be biologically viable, we conclude that water quantity conditions in the ESU, although not ideal, are sufficient to sustain coho populations. Key elements of a broad-based, protective water quantity management program are listed following. These programs, plus ongoing nonregulatory actions work to address water quantity problems in priority areas should tend to conserve existing ecological conditions to conserve the existing viability of the Coastal coho ESU.

- Establishment of instream water rights
- Water distribution and regulation by priority date of water rights of record, including instream water rights
- Protection of instream water rights from injury during review of water right transfers
- Public interest review, water right conditions, and water allocation policy in considering new out of stream water uses
- Restoring streamflows occurs through voluntary instream lease agreements, voluntary instream transfers, and allocations of conserved water.

Oregon concludes that the *water quantity* management frameworks and policies currently in effect are sufficient to conserve the existing viability of the Coastal coho ESU in the foreseeable future.

SYNTHESIS – CREATING FUTURE CONDITIONS THAT FURTHER STRENGTHEN ESU VIABILITY AND SUPPORT ACHIEVEMENT OF BROAD OREGON PLAN OBJECTIVES

The intent of this section is to report Oregon's evaluation of management actions in relation to creating future conditions that will strengthen the *existing* viability of the ESU. As noted in the two previous sections of this document, Oregon concluded:

1. Historical factors for decline have been sufficiently addressed by a broad-based set of environmental protection laws and programmatic work.
2. The same broad range of environmental protection laws and programmatic work is sufficient to conserve the *existing* viability of the ESU.

The remainder of this section summarizes Oregon's evaluation regarding whether additional focused conservation action would be expected to strengthen future ESU viability. This evaluation is organized by the following risk factors: ocean conditions, fishery harvest, hatchery impacts, stream complexity, fish passage, water quality, and water quantity; additional information is considered in relation to 1) abundance and distribution of coho in the ESU and 2) conservation and restoration delivery mechanisms.

Ocean Conditions

Additional focused action is not required to strengthen future ESU viability. This risk factor exerts strong influence on life-cycle survival; however, Oregon is unable to directly alter this environmental condition through management action. The State's management response to this risk factor consists of implementing conservative management that directly affects all other risk factors (e.g., fishery harvest, hatchery impacts, stream complexity, etc.).

Fishery harvest

Additional focused action is not required to strengthen future ESU viability. This factor for decline has been addressed effectively. The present harvest regulation matrix also provides sufficient protection to conserve existing ESU viability and is consistent with strengthening future ESU viability by continuing to manage harvest.

Hatchery Management

Additional focused action related to hatchery impacts would be expected to strengthen future ESU viability. This factor for decline has been addressed effectively in all but two of the populations that comprise the Coastal coho ESU. Oregon's current hatchery management policies provide sufficient protection to conserve existing ESU viability and are consistent with strengthening future ESU viability. Opportunities still exist to alter hatchery programs in a small number of basins. Managers and stakeholders will consider possible programmatic responses that could effectively strengthen viability of specific populations in the ongoing conservation planning process.

Habitat (Stream complexity)

Additional focused action related to stream complexity would be expected to strengthen future ESU viability. Existing regulatory programs and implementation of a comprehensive restoration effort have addressed this factor for decline sufficiently; however, the relative scarcity of stream complexity (high quality habitats that support over-wintering juvenile coho) dictates continued vigilance and maintenance of conservation and restoration work to increase the future availability of these habitats.

Opportunities exist to focus restoration work on stream complexity in several basins where populations failed viability criteria and in many populations that are currently viable.

1. Regulatory programs currently in place are likely to create improved habitat conditions (more stream complexity) on federal, state, and private lands.

2. Restoration on all land ownerships is also likely to increase availability of stream complexity. Restoration investments in the Coastal coho ESU during 1997-2003 are summarized in Figure 4 and may be viewed on the internet by population unit at: http://mtjune.uoregon.edu/website/OWEB/Assessment. Restoration investments to date: (1) have primarily addressed sediment delivery to streams (roads), fish passage, and stream complexity (riparian and instream), (2) have been supported by private, federal, and state funds in nearly equal proportions, (3) and have been well distributed across the ESU throughout the post-1997 Oregon Plan era.

Oregon's broad-based restoration program is an effective tool to address primary and secondary *population bottlenecks* that were identified for the vast majority of the independent populations in the ESU (e.g., stream complexity and water quality were the most commonly identified bottlenecks to these coho populations). Stream complexity was identified as the primary risk factor bottleneck for four populations that did not pass viability criteria. For these populations in particular, (Tillamook, Siletz, Alsea, and Sixes) future restoration investments should be prioritized to improve the availability of complex stream habitat used by over-wintering coho. Oregon may also consider whether or not to prioritize restoration investments in basins where populations did not pass criteria over restoration in basins where populations did pass viability criteria. On one hand, restoration to bring populations from failing to passing status would seem to be the most direct approach to strengthening ESU viability. On the other hand, restoration in populations that currently pass criteria, if directed to primary bottlenecks would also strengthen ESU viability. The conservation/recovery planning process currently underway with NOAA and stakeholder participation will be able to consider alternative future approaches to prioritize restoration that are consistent with an overall strategy of strengthening the existing viability of the ESU.

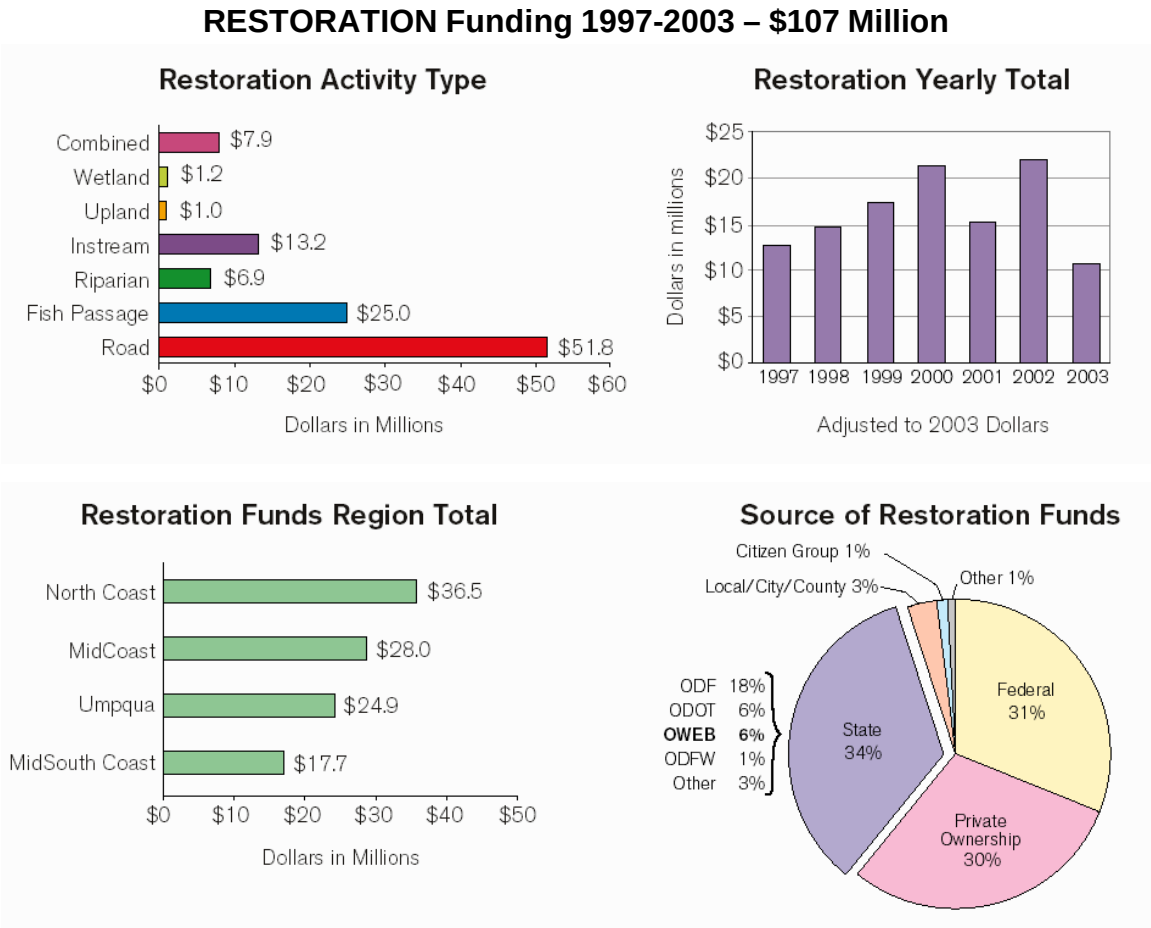

Figure 4. Restoration funding data for the Coastal coho ESU. (*Source*: OWEB Restoration Database and federal Regio nal Ecosystem Office. *See also* maps by population: http://mtjune.uoregon.edu/website/OWEB/Assessment).

Fish Passage (culverts)

Additional focused action related to fish passage would be expected to strengthen future ESU viability. Oregon's analysis indicates that access by coho may be somewhat impaired within 10% of the species distribution within the ESU; and that the condition of passage structures allowing access to ~30% of the species distribution is not clearly documented. Oregon concludes that the restoration work done during 1997-2004 to improve fish passage has made substantial progress in resolving concerns related to this risk factor. Presently, *impaired fish passage* is identified as a low level of risk to ESU viability and is not a primary risk factor for any populations in the ESU. Future restoration work should focus on (1) documenting the fish passage status of the culverts that have not been surveyed or lack sufficient documentation and (2) providing passage preferentially above culverts that impair passage to streams that will immediately provide high quality, complex over-winter habitat.

Water quality

Additional focused action related to water quality would be expected to strengthen future ESU viability. Current regulatory and programmatic elements of Oregon's water quality program provide sufficient protection to conserve and strengthen existing ESU viability. AWQMPs and forest practices are monitored and will be adjusted based upon adaptive management principles. New actions should focus on site-specific issues and those populations identified with potential water quality threats. As noted previously, restoration work should probably be directed toward both the primary and secondary population bottlenecks (*See also* Applying Bottleneck Determinations to Restoration Prioritization in this document). This conclusion also recognizes that programmatic and restoration work to address water quality across the ESU is likely to support conservation and creation of stream complexity.

Water quantity

Additional focused action related to water quantity would be expected to strengthen future ESU viability. Current regulatory and restoration elements of the WRD water quantity program provide sufficient protection to conserve existing ESU viability. Improvements in water management that produce increased streamflow in the Middle and South Fork Umpqua population would directly target strengthening viability of these two specific populations. WRD conservation and restoration efforts will be responsive to the conclusions of Oregon's determination of population bottlenecks and will provide increased emphasis on this population. Other opportunities may also exist at local spatial scales for water conservation or restoration to strengthen the existing viability of the ESU. The conservation and recovery planning process currently underway may consider these opportunities as are identified.

Abundance and Distribution of Coho in the ESU

Additional focused action related to abundance and distribution of coho across the ESU is not required to strengthen future ESU viability. When the Oregon Plan was being developed and the Coastal coho ESU was first proposed for ESA listing, the abundance and density (number of spawning fish per mile of stream) of coho that were observed during the mid 1990s was a matter of serious concern. However, nearly all of the populations appeared to have *stabilized at low levels* during that extended period of poor ocean survival; and then increased rapidly when the ocean environment improved coho survival in the late 1990s.

This rapid improvement in abundance was essentially an order of magnitude increase from around twenty thousand spawners to over two hundred thousand spawners in 2002 and 2003. The increase in wild coho occurred throughout the ESU with only 1 of 21 populations (the upper Umpqua) obviously lagging. This rapid and ESU-wide response in abundance was somewhat unexpected – previous population modeling had indicated that improvements in abundance would occur more gradually after the ocean environment improved. Average abundance of wild coho spawners in the ESU during 2001-2003 was greater than the average for any of the previous five decades (Figure 5). These observations offer encouraging signs that the ESU retained considerable resilience

and inherent productivity through the period of extended low spawner abundance that extended from the 1950s through the late 1990s and support the conclusion that the viability of the ESU was not as precarious as was perceived in the mid- to late 1990s after significant changes to harvest and hatcheries, but before the ocean environment improved.

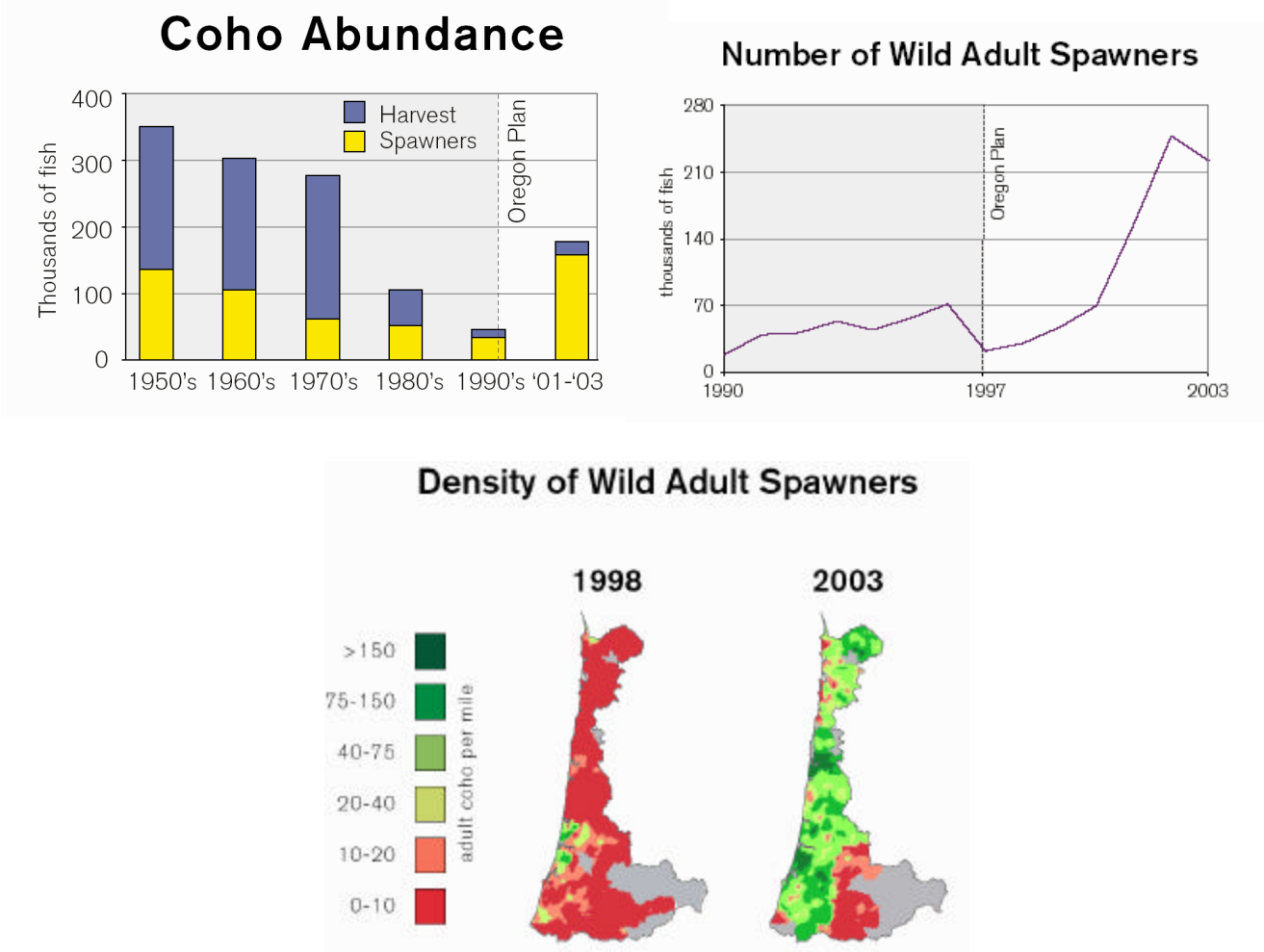

Figure 5. Adult coho abundance and spawner escapement during the past five decades and spawner distribution patterns resulting from unfavorable (1998) and favorable (2003) ocean conditions (*Source*: ODFW unpublished data; Coastal Salmonid Inventories Project).

These observed improvements in abundance and distribution of spawners in the Coastal coho ESU, in context with performance prior to and during the recent period of adverse ocean survival, provide a basis for viability analysis and suggest the ESU is more resilient than previously recognized. The improved densities and distribution of coho spawners in recent years should result in improved inputs of marine nutrients derived from coho carcasses. Recent levels of marine nutrient input from coho carcasses are likely lower than historical levels (compared to pre-development coho populations), however, current marine nutrient input has improved considerably over nutrient levels during the last five decades.

Oregon concludes that the recent abundance and distribution of coho spawners across the ESU supports optimism that the ESU will remain viable. Monitoring programs would promptly detect a decline in number and distribution of coho in populations across the ESU.

Conservation and Restoration Delivery Mechanisms

Additional focused action related to conservation and restoration delivery mechanisms is not required to strengthen future ESU viability. Oregon currently possesses both regulatory and non-regulatory programs and funding necessary to implement a broad based effort to both maintain and strengthen the current viability of the Coastal coho ESU under the Oregon Plan for Salmon and Watersheds. The Oregon legislature has enacted several pieces of legislation that codify the Oregon Plan. The state agencies that participate in the Oregon Plan have the legal and regulatory authority, resources, authorizations, staffing, and commitment to carry out their conservation efforts. A broad range of Oregon laws supports Oregon Plan conservation efforts. Key laws are listed in Table 7. A diverse and long-standing body of laws strongly supports Oregon's judgment that the current viability of the ESU will be protected in the future.

Table 7. Oregon statutes (laws) related to and included in the Oregon Plan under SB945.

Statute	Topic
196.105 to 196.125	Columbia Gorge Protection
196.600 to 196.905	Wetlands
197	Land Use Planning Coordination
274	Submerged & Submersible Lands
366	State Highways
390	State & Local Parks; Recreational Programs; Scenic Waterways; Recreation Trails
465,466, 468 and 468b	Hazardous Waste & Materials; Environmental Quality; Water Quality
469.300 to 469.563, 469.590 to 469.619, 469.930 and 469.992	Regulation of Energy Facilities
477	Fire Protection of Forests & Vegetation
496, 497, 498, 501, 506, 507, 508, 509, and 511	Fish & Wildlife Laws
517.702 to 517.989	Mineral Exploration
527.310 to 527.370, 527.610 to 527.770, 527.990 (1) and 527.992	Insect & Disease Control; Forest Practices
530	Acquisition & Development of State Forests
536 to 543A	Water Resources Administration, Watershed Enhancement
543A.005 to 543A.415	Hydroelectric Projects
568.210 to 568.808 and 568.900 to 568.933	Soil & Water Conservation Districts, Agricultural Water Quality Management Program

Oregon also has established an 8-year track record of implementing the Oregon Plan, ranging from supporting watershed councils (Table 8), funding restoration (Figures 4 and 6), conducting monitoring, reporting the results of independent scientific oversight by the IMST, and improving state management programs based on new data and the conservation needs of the ESU. This track record is substantive and broad based, and offers strong evidence that the state will continue to implement the Oregon Plan as

currently defined in statute. Oregon has a reliable long-term source of funding for restoration under Ballot Measure 66, including a review to consider funding The Oregon Plan after 2014.

Table 8. Watershed councils in the Coastal coho ESU.

Monitoring Unit	**Watershed Council**
North Coast	Necanicum, Lower Nehalem, Upper Nehalem; Ecola; Tillamook Bay; Nestucca-Neskowin
Mid Coast	MidCoast Council, including Salmon, Drift Creek, Yaquina, Alsea, Siletz; Siuslaw
Umpqua	Umpqua; Elk; Smith
Mid-South Coast	Tenmile Lakes; Coos; Coquille; Floras/New; and Elk-Sixes

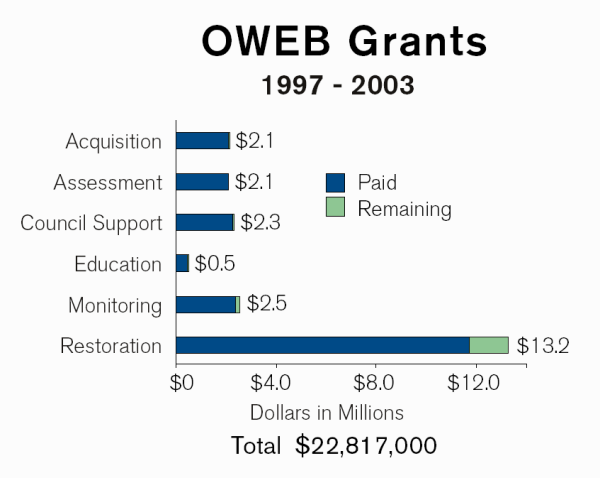

Figure 6. Funding commitment of the Oregon Watershed Enhancement Board (OWEB) to support conservation and restoration efforts in the Coastal coho ESU, 1997-2003. In context with previously provided information on restoration within the ESU, this shows that OWEB has provided roughly 10% of the funding for restoration in the ESU (*Source*: Oregon Watershed Enhancement Board Grants Program Fiscal Database).

Examples of the diverse array of mechanisms to deliver restoration public and private lands in the Coastal coho ESU are listed following.

- ***Local Watershed Councils (LWC)*** **–** In 1993, Oregon created an LWC program under House Bill 2215. Since that time approximately 95 watershed councils have formed across the state. In the Coastal coho ESU there are 16 councils currently in existence as shown in Table 2. Watershed councils are well distributed across the Coastal coho ESU and the functionally independent populations within each of the 4 Monitoring Units in the ESU.

- ***Soil and Water Conservation Districts (SWCDs) –*** Oregon's 45 Soil and Water Conservation Districts (SWCDs) are organized under Oregon Revised Statutes (ORS) Chapter 568 and are governed by an elected board of directors who serve without pay. SWCDs identify and address natural resource concerns within their respective boundaries and work with local, state, federal and private interests to deliver conservation services. SWCDs provide direct technical assistance to landowners to plan, design, survey, and implement conservation practices and systems. The coastal SWCDs include Clatsop, Coos, Curry County, Lincoln, Siuslaw, Tillamook County, and Umpqua SWCDS. SWCDS effectively address riparian condition, sediment, water temperature, pH, dissolved oxygen, bacteria, and excessive nutrients from agricultural and rural lands.

- ***ODFW Western Oregon Stream Restoration Program –*** This program provides trained fish biologists to assist private landowners in the design and accomplishment of restoration work. The Program is described in a separate report provided as part of this overall assessment (*See* Part 4(C) ODFW (9) Western Oregon Stream Restoration Program). Work accomplished is reported to the OWEB restoration database and is summarized as work accomplished in this ESU.

- ***Federal Lands Restoration Program –*** Restoration work on federal lands consists of both passive and active restoration work. Specifically, the Riparian Reserve program as part of the Key Watershed Program contributes passive restoration of watershed function that supports the sustainability of the Coastal coho ESU. Active restoration on federal lands in this ESU is also provided by activities that include placement of wood, culvert improvements, and road upgrades and de-commissioning. The contribution of restoration work on federal lands is described in a separate report provided as part of this overall assessment (*See* Part 4 (E) Federal Forest Management). Work accomplished is reported to the federal IDRIS restoration database and shared with OWEB.

- ***State Lands Restoration Program –*** Restoration work on state lands consists of both passive and active restoration work. Active restoration on federal lands in this ESU is provided by activities that include placement of wood, culvert improvements, and road upgrades and de-commissioning. The contribution of restoration work on state lands is described in a separate report provided as part of this overall assessment (*See* Part 4(D) Chapter A2 State Forests Program). Work accomplished is reported to the OWEB restoration Database and is summarized as work accomplished in this ESU.

- ***Private Landowner Initiative*** – Private landowners voluntarily funded roughly one-third of the reported restoration in the ESU during 1997-2003. Landowners initiated and conducted restoration independently, or in partnership with watershed councils, SWCDs, or government programs.

SYNTHESIS – MONITORING TO DETECT FUTURE TRENDS AND SUPPORT ADAPTIVE MANAGEMENT

The intent of this section is to describe Oregon's monitoring program and explain how it will permit the State to detect future changes in the status of the ESU or the management or habitat conditions that currently support viability of the ESU.

Monitoring context

Oregon has made significant investments ($16 million, 1997-2003) in new and enhanced monitoring of fish, habitat, and water quality since the initiation of the Oregon Plan (Figure 7). Monitoring implemented in 1997 to evaluate status and trend in fish abundance, habitat and water quality across the Coastal coho ESU provided essential data to conduct this assessment.

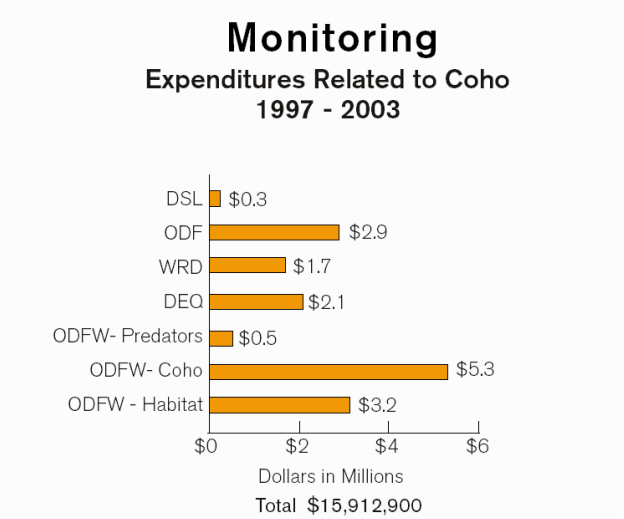

Figure 7. Monitoring expenditures by state agency programs in the Oregon Coastal coho ESU, related to coho salmon, 1997-2003. These values do not include monitoring by federal agencies, private landowners, or watershed councils. (*Source*: Unpublished responses to enquiry posed to state agencies participating in the Oregon Coastal coho ESU Assessment)

These key subjects of Oregon's monitoring effort are detailed following.

- Fishery harvest
- Hatcheries
- Coho
- Habitat
- Watersheds Research Cooperative
- Headwaters Research Cooperative (OHRC)
- Forest Practices Program Monitoring
- Restoration
- Watershed assessments
- Fish passage
- Water quality

- Water Quantity
- Abundance and distribution of coho within the ESU
- Ocean conditions

Fishery Harvest Monitoring (ODFW)
An extensive system exists to monitor the direct and indirect mortality of coho salmon caused by commercial and recreational fisheries along the western coast of North America. Monitoring is conducted by states, coordinated through the PFMC. In Oregon, commercial and recreational landings occur in five major catch areas including twelve individual ports. Port sampling is conducted via an established sampling plan using a stratified random design. Samplers gather biological data, coded-wire-tags, catch composition, and catch. Harvest in freshwater fisheries is monitored through angler catch-record cards with some creel census data available for some basins/areas. Oregon recreational anglers are required to record all salmon or steelhead on a catch-record card and return the completed card to ODFW at the end of the year. Harvest of non-hatchery coho salmon has not been permitted in Oregon estuaries or coastal rives since the mid 1990s. No commercial fishery catch occurs in freshwater.

Hatchery Monitoring (ODFW)
ODFW's Fish Hatchery Management Policy requires monitoring and evaluation to evaluate success meeting hatchery program and fish management objectives, improve understanding of the reasons for success or failure, evaluate impacts of the hatchery program on naturally produced native fish, contain impacts of hatchery programs within policy limits, and support adaptive management. Each hatchery program management plan describes how operations and objectives will be monitored and evaluated. Monitoring and evaluation programs use generally accepted scientific procedures and gather information to evaluate hatchery programs relative to measurable criteria.

Coho Monitoring
Coho Spawner Monitoring (ODFW)
ODFW's Coastal Salmonid Inventory Project conducts "standard" and "probabilistic" surveys to monitor the abundance and distribution of wild and hatchery coho spawning in streams in the ESU. Standard surveys are conducted annually at sites selected 30-50 years ago. While these sites were not chosen at random, they do provide the best long-term information on coho population trends in the ESU. Probabilistic survey sites are selected randomly across the ESU and can be used to statistically describe the status and trend of coho spawners down to the scale of independent and potentially independent coho populations units within the ESU.
http://oregonstate.edu/Dept/ODFW/spawn/index.htm

Juvenile Fish Monitoring (ODFW)
ODFW's Western Oregon Rearing Project conducts "probabilistic" surveys to provide statistically rigorous information on the abundance and distribution of juvenile coho in the ESU. Surveys are primarily conducted by snorkel count, with electrofishing used in situations necessitated by poor underwater visibility.
http://oregonstate.edu/dept/pacrim/index.htm

Marine and Freshwater Survival Monitoring (ODFW)
ODFW's Life Cycle Monitoring Project traps upstream migrating adult and downstream migrating juvenile coho at five sites in the ESU. This information is used to monitor trends in freshwater and marine survival rates of naturally spawning fish in the ESU.
http://oregonstate.edu/Dept/ODFW/life-cycle/index.html

Habitat Monitoring (ODFW)
Since 1998, ODFW has conducted a monitoring program designed to provide unbiased, statistically rigorous data on instream physical habitat condition, riparian condition, and geomorphic characteristics of streams at the scale of the ESU and four Monitoring Areas within the ESU. ODFW habitat surveys are designed to assess habitat in all wadeable streams within the distribution of coho in the ESU. Specifically, the sample frame is derived from 1st through 3rd order streams coho bearing streams depicted on a 1:100,000 scale digital hydrography layer developed by the USGS. Streams above dams that block anadromous fish passage are removed from the selection frame. The sample plan protocol results in a pool of random, spatially balanced sites across the landscape, thereby reducing potential site selection bias. Roughly 10 percent of the sites per year in each monitoring area are resampled by a separate two-person crew to measure variation within season and crew variation crews in four monitoring areas in the ESU.
http://oregonstate.edu/Dept/ODFW/freshwater/inventory/index.htm

Federal Forest Aquatic Riparian Effectiveness Monitoring Plan (AREMP)
The USFS and BLM are conducting monitoring to assess progress toward the Northwest Forest Plan's Aquatic Conservation Strategy objectives across the Northwest Forest Plan area. The Aquatic Riparian Effectiveness Monitoring Plan (AREMP) was approved in March 2001 and published in 2004. Under the AREMP, the condition of various watersheds across the Northwest Forest Plan area will be evaluated. Over time, AREMP will assess trends in watershed condition. Parameters measured include channel condition, riparian condition, and upland condition. The results of this work are broadly applicable to federal forestland in the Coastal coho ESU.

State Managed Forest Lands Monitoring (ODF)
The State Forests Program conducts extensive monitoring to evaluate effectiveness and implementation of the integrated resource management strategies described in the Northwest and Southwest Forest Management Plans. Monitoring includes: (1) road systems, (2) watershed scale effectiveness, and (3) effects analysis. The State Forests Program is currently involved in a collaborative effort with Private and Community Forests Program to evaluate site-scale effectiveness of riparian and aquatic strategies.
www.odf.state.or.us.
http://www.odf.state.or.us/divisions/protection/forest_practices/fpmp/default.asp

Watersheds Research Cooperative
The Watersheds Research Cooperative (Oregon State University Colleges of Forestry and Agriculture) is implementing paired watershed studies evaluating the effects of modern forest practices (e.g., harvesting and roads) on physical and biological watershed characteristics. A paired watershed project at Hinkle Creek is already well underway

and two replicates are planned to be located elsewhere. These studies are designed to address two key questions: (1) what are the effects of contemporary forest practices on water quality and aquatic habitat in headwater or non-fishbearing streams, and (2) what are the direct and cumulative effects of timber harvesting in headwater basins on fish populations downstream?

Headwaters Research Cooperative (OHRC)

The Oregon Headwaters Research Cooperative is a broad coalition of agencies, associations, and corporations that share an interest in research regarding small, generally non-fish bearing streams commonly referred to as "headwater" streams. The OHRC seeks participation from state and federal agencies, private industry, and non-governmental organizations in Oregon. The purpose of the OHRC is to investigate local and downstream effects of forest management on biota and habitat characteristics of headwater stream systems. The goals of the research cooperative are: (1) to gain scientific understanding of the physical and biological processes of headwater stream systems; and (2) to test the local and downstream response of headwater streams to a range of forest management prescriptions.

Forest Practices Program Monitoring

Over the years, the Forest Practices Act rules have adapted in response to improved knowledge about interactions between forest management and resource protection. The FPMP objective is to evaluate forest practices on private forestland and coordinate with research and monitoring at the state and national level. The focus of the monitoring efforts are currently on evaluating riparian protection and water temperature interactions, impacts of headwater streams on downstream wood and temperature functions, and data collection related to recently proposed changes to forest practices.

Restoration Monitoring

OWEB and Federal Restoration Databases

The OWEB Restoration Database and the federal restoration reporting systems provide data on restoration work accomplished. Data available include spatial location of work, type of work done, cost of work done, source of funds to do the work, amount of work done (miles of stream bank treated, miles of instream structure treated number of culverts replaced, and so on).

ODFW Western Oregon Habitat Restoration Program

Stream habitat restoration monitoring is used to track change that occurs as a result of stream enhancement projects. Types of enhancement activities include in-stream wood and boulder placement, construction of off channel ponds, culvert replacement and bridge placement, conifer and hardwood riparian plantings, fencing and livestock management, removal of artificial barriers, and road decommissioning. Monitoring of restoration activities consist of pre-treatment and post-treatment assessments of stream conditions using the methods of the ODFW's Aquatic Inventories Project.
http://oregonstate.edu/Dept/ODFW/freshwater/inventory/restoratn.htm

Watershed Assessments

Watershed assessments are a fundamental basis for the conduct of effective restoration work. When the Oregon Plan was first implemented in 1997, assessments had been completed for about 30% of the ESU. At the time of this report (2004) assessments have been completed for about 97% of the ESU. These assessments have employed OWEB protocols or federal assessment protocols (on federal lands), and watershed action plans have been completed for all of the watersheds in the ESU except the Tillamook Basin.

Fish Passage

An extensive database of information related to fish passage has been compiled as part of the Coastal coho ESU Assessment. The database includes the location and condition of fish passage structures (culverts, road crossings) on county roads, state highways, private roads, state forest lands, and federal forest lands, plus information regarding fish passage improvements implemented since 1997 on public and private lands. This database has been a key element in Oregon's evaluation of fish passage improvement status, accomplishments, and future needs.

Water Quality Monitoring

Probabilistic Survey Water Quality Monitoring (ODEQ)

ODEQ conducts monitoring in the ESU using a probabilistic approach to describe water quality conditions on a regional basis. The probabilistic monitoring design allows for an assessment of the status of water quality conditions of wadeable, 1st through 3rd order streams, across the entire Coastal coho ESU and within subunits (four monitoring units and five land use categories) of the ESU for which sufficient data were collected. Because of the random site selection design, the results from individual sites can be used to estimate the status of all wadeable stream miles within the ESU and subunits with a known level of confidence.

Ambient Site Water Quality Monitoring (ODEQ)

ODEQ maintains a statewide network of more than 130 ambient water quality monitoring stations; 31 of these sites are located within the Coastal coho ESU. These sites are located on larger non-wadeable streams (4th order and larger), and are typically sampled for long-term water quality status and trending. Sites were selected to represent conditions at the lower ends of major watersheds or basins. The water quality variables measured at these sites are temperature, dissolved oxygen (percent saturation and concentration), biochemical oxygen demand, pH, total solids, ammonia and nitrate, total phosphorus, and bacteria (E. coli).

TMDL Monitoring (ODEQ)

Under the federal Clean Water Act, Oregon is required to calculate pollution load limits, known as Total Maximum Daily Loads (TMDLs), for each pollutant entering a body of water for those waterbodies on the State's 303(d) List. TMDLs describe the amount of each pollutant a waterbody can receive and still not exceed water quality criteria in accordance with Oregon's water quality standards. ODEQ reviews existing data and conducts monitoring to determine what pollutant is causing water quality problems and in what amounts it is entering the water.

Water Quantity Monitoring

As required by Oregon Revised Statute (ORS) 537.099, WRD monitors and reports "water use" by instream water rights (ISWRs) in regular reports to the Water Resources Commission. There have been up to 35 continuous recording streamflow gages operated by WRD or the US Geological Survey (USGS) that measure streamflows at instream water right locations within the Oregon Coastal coho ESU. Published streamflow data for these sites is available on the Department's website at**:**
http://www.wrd.state.or.us/OWRD/SW/index.shtml#Surface_Water_Data

Ocean Conditions Monitoring

This risk factor *Ocean Conditions* exerts strong influence on life-cycle survival; however, Oregon is unable to directly alter this environmental condition through management action. The State's management response to this risk factor consists of implementing conservative management that directly affects all other risk factors (e.g., fishery harvest, hatchery impacts, stream complexity, fish passage, etc.).

Survival of coho returning to Oregon hatcheries has been monitored for decades, and survival of wild coho has been estimated at several life-cycle monitoring sites throughout the ESU since 1998. Data from these distinct sources support a conclusion that the ocean environment exerts a very strong influence on returns of coho salmon. The ocean was relatively favorable to coho survival during the 1950s and 1960s, and then became very unfavorable to coho survival during the late 1980s and 1990s. This period of harsh ocean environment was indicated by very poor returns of hatchery fish and low abundance of wild coho. The ocean environment became much more favorable to survival of both hatchery and wild coho in the late 1990s, coinciding with initial implementation of the Oregon Plan (Figure 8).

The recent survival shift supported by favorable ocean conditions has allowed us to document a positive response by wild coho (that were at very low levels of abundance and spawner density in the ESU) to levels that have not been observed for the last five decades (Figure 5). Whether ocean conditions will remain favorable for one or more decades, as has apparently been the regional pattern, or become adverse again shortly, is a matter that cannot be reliably predicted. However, the recent performance of the Coastal coho ESU lends confidence that the ESU, which it at higher average levels of spawner escapement than during the last five decades, will be capable of maintaining viability during a future period of poor ocean environment similar or slightly more adverse than the 1990s.

Future declines (of unknown duration and severity) in the ocean survival of coho salmon are expected; however, future declines in ocean survival of the coho ESU would be detected at hatcheries, response of wild fish would be detected at life-cycle monitoring sites and in spawning areas, and appropriate management responses *(harvest regulations are especially important, see the next section for a discussion)* could be implemented to manage impacts of fisheries consistent with the conservation of the ESU.

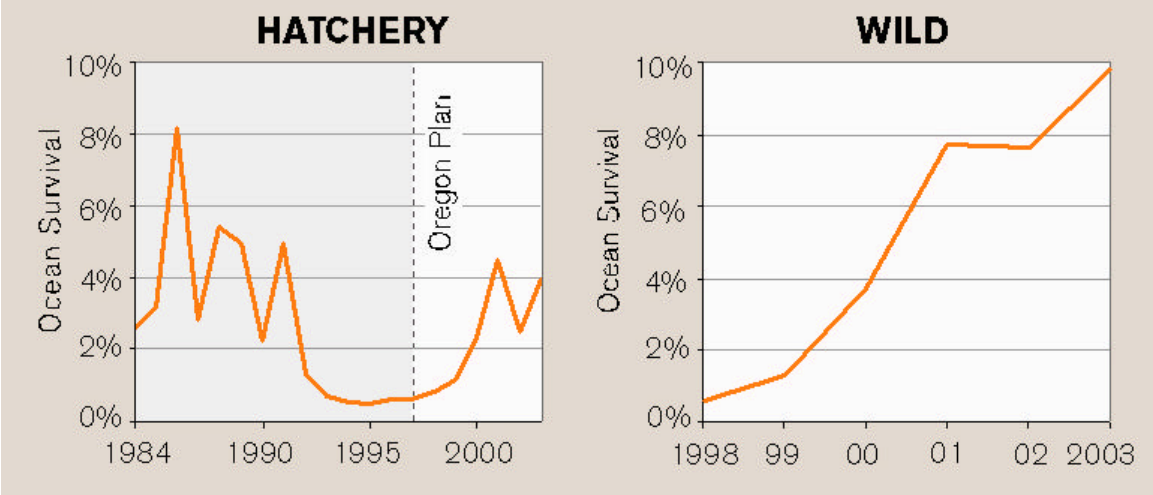

Figure 8. Survival of hatchery and wild coho salmon is strongly influenced by ocean conditions. The graph at left represents an average survival for all coho returning to Oregon hatcheries; the graph at right represents an average survival of wild coho returning to 5 life-cycle monitoring sites in the ESU. Year indicates year of return. (*Source*: ODFW unpublished data; personal communication Tom Nickelson)

Other Elements of Oregon's Monitoring Effort

In addition to the key elements of Oregon's monitoring efforts noted above, a diverse set of monitoring programs and efforts provide additional information that allow Oregon to assess of environmental and management conditions that could affect future viability the Coastal coho ESU. The following list includes the more prominent of these efforts and notes the entity conducting the monitoring.

- Riparian conditions (ODA)
- Water quality (volunteers)
- Pesticide law compliance (ODA)
- Forest practice rule compliance (ODF)
- Fish presence/absence surveys (ODFW and
- ODF)Confined animal feeding operation program requirements (ODA)
- Monitoring by Watershed Councils and Soil and Water Conservation Districts
- Dredge, fill, and inwater construction (ODSL)
- Streamflow (OWRD)
- Fish disease (ODFW)
- Predator abundance trend and impacts (ODFW)
- Exotic Fish (ODFW)
- Scientific and educational take (ODFW)
- Illegal take and habitat violation (OSP)

Future Monitoring Needs

This assessment has initiated extensive re-examination of monitoring plans, data storage and analysis systems, and processes for integrating analyses and sharing information among agencies and watershed councils. The recent definition of ESU population structure by the NOAA Fisheries TRT poses unanticipated challenges to the Monitoring Plan established when the Oregon Plan was initiated. Overall, the assessment has provided stimulus to improve sampling design and enhance future multi-disciplinary analytical efforts. Oregon is in the process of implementing four refinements to the existing broad based monitoring and analysis effort in the Coastal coho ESU.

1. OWEB is in the process of developing an effectiveness monitoring plan. Monitoring implemented as a result of this plan will be funded from a combination of sources including OWEB, NOAA Fisheries, BLM, and USFS.
2. Much of the monitoring of fish, habitat, and water quality in the ESU is currently designed at the spatial scale of Monitoring Areas rather than populations or population strata. At the conclusion of this assessment, Oregon will examine the possibility of modifying monitoring sampling plans to provide estimates at finer spatial scales, consistent with the current understanding of ESU population structure.
3. Oregon has established an Internet based *Data Library* to house and distribute data and information related to this coho ESU assessment. The goal is to improve Oregon's information archiving and retrieval capability by developing a tool based on the Coastal coho ESU assessment – a tool that can be applied statewide in the future.
4. ODFW, ODEQ, and statisticians at Oregon State and Colorado State University are conducting a review of the statistical needs of monitoring conducted under The Oregon Plan. The results of this review will include a development of needed statistical tools and will be published in a special issue of the journal Environmetrics.

Summary Conclusion – Monitoring

Considering Oregon's extensive array of monitoring effort in the Coastal coho ESU, it is unlikely that conditions currently supporting viability of the ESU could change so rapidly as to preclude future, timely detection and protective action under state and federal management programs.

SYNTHESIS – EVALUATING CURRENT THREATS TO ESU VIABILITY

The Coastal coho ESU Assessment has provided Oregon an opportunity to evaluate current threats to ESU viability. This re-evaluation is based on a broad review of scientific data, programmatic implementation, and policy analysis. Oregon's analysis of threats to ESU viability was organized around the factors for decline identified as part of the initial NOAA status review and decision to list this ESU under the federal Endangered Species Act. The preceding sections of this document provide a basis for the threat level determinations that are presented in this section. Determination of current threats to ESU viability required a progressive deliberation for each risk factor that sequentially considers three elements of Oregon's coho Assessment.

1. Oregon's finding that the ESU is viable.
2. Oregon's identification of population bottlenecks.
3. Oregon's evaluation of management and restoration programs that address historic *Factors for Decline* and create future conditions intended to conserve or improve ESU viability provide overall context for threat determinations.

Threat level determinations were established by consensus of principle members of Oregon's Assessment Team.

Previous Threats to ESU Viability

Oregon recognizes that many risk factors (*Factors for Decline*, *see* Table 4) have caused an erosion of the Coastal coho ESU viability during the last two centuries. It is instructive to reflect on levels of threat to ESU viability that were being discussed when the species was first listed in 1997 and when the listing was again being evaluated in 2003. Threat levels that were implied in NOAA documents (Table 9) were not based on a formal analysis of ESU viability.

Table 9. Oregon's interpretation of NOAA's threat determinations in 1997 and 2003. Oregon conferred with NOAA to verify that these are fair representations of NOAA's determinations.

Risk Factor (*Also*: Factor For Decline)	**1997 Threat to ESU Viability**	**2003 Threat to ESU Viability**
Ocean Conditions	High	Moderate
Fishery Harvest	High	Low
Hatchery Impacts	High	Low
Habitat (Stream complexity)	High	High
Fish Passage	High	Low
Water Quality	High	Low
Water Quantity	Moderate	Low
Other factors: toxics, DO, hydro power, disease, exotic fish interactions, predation, etc.	Low	Low
***Source of 1997 threat level*:** NMFS 1997. Status Review Update of Coho Salmon from the Oregon and Northern California Coasts. West Coast Coho Salmon Biological Review Team. March 28, 1997. 101 p. Available on the Internet at: http://www.nwr.noaa.gov/1salmon/salmesa/pubs/sru970403.pdf ***Source of 1997 threat level*:** NMFS 2003. Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead. West Coast Salmon Biological Review Team. July 2003. Available on the Internet at: http://www.nwr.noaa.gov/AlseaResponse/20040528/brtusr.html		

The change in perceived threats to ESU viability in 2003 versus 1997 reflected three key thoughts.

1. NOAA concluded that Oregon had effectively altered harvest & hatchery management programs to address these two factors for decline.
2. NOAA noted that coho survival rates and escapement had demonstrated positive improvements.
3. NOAA still had significant concern regarding the potential impact of an adverse marine environment and degraded (and possibly still deteriorating) stream complexity conditions in freshwater rearing environment.

Current Threats to ESU Viability

Oregon provides the following rationale for assigning current relative risk level associated with key risk factors.

Risk Factor: *Ocean conditions*.

Oregon's 2005 risk level determination: *Moderate.*

Rationale: Oregon's rationale starts from a finding that the ESU is currently viable. Oregon also recognizes that the ocean environment exerts a very large influence on life-cycle survival of coho salmon and that the ocean environment has and will continue to cause cyclic and annual variation in coho survival. Persistence modeling predicts that future downturns in ocean survival of greater duration than observed between 1950 and 2000 would not significantly impair ESU viability, but ESU viability may be in doubt if survival is more than 15% worse than has been observed. Oregon does not have reliable predictions regarding the relative effect of future ocean conditions, but recognizes the significance of the ocean environment on ESU viability. Extensive coho population monitoring is in place and will be able to detect annual variation in adult spawner numbers and rearing juvenile densities. Thus, Oregon would be able to detect future declines in coho across the ESU and will be able to weigh appropriate management response to declines, including future listing under Oregon or federal Endangered Species laws.

Oregon now therefore assigns a *moderate threat-level* to this risk factor in recognition of the great influence ocean environment exerts on coho, the inability to directly affect the risk factor, and uncertainty regarding future ocean conditions that may actually occur.

Risk Factor: *Fishery harvest*.

Oregon's 2005 risk level determination: *Low*.

Rationale: Oregon's rationale starts from a finding that the ESU is currently viable. Oregon also recognizes fishery harvest and related mortality is potentially capable of exerting a very large influence on life-cycle survival of coho salmon. Harvest related mortality on the Coastal coho ESU was clearly greater than the species could sustain during several decades before the mid 1990s. The current fishery management regime is regulated by PFMC and both Oregon and NOAA participate in the fishery management process. The Coho harvest matrix defined under PFMC Amendment 13 is constructed to

provide protection to the coho ESU under adverse ocean and population conditions. This fishery management matrix is in place to protect the ESU from excessive harvest related mortality during any future periods of poor ocean survival or population performance. Extensive coho population monitoring is in place that is considered in ocean fishery and harvest level setting.

Oregon now therefore assigns a *low threat-level* to this risk factor in consideration of the State's conclusion that the ocean and in-river fishery management processes are currently consistent with conserving and recovering the ESU.

Risk Factor: ***Hatchery impacts.***
Oregon's 2005 risk level determination: *Low*.
Rationale: Oregon's rationale starts from a finding that the ESU is currently viable. Oregon also recognizes a variety of interactions with hatchery fish and the operation of hatcheries is potentially capable of exerting a very large influence on life-cycle survival of coho salmon. Hatchery related impacts on the Coastal coho ESU were clearly much greater during several decades before the mid 1990s than it has been recently. The current coho hatchery programs in the ESU are at relatively low levels and practices have been modified consistent with new ODFW policies; current and planned hatchery programs for coho and other species in the ESU are being managed consistent with conservation and recovery needs of the species. Extensive coho population monitoring is in place that it would detect stray hatchery coho in natural spawning areas.

Oregon concludes that the hatchery management programs and policies are currently consistent with conserving and improving the ESU viability because (1) the number of hatchery fish released in the ESU is very small compared to historic release levels; (2) hatchery strays generally comprise less than 10% of coho in spawning areas, a value smaller than historic values and consistent with the Native Fish Conservation Policy; (3) continued implementation of Oregon policies including Native Fish Conservation Policy (NFCP), Hatchery Management Policy (HMP), and Hatchery and Genetic Management Plans will continue to support the viability of the ESU; and (4) hatchery impacts designated as a bottleneck to individual populations within the ESU will be considered and addressed through ongoing development of a conservation plan based on the NFCP and HMP.

Oregon now therefore assigns a *low threat-level* to this risk factor.

Risk Factor: ***Stream complexity.***
Oregon's 2005 risk level determination: *Moderate.*
Rationale: Oregon's rationale starts from a finding that the ESU is currently viable. Oregon also has concluded that a scarcity of stream complexity was a bottleneck for 13 of 21 independent populations that compose the ESU. Thus, stream complexity is the most common risk factor that limits populations across the ESU. That said, it is also crucial to note that 16 of these 21 populations passed viability criteria. The fact that stream complexity is the primary bottleneck for so many populations highlights the

sensitivity of the ESU to this habitat feature. Oregon concludes that current state and federal policies and programs are consistent with conservation and improvement of stream complexity in the ESU, recognizing some uncertainty associated with this conclusion. Also, although extensive habitat monitoring is in place that will improve the State's ability to detect significant declines in future habitat conditions, the sensitivity of the data at present is limited.

Oregon now therefore assigns a *moderate* threat-level to this risk factor in recognition of the great influence that stream complexity exerts on coho, the long time span required to significantly improve the feature across the ESU, and uncertainty regarding the cumulative future conditions that management and restoration programs will produce across the ESU.

Risk Factor: ***Fish passage***.
Oregon's 2005 risk level determination: *Low*.
Rationale: Oregon's rationale starts from a finding that the ESU is currently viable. Oregon also recognizes that recent restoration work on federal, state, and private lands has significantly improved access by coho salmon. Coho salmon require access as juveniles and adults to spawning and rearing habitats and that timing of access to these habitats can be critical. Fish passage concerns received considerable attention when the Oregon Plan was initiated in 1997 and a relatively high priority has been given to restoration work designed to improve fish passage throughout the ESU. At that time, simply providing more access in the watersheds was thought of as being a straightforward way to improve the status of the ESU.

Overall, Oregon estimated that coho salmon in 2003 versus 1997 had improved access to 6% of the high intrinsic potential coho streams and to 10% of the remainder of the coho distribution. Oregon estimated that access by coho remained impaired to approximately 10% of the species distribution (including access to 10% of high intrinsic potential habitat) and that the status of access to about 30% of the coho distribution is currently unknown (not documented in such a manner that could be determined during the Assessment). Oregon concludes that improved population viability will only accrue from providing access to high quality overwintering habitat as opposed to improving access to all habitat. Since high quality overwintering habitat is relatively scarce across the ESU, upgrading or replacing many remaining passage barriers would only provide access to marginal habitats and therefore would not improve population viability. Oregon concludes that the current fish passage policies and rules, including fish passage guidelines and restoration efforts underway, are consistent with conserving and recovering the ESU. Also, Oregon intends to focus future fish passage (culvert) inventories and habitat surveys in a manner that will identify high quality habitat that exists above passage barriers and to identify impaired passage structures in high intrinsic potential habitat.

Oregon now therefore assigns a *low* threat-level to this risk factor.

Risk Factor: ***Water quality***.
Oregon's 2005 risk level determination: *Low*.
Rationale: Oregon's rationale starts from a finding that the ESU is currently viable. Although water quality was not identified as a primary risk factor bottleneck for a single coho population, this risk factor was identified as a secondary risk factor bottleneck for 15 of 21 populations. Oregon recognizes that water quality exerts a strong influence on coho survival and that significant water quality concerns exist across the ESU. Improving water quality across the ESU and in the 15 populations previously mentioned (only 3 failed viability criteria – 12 passed) is consistent with improving watershed function and addressing Oregon's responsibilities under the federal Clean Water Act. However, Oregon concludes that improving water quality, absent immediate increase in the availability of stream complexity, will not improve viability of coho populations. The fact that water quality is impaired across the ESU highlights the State's interest in management and restoration action that will improve water quality. Oregon concludes that current state and federal policies and programs are consistent with conservation and improvement of stream complexity in the ESU, and also recognizes some uncertainty associated with this conclusion.

Oregon now therefore assigns a *low* relative risk-level to this risk factor.

Risk Factor: ***Water quantity***.
Oregon's 2005 risk level determination: *low*.
Rationale: Oregon's rationale starts from a finding that the ESU is currently viable. Water quantity was identified as a primary risk factor bottleneck for 2 of 21 coho population. Oregon recognizes that water quantity exerts a strong influence on coho survival and that availability of water during summer low flow periods is limited across the ESU. Maintaining water quantity across the ESU and improving summer flows in the 2 populations previously mentioned is consistent with improving watershed function and supporting juvenile coho rearing. However, Oregon concludes that improving water quantity, absent an immediate resolution of the primary population bottlenecks (e.g., stream complexity) will not improve viability of coho populations. Oregon concludes that current state policies and programs are consistent with conservation and improvement of water quantity in the ESU, and also recognizes some uncertainty associated with this conclusion.

Oregon now therefore assigns a *low* risk-level to this risk factor.

Risk Factor: ***Other factors***: toxics, DO, Hydro Power, disease, exotic fish interactions, predation, etc.
Oregon's 2005 risk level determination: *Low*.
Rationale: Oregon's rationale starts from a finding that the ESU is currently viable. Oregon identified *other* risk factors as primary bottlenecks for 4 of 21 coho populations in the ESU; however, all of these populations met viability criteria. Of these 4 populations, one was thought to be bottlenecked by availability of spawning gravel and 3 populations are thought to be limited by exotic fish species interactions. Oregon

recognizes that predation by protected marine mammals and birds could exert significant adverse impact on specific populations. Predation was not identified as a primary bottleneck for a single population, however, perhaps reflecting a lack of sufficient data to document effects that might be occurring. Oregon is open to considering the possible impacts of other risk factors on the viability of coho populations that comprise the ESU.

Oregon now therefore assigns a *low* risk-level to these risk factors.

Summary: Current Threats to ESU Viability

The following table summarizes Oregon's assessment of the current level of risk (threat) posed by risk factors at the ESU scale (**Table 10**).

Table 10. Oregon's 2005 determination of threats to ESU viability.

Risk Factor	2005 Threat to ESU Viability
Ocean Conditions	Moderate
Fishery Harvest	Low
Hatchery Impacts	Low
Stream complexity	Moderate
Fish Passage	Low
Water Quality	Low
Water Quantity	Low
Other factors: toxics, DO, Hydro Power, disease, exotic fish interactions, predation, etc.	Low

CONCLUSIONS OF THE ASSESSMENT

1. The Coastal coho ESU is viable, that is, coho populations generally demonstrate sufficient abundance, productivity, distribution and diversity to be sustained under current conditions. In fact, the ESU should be sustainable through a future period of adverse ocean, drought and flood conditions similar to or somewhat more adverse (up to 15% worse) than the most recent period of poor survival conditions (most of the 1980s and 1990s).

2. Oregon reasons that, because the ESU is viable, therefore it must currently be supported by a sufficient quantity and quality of habitat. This reasoning does not imply that habitat conditions are optimum for coho nor that habitat is currently sufficient to achieve broader Oregon Plan or recovery goals for the ESU.

3. A diverse set of conditions supports the conclusion that this ESU will maintain its viability into the foreseeable future. This set of conditions includes laws, management programs, monitoring, the contemporary environment, and societal networks. In concert, these conditions serve to sustain and improve future viability of the ESU by: (1) reversing many of the environmental alterations and fishery impacts caused by historical management practices, (2) conserving existing conditions that support viability of the ESU, (3) creating future environmental conditions, based on an understanding of primary threats to individual populations, that will further improve the viability of the ESU in fulfillment of Oregon Plan objectives; and (4) maintaining a comprehensive monitoring program to allow adaptive management of conservation efforts as new information is gained.

4. It is unlikely that circumstances currently supporting viability of the ESU will change so rapidly or dramatically as to preclude future, timely detection and protective action under Oregon management programs or the federal ESA.

5. Ongoing vigilance regarding conservation and restoration programs is necessary to sustain and improve viability of the ESU, most notably the responsiveness of these programs to variation in marine survival.

6. Recognizing that some uncertainty does indeed exist in relation to data, modeling, and interpretation of future trends, Oregon concludes nevertheless, that a modest level of optimism is warranted regarding the overall status and management of this ESU.

7. Oregon also concludes that future evaluation of data will be conducted and that this future analysis will provide sufficient accountability to detect any errors that may have been made in interpreting the present status of the ESU.

8. Oregon's conclusions regarding sufficiency of conservation efforts and threats to future ESU viability are presented in Table 11.

Table 11. Summary of Oregon's conclusions regarding the sufficiency of conservation efforts. The term *conservation effort* refers to a broad set of state and federal laws, policies, programs, and nonregulatory restoration actions. Detailed discussions of the rationale for conclusions reported here are contained in the body of this report.

Risk Factor	Have conservation efforts sufficiently addressed factors for decline? [A]	Are conservation efforts sufficient to conserve the *existing* viability of the ESU in the foreseeable future? [B]	Would *additional* focused action be expected to strengthen future viability of the ESU? [C]
Ocean Conditions [D]	*n/a*	*n/a*	*n/a*
Fishery Harvest	Yes	Yes	No
Hatchery Impacts	Yes [E]	Yes	**Yes –** Opportunities exist to alter hatchery programs in a small number of basins. Such changes could potentially improve viability of the affected populations.
Stream complexity	Yes [F]	Yes	**Yes** – Opportunities exist to focus restoration work on stream complexity in several basins where populations failed viability criteria and in many populations that are currently viable.
Fish Passage	Yes	Yes	**Yes –** Restoration and inventory opportunities exist that would provide access to high quality overwintering habitats.
Water Quality	Yes	Yes	**Yes –**Opportunities exist to focus restoration work on water quality in several basins where populations failed viability criteria and in many populations that are currently viable.
Water Quantity	Yes	Yes	**Yes** – Opportunities exist to focus restoration work on water quantity in two basins where populations failed viability criteria.
Other factors: toxics, DO, Hydro Power, disease, exotic fish interactions, predation, etc.	Yes	Yes	**Uncertain**. Opportunities may or may not exist to focus restoration or management on specific *other factors* that might be limiting certain populations.

A – *See SYNTHESIS* OF CONSERVATION EFFORTS: ADDRESSING THE FACTORS FOR DECLINE in this document.

B – *See SYNTHESIS* – CONSERVING EXISTING CONDITIONS THAT SUPPORT VIABILITY OF THE ESU BY ADDRESSING CURRENT AND FUTURE THREATS TO ESU VIABILITY in this document.

C – *See SYNTHESIS* – CREATING FUTURE CONDITIONS THAT FURTHER STRENGTHEN ESU VIABILITY AND SUPPORT ACHIEVEMENT OF BROAD OREGON PLAN OBJECTIVES in this document.

D – Ocean conditions exerts strong influence on life cycle survival, however this risk factor must be addressed indirectly by management action directed at all other risk factors.

E – Although action has been taken to address hatchery impacts in several populations that did not pass viability criteria, it is likely to require more time before legacy effects are remediated by current practices.

F – Loss of *stream complexity*, as a factor for decline, has been sufficiently addressed. The legacy effects of past management practices that reduced stream complexity and that could potentially affect the future viability of the ESU are being addressed by existing conservation efforts.

LESSONS LEARNED AND ADAPTIVE MANAGEMENT

The Coastal coho ESU Assessment represents one example of Oregon's long-standing effort to learn and adapt management programs through time. Examples of adaptive management that have already been discussed include adoption of Fill and Removal Rules, adoption of Forest Practices Rules, reductions in fishery harvest rates, and re-design of hatchery management policies. Implementation of the Oregon Plan for Salmon and Watersheds in 1997 also represents a significant and constructive departure from historic practices. In addition, Oregon provides the following description of three key lessons (revelations) from this Coastal coho ESU Assessment and makes the following commitments regarding Oregon's intended action in response to each lesson.

Assessment Lesson 1. Although considerable on-the-ground work has occurred under the Oregon Plan umbrella since 1997, adequate resources have not been devoted to analysis and interpretation and monitoring sampling designs were not always scaled appropriately for inferences at the fish population level. Collaborative analysis is a difficult, resource-demanding process that does not occur as a routine part of agency workloads – it requires specific assignments and deadlines. Also, current systems for storage, inventory, and sharing of data collected by state and federal agencies (including work programs within agencies) are so distinct and disparate that collaborative analysis is hampered; most of these data systems were never designed to facilitate integrated analyses.

Oregon's Commitment to Action. The Oregon Plan Core Team will direct state agencies to:

1. Produce a comprehensive assessment detailing the status of the Oregon Coast coho ESU at 5 year intervals. The first report would be produced in 2010 and contain data collected though 2008. The report will update information on coho viability, instream habitat, riparian conditions, water quality, water quality, effectiveness monitoring, and conservation efforts undertaken to conserve and recover the ESU.

2. Determine if (monitoring) sampling designs should be modified to answer key questions related to species recovery and other Oregon Plan effectiveness issues, specifically at the fish population scale. Focus this evaluation first in the Coastal coho ESU and complete prior to the 2006 field season.

3. Improve state agency capability to store, retrieve, and share data collected by all parties. Implement this action first in data systems that incorporate information related to the Coastal coho ESU.

Assessment Lesson 2. An effort to improve the viability of a listed fish species is likely to be most effective if restoration is focused on *bottlenecks* identified for specific populations. For example, there has been considerable investment in a broad range of restoration work across the Coastal coho ESU since the Oregon Plan was implemented in

1997 – well over 110 million dollars. All of this restoration investment is consistent with the Oregon Plan, i.e., conserving or restoring watershed function and water quality. However, much of the restoration work did not specifically address population bottlenecks that are now thought to be limiting coho viability. The broad scope of the Oregon Plan (native salmonids, water quality, and watershed health) is not sufficient to guide prioritization of restoration resources. This prioritization does not exclude more general actions to maintain current watershed health, nor does it preclude prioritized actions that are custom-tailored to meet site-specific needs.

Oregon's Commitment to Action. Develop a draft conservation plan for the Oregon Coast coho ESU by December 2005. The conservation/recovery plan that is currently being developed for the Coastal coho ESU will consider the results of the viability analysis in context with population bottlenecks identified in the Assessment. This information will provide a basis for focusing future conservation, management, and restoration action to most effectively conserve viability of the ESU and meet Oregon Plan goals (that are being established through the conservation/recovery planning process) for the ESU.

Assessment Lesson 3. The resiliency observed in coastal coho is an important part of their population dynamics and their ability to meet viability criteria. The mechanism for this resiliency is likely a combination of a strong density-dependent response in productivity at low spawner density as well as an increased importance of habitats that are of sufficiently high quality (especially over-wintering refuge habitats) to sustain populations during periods of extremely poor ocean survival. Given this observed resiliency and hypothesized habitat relationship, it is very important to define, map and track the status of these high quality habitats over time to ensure they are conserved or enhanced consistent with the conservation/recovery plan that is currently being developed.

Oregon's Commitment to Action: Oregon will build on existing information to ensure that high quality habitats are well defined and mapped. Monitoring will be adjusted to increase sensitivity to measure potential deterioration in key habitat parameters. Restoration activities that provide increased access to high quality habitats or that maintain/enhance currently accessible high quality habitats will be given higher priority for implementation. Oregon anticipates that certain of the already mapped areas of High Intrinsic Potential (HIP) may offer the greatest opportunity for future conservation and restoration efforts.

CHANGES TO
THE OREGON COASTAL COHO ESU ASSESSMENT
PART 1 SYNTHESIS

Introduction

Oregon has received and reviewed comments on the Coastal Coho Assessment from approximately 20 sources, including Oregon's Independent Multidisciplinary Science Team, NOAA, the Stakeholder Work Group, various representatives of environmental and resource industries, and citizens. The State appreciates the effort and commitment of reviewers and has taken all suggestions under consideration. These review comments, collectively, have been extremely constructive and have helped authors of various Assessment documents improve the technical content and clarify Oregon's message. The revision of Coastal Coho Assessment documents incorporates revisions that were deemed appropriate and executable given constraints of time and resources. Oregon has focused revisions on areas of the report judged to be most important to provide a thorough evaluation of ESU viability and to present Oregon's interpretation of management programs and restoration actions related to future viability of the ESU.

Oregon wishes to note the following observation related to the overall body of review comments received. First, many perceptive and constructive comments were received, both affirmative and critical in nature. These comments have helped focus the State's revision of the Assessment documents. Second, Oregon also found that some reviewer comments were not as constructive, and reveal the following:

1. The individual reviewers' incomplete reading of the 4 documents Oregon submitted.
2. The individual reviewers' incomplete understanding of (1) the federal Endangered Species Act; including protections that have actually been provided to the coho ESU since 1997; (2) NOAA , PFMC, and Oregon policies and programs; (3) The legislative and procedural basis for Oregon's receipt of PCSRF funds and dispersal of restoration funds within Oregon.
3. Fundamental disagreements among NOAA scientists, specifically, and among scientists in general.
4. A tendency to characterize every concern, question, and clarification as a key issue that might affect the State's conclusions.

The following review topic categories summarize Oregon's responses to key review comments and description of revisions that have been made. A list of the comment topics and Oregon's responses follows.

CONTEXT, TONE, AND UNCERTAINTY ISSUES

- Context: what happens after this ESU Assessment?
- Redundancy of documents and nomenclature of the Part 1 Synthesis document.
- Need for citations in document.
- Optimistic tone of the Part 1 Synthesis document.

- Unwarranted optimism and lack of accountability.
- Convergence of environmental conditions detrimental to coho salmon.
- Convergence of certain adverse non-biological factors.

LESSONS LEARNED AND ADAPTIVE MANAGEMENT

- Lessons Learned from the Assessment

VIABILITY ANALYSIS ISSUES

- Characterizing Oregon's viability analysis as introducing a "new low abundance paradigm".
- Status of Oregon Coastal coho ESU on a continuum.
- Circularity of reasoning regarding habitat and ESU viability.
- Integrating NOAA and TRT analyses.
- Modeling for persistence under more adverse ocean conditions.
- Appropriateness of ESU structure in Oregon's viability analysis.
- Inclusion of additional data for Floras and Sixes populations.

PREVIOUS LEVELS OF PERCEIVED THREAT TO ESU VIABILITY.

DETERMINING RISK FACTOR BOTTLENECKS: A DELPHI-LIKE PROCESS.

RANKING CURRENT LEVEL OF THREATS TO ESU VIABILITY.

MISCELLANEOUS ISSUES

- Disproportionate emphasis on forestland streams.
- Defining stream complexity.
- Importance of gravel removal to coho salmon.
- Importance of estuaries to coho salmon.
- Impact of predation on coho salmon.
- Impact of hatchery coho on natural production of coho salmon.

CONTEXT, TONE, AND UNCERTAINTY ISSUES

Context: What Happens After this ESU Assessment?
Many reviewer comments seemed to reflect a concern that Oregon, in concluding that the ESU is viable, was expressing satisfaction with the condition of fish and habitat across the ESU and perhaps implying that the ESU met the broad vision of the Oregon Plan for Salmon and Watersheds i.e., *To restore the watersheds of Oregon and to recover the fish and wildlife populations of these watersheds to productive and sustainable levels in a manner that provides substantial environmental, cultural, and economic benefits.*

Response. Oregon acknowledges that none of the various draft Assessment documents laid out the successive processes and actions Oregon has committed to undertake in connection with this ESU Assessment. Specifically, Oregon's intent has always been to conduct this ESU Assessment and use the findings to develop a conservation and recovery plan to guide future management action and restoration investment in the ESU. Oregon has engaged a stakeholder team and NOAA policy staff from the outset of the ESU Assessment and has already begun work with the Stakeholder/NOAA group to develop a conservation/recovery plan for the ESU. It is being referred to as a conservation/recovery plan because it will be developed with appropriate components to satisfy the requirements of both Oregon's Native Fish Conservation Policy and NOAA's recovery planning policies regardless of the federal listing status of the ESU.

Thus, the Coastal Coho ESU Assessment is not the end of the road; it is the starting point for more effective future restoration investment, monitoring, and adaptive management action. Oregon is proceeding to use the Assessment to focus both landscape and population specific concerns to develop a conservation /recovery plan for the ESU. The conservation/recovery plan will contain (1) guidance in the form of measurable attributes regarding fish numbers, productivity, and distributions; (2) guidance regarding the sort of management and restoration actions would be most effective for specific populations; (3) guidance regarding expected coho population and management responses under both good and adverse future ocean conditions; and (4) a clear adaptive management strategy that includes specific triggers for responsive actions.

Redundancy of documents and nomenclature of the Part 1 Synthesis document.
Some review comments noted considerable redundancy of material presented in the various documents that comprise Oregon's coastal Coho Assessment. Other review comments suggested that the Part 1 Synthesis document is actually more of a summary and less of a synthesis.

Response. Oregon agrees that similar material is presented in several locations throughout the various Assessment documents. This redundancy is deliberate. Oregon has determined that the story of the Coastal coho ESU Assessment is a large, complex story – a story that is a challenge to communicate. A decision has been made that it is preferable to repeat material throughout the documents rather than to present each data set, context, interpretation, or conclusion only once in a completely linear fashion. Thus,

repetition and re-statement are frequently employed to provide context throughout the various Assessment documents.

The intent of producing the synthesis document was to present an overview of the entire ESU Assessment in one place. So the synthesis document does indeed contain a summary. In addition, the Part 1 Synthesis document contains material that exists nowhere else in the various Assessment documents, e.g., identifying population bottlenecks, establishing level of threat to ESU viability, setting context for Oregon's current habitat management programs.

In conclusion, Oregon has chosen to use selective repetition throughout the Assessment documents and continues to provide an overall summary as a lead-in to the Part 1 Synthesis document.

Need for citations in document.
Some review comments requested additional citations in the various documents, stating that it was difficult to distinguish between fact, opinion, data, and interpretation because of a scarcity of references and citations.

Response. Oregon has made an effort to note more of the sources of data presented in the revised Assessment documents. However, the overall intent of the Assessment documents is to communicate – to tell Oregon's story of the Assessment – rather than to produce a paper for a scientific journal.

Optimistic tone of the Part 1 Synthesis document.
Several reviewers expressed a concern that the Part 1 Synthesis document was written in a single-mindedly optimistic tone of voice that did not adequately report uncertainty and weaknesses in data, models, future scenarios, and so on.

Response – The State, upon re-reading Part 1, agrees only in a small part with this criticism. The State has conducted a *global uncertainty evaluation* including a thorough review of the Viability Analysis (Part 2) and the entire range of data and information available for this evaluation. Oregon's conclusions have not changed as a result of this uncertainty evaluation.

An effort has been made to add or modify language in the revised document to remind the reader that considerable uncertainty does indeed exist in relation to data, modeling, and interpretation of future trends.

Oregon has repeatedly noted that historical land uses and a variety of management programs were in many respects detrimental to coho salmon. Compared to pre-development conditions in the ESU, estuaries and wetlands have been filled, stream channels have been simplified, large wood is scarce in stream channels, gravels in many spawning areas contain significant fine sediment, potential off-stream wintering habitats

are not accessible, and riparian areas support fewer large conifers. Nothing in the Assessment is intended to imply that current management or habitat conditions are optimum for coho salmon. Current habitat and fishery management conditions and programs are clearly a compromise intended to at least sustain and preferably to improve ESU viability.

An overall positive or optimistic tone in the Assessment documents is based on recognition that many positive changes in habitat and fishery management policies have occurred over the last several decades and a belief that these changes have already and will continue to support viability of the Coastal coho ESU.

Unwarranted optimism and lack of accountability.
The IMST recommended that Oregon read and seriously consider Mc Evoy (1986) who warns that undue optimism and lack of accountability can impair effective management.

Response – The State has done this. Certainly, efforts to secure and improve the viability of the Coastal coho ESU could fail. The State is optimistic that existing and new efforts to secure and improve the viability of this ESU are, and will continue to be, effective. This measured optimism is centered around four key areas: (1) the performance of the fish; (2) the funding and institutional structure to address ongoing threats; (3) the adaptive management framework whose power to detect change is increasing with each passing year; and (4) the active participation of stakeholders in fish conservation and watershed stewardship.

Regarding accountability, Oregon's efforts to conduct monitoring, implement restoration, assess the effects of programs across this ESU, and report findings are unparalleled. Data for fish, habitat, water quality, and restoration effort are relatively scant in other ESUs of similar geographic scale.

So, after thoughtfully considering McEvoy (1986) Oregon concludes that a modest level of optimism is indeed warranted regarding the overall status and management of this ESU. Oregon also concludes that future evaluation of data will be conducted (*see* description of Oregon's adaptive management commitments) and that this future work will provide sufficient accountability to detect substantive errors that may have been made in interpreting the present status of the ESU.

Convergence of environmental conditions detrimental to coho salmon.
Some review comments suggested that the Assessment took an unduly static view of the Oregon coastal landscape and was overly dismissive of the likelihood that a number of environmental conditions (e.g., ocean conditions, drought, fire, human population increases, etc.) could converge and be detrimental to fish.

Response – Oregon recognizes that the oceanic, estuarine, and freshwater environments that support coho salmon throughout their life cycle are dynamic and may exhibit annual

and cyclic variability and trends over time. The conclusion that the Oregon Coastal coho ESU is viable does not include an assurance that convergence of a number of detrimental environmental conditions could not occur or that such a convergence could not threaten ESU viability. However the past 50 year record includes a mix of adverse oceanic conditions integrated with relative low flow and high flow years across a landscape that has been extensively modified by management activities. Extremely poor marine survival in the 1990s was unprecedented in the past half century. During this period, coho also experienced drought and a major flood event. The performance of coastal coho during this period, and their response as conditions moderated, was the focus of our assessment.

Although coastal coho remained viable through this latest challenge, additional and more dramatic adverse environmental conditions could indeed have an adverse impact on ESU viability. Successive years of extremely poor ocean conditions, extreme summer drought, extreme winter floods, fire on unprecedented geographic scale across the ESU, rapid deterioration of lowland and estuarine habitats, rapid increases in human population and ESU-wide land use conversion, together, would be expected to reduce probability of persistence for some populations in the ESU.

Reviewers seemed only to suggest that convergence of harsh environmental conditions would cause reduction in viability of the Coastal coho ESU. However, predicting outcomes of environmental convergence is not clear-cut. For example, wide-spread occurrence of flooding or forest fire (or both) could create short term adverse impact to affected populations while creating improved future conditions, *hypothetically*, by speeding delivery of large wood, recruiting gravel; and restoring channel complexity in low gradient stream reaches; *conditions that could actually improve future viability of the populations*. Similarly, a tsunami could create improved future conditions for overwintering juvenile coho by reclaiming and reconnecting lowland wetlands and estuarine habitats that have been lost to coho production by diking, tide-gating, and filling.

Oregon's conclusion remains that the life cycle of the species, its population dynamics and structure, and its broad geographic distribution all provide protection and reduce the likelihood of succumbing to a perfect storm of adverse environmental conditions in the foreseeable future.

Convergence of certain adverse non-biological factors.
Oregon acknowledges that convergence of adverse political, demographic, economic, and land use conditions could erode future viability of the Coastal coho ESU.

Response – The State is challenged regarding how to address this uncertainty other than to acknowledge that fishery and habitat management policies and programs do represent social and political compromises. Extreme changes in the political climate, changes in environmental protection laws, the economy, and the human population are always possible at geographic scales ranging from local to national. Therefore, Oregon

acknowledges that if enough adverse non-biological conditions converge, viability of the ESU is not certain. The Oregon Plan for Salmon and Watersheds is helping reduce this risk. By institutionalizing salmon and watershed conservation and restoration through statute and rule, Oregon has helped build a durable platform to address future challenges and buffer potential erosion of commitments.

LESSONS LEARNED AND ADAPTIVE MANAGEMENT

Lessons Learned from the Assessment.
Reviewers requested that the State provide examples of how evaluation of state programs or results of the Assessment demonstrated Oregon's responsiveness to new information and a willingness to implement needed changes to management or restoration programs. In addition reviewers requested the Oregon provide some specific details regarding its Adaptive Management strategy and describe timelines and actions that could be expected to occur in the future.

Response. The Part 1 Synthesis Report provided many specific examples that demonstrated Oregon's response to information that generated fundamental changes in management programs. For example, adoption of Fill and Removal rules, adoption of Forest practices rules, reductions in fishery harvest rates, and re-design of hatchery management policies represent huge departures from historic practices – changes that were based on data and analysis.

In response to this review comment, the Part 1 Synthesis document has been revised to include a section describing three key lessons from the Coastal coho ESU Assessment and corresponding commitments that demonstrate response to each lesson.

VIABILITY ANALYSIS ISSUES

Characterizing Oregon's viability analysis as introducing a "new low abundance paradigm".
The use of the phrase "new low abundance paradigm" was an inaccurate word choice in Oregon's draft ESU viability Assessment document. Extensive but preliminary work to model coho populations in this ESU in 1996 were reported in the Original Oregon Plan, Chapter 14 Oregon Coastal Coho Salmon – *Production Potential, Recent Population Trends, and Prospects for the Future. (State of Oregon. 1997. Oregon Governor's Office, Salem, OR.)*

Several aspects of the work reported in 1997 merit clarification. Although the work reported in 1997 was not a full analysis of ESU viability, it did suggest optimism regarding long-term sustainability of the ESU given the condition of freshwater habitat at that time. This point is important to counter the assertion of some reviewers who suggested that Oregon was predicting extinction of the ESU in 1997 and that the current viability analysis therefore represents a virtual turn-around of the State's 1997 position.

A re-examination of the 1997 population modeling and comparison with the State's current ESU viability analysis demonstrates the following.

- The current analysis is not a fundamental change-of-story; both 1997 and 2005 analyses suggest strong resiliency of populations and an ability to persist during extended periods of poor ocean survival.
- Whereas the 1997 analysis only examined coho in a subset of basins in the ESU, the 2005 analysis incorporates the current thinking of the NOAA TRT regarding ESU population structure.
- The 2005 analysis is far more comprehensive, includes empirical data on coho populations under adverse and improving conditions of ocean survival, harvest rate, and hatchery programs.

Status of the Oregon Coastal coho ESU on a continuum.
Oregon has concluded that this ESU meets criteria for viability. Various reviewers expressed concern over this determination and seemed to equate a classification of "viable" with meeting "broad-sense recovery" or "Oregon Plan goals".

Response – The Assessment documents have been revised to clarify that meeting criteria for viability does not imply that populations or the ESU are without risk, or that broad sense recovery goals or all Oregon Plan objectives have been met (*see also* Context: what happens after this ESU Assessment). The process of establishing the social values and fish numbers associated with broad sense recovery or meeting Oregon Plan goals has begun with the Coho Assessment Stakeholder Team. The following table provides context for various relative levels of ESU status including viable.

Classification	Definition
Pristine	All historical populations within the ESU are healthy and adverse impacts from human activities are insignificant at the population and ESU scale.
Broad-sense recovery, or Oregon Plan recovery	Populations of naturally produced fish comprising the ESU are sufficiently abundant, productive, and diverse (in terms of life histories and geographic distribution) that the ESU as a whole a) will be self-sustaining, and b) will provide environmental, cultural, and economic benefits.
Viable	Populations of naturally produced fish comprising the ESU are sufficiently abundant, productive, and diverse (in terms of life histories and geographic distribution) that the ESU as a whole will be self-sustaining.
Threatened	The ESU is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
Endangered	The ESU is likely to become extinct within the foreseeable future throughout all or significant portion of its range.
Extinct	The ESU contains so few members there is no chance their evolutionary legacy will re-establish itself within its native range.

Circularity of reasoning regarding habitat and ESU viability.
Some review comments suggested that Oregon used circular reasoning in discussing ESU viability and current availability of habitat suitable to support coho during adverse ocean cycles.

Response. Oregon's analysis of coho population data indicates that, overall, the ESU meets criteria for viability. This conclusion, alone, is in fact the basis for asserting that current habitat conditions must therefore be sufficient (in quantity and quality) to support the ESU under similarly adverse marine survival conditions as experienced in the 1990s.

Oregon is *not* stating that because sufficient habitat is available to support the ESU, the ESU must therefore be viable. Viability was assessed based on specific fish performance attributes. Oregon is also not asserting that habitat is sufficient to achieve viability of every population within the ESU, because several populations failed viability criteria.

Further, Oregon is not asserting that habitat is *optimum* or *necessarily sufficient* to support any higher level of production above that necessary to meet viability criteria. Oregon recognizes that contemporary habitats across the ESU reflect substantial loss of estuarine and wetland habitats, reduction in channel complexity, loss of large wood, degradation of riparian habitats and the like. The conservation and recovery planning process that is currently underway with Oregon, NOAA and stakeholder participation will explore improving habitat conditions in specific geographic areas to increase population and ESU viability and production potential.

Integrating NOAA and TRT analyses.
Some review comments suggested that a comparison of the Oregon and NOAA viability analyses would yield a stronger overall perspective of ESU status.

Response. Oregon has in fact been iteratively providing results of viability assessments to the NOAA TRT, and several of the scientists conducting Oregon's viability analysis are members or adjunct members of the NOAA TRT. Oregon believes that the exchange of analytical approaches and mutual-but-separate consideration of reviewer's comments has strengthened both the Oregon and TRT viability analyses.

Modeling for persistence under more adverse ocean conditions.
Some reviewers suggested that Oregon explore possible scenarios for population persistence under ocean conditions that were more adverse than were observed during the 1990s and under adverse conditions that extended longer than the decade long survival downturn.

Response. Oregon did in fact model both conditions as part if the viability analysis summarized in the Part 1 Synthesis document dated 31 January, 2005. Generally, longer duration of adverse ocean conditions did not significantly decrease probability of persistence of coho populations. Modeling for conditions more adverse than were

observed in the last 5 decades predicted lower probability of persistence for specific populations, with more populations at risk as several successively more adverse ocean survival rates were modeled. Oregon has not revised the viability analysis to consider all reviewers comments and suggestions, including modeling more adverse ocean survival conditions. The new analysis suggests that up to a 15% decrease in life-cycle survival may not affect the conclusion that the ESU meets viability criteria. Thus, Oregon continues to conclude that the ESU will remain viable under similar or slightly more adverse ocean conditions than had been observed during the last 5 decades.

Appropriateness of ESU structure in Oregon's viability analysis.
Some review comments questioned the ESU population structure Oregon used in the viability analysis, suggesting that a more complex (i.e., many more populations) would be more appropriate to reflect genetic structures exhibited in preliminary analyses.

Response. Oregon recognizes that ongoing analyses and future deliberations may cause a reconsideration of ESU population structure and that future descriptions of ESU structure may indeed describe more than the 19 independent populations used as part of Oregon's initial viability assessment. Oregon noted that the NOAA Technical Recovery Team (TRT) has revised ESU population structure and now describes 21 rather than 19 independent populations across the ESU.

The State has decided to apply viability analysis to the same ESU population structure (i.e., now 21 independent populations) that is being analyzed by the NOAA TRT. Failure to do so would create a significant disconnect between the Oregon and TRT viability analyses and would impair opportunities to compare and contrast conclusions derived from the 2 approaches to evaluate ESU viability.

Inclusion of additional data for Floras and Sixes populations.
Some review comments encouraged Oregon to attempt to characterize status of the Floras and Sixes populations rather than to state that insufficient data were available to assess their viability. In other words, it was thought to be better to try to say something about these populations rather than saying nothing, in case these observations might influence an overall perception of ESU viability.

Response. Oregon did not initially search beyond data files that contained standard EMAP survey data. The population strata that included the Floras and Sixes populations passed viability criteria on the strength of the other populations in the strata, so a lack of analysis for these 2 populations did not affect the outcome of the ESU viability. However, Oregon has sequentially retrieved considerable data from counts of spawners and juvenile coho in these two systems and has analyzed these data to shed light on the status of these small populations at the southern edge of the ESU. Oregon's interpretation of data for these populations is that the Floras population passes viability criteria and the Sixes population fails. This new examination of data does not change Oregon's conclusion that the ESU passes viability criteria.

PREVIOUS LEVELS OF THREATS TO ESU VIABILITY.

The Part 1 Synthesis document reports Oregon's interpretation of NMFS findings in 1997 and in 2003 relating the severity of threat posed to ESU viability by key risk factors. Reviewers suggested that the material in the Part 1 Synthesis document needs to define terms used, cite references, and clarify the source of the information presented.

Response. The Draft Part 1 Synthesis document did, in fact, contain term definitions and cite references. However, Oregon has consulted with NMFS staff regarding the definitions and interpretations of NMFS findings that were included in the Part 1 Synthesis draft dated 31 January, 2005 to ensure that the State's interpretations of NOAA's documents are fair. Definitions, citations, and interpretations presented in the revised Part 1 Synthesis document have been verified to reflect reasonable mutual agreement between NMFS and Oregon. NOAA offered alternate citations for this section of the report, and Oregon has used the new citations.

DETERMINING RISK FACTOR BOTTLENECKS – A DELPHI-LIKE PROCESS.

Determining Population Bottlenecks.
Several reviewers noted that Oregon did not explain its process for making these determinations.

Response. Oregon concurs and has provided an explanation of the process used to identify bottlenecks to each of 21 independent populations that comprise the ESU. The State acknowledges that future monitoring, research and analysis should be devoted to ground-truth these bottleneck determinations.

RANKING CURRENT LEVEL OF THREATS TO POPULATION VIABILITY

Reviewers requested additional rationale and explanation of how Oregon evaluated current level of risk to ESU viability associated with various risk factors.

Response – Oregon has described the rationale for assigning current threats to ESU viability in the revised Part 1 Synthesis document.

MISCELLANEOUS ISSUES

Disproportionate emphasis on forestland streams

Some review comments noted that Oregon provided a relatively large volume of data and analysis related to forestland streams and small headwater streams, without providing nearly as much data and analysis on lowland streams, many of which are not in a forestry land use category. One concern regarding the disproportionate volumes of information presented is that Oregon may not have clearly stated that coho salmon tend to be far more densely distributed in lower gradient, lowland streams than they are in high gradient headwater streams.

Response. Oregon concurs that lowland streams are particularly important to coho salmon. The State recognizes that coho populations depend on whole watersheds to support their life cycle, but also recognizes that the species does not occupy or utilize entire watersheds equally throughout their juvenile rearing or adult spawning phases. Oregon also recognizes that upriver habitats and watershed processes influence downstream conditions and processes. Coho salmon are most densely distributed in moderate to low gradient streams rather than headwater reaches of basins; low gradient streams with moderate valley form that are often located in lowland areas seem to have the highest production potential for coho. Efforts to restore high quality coho habitat should probably target lowland streams with high intrinsic potential (low gradient, moderate valley form, modest stream size). Small headwater streams probably contribute water quality and may contribute wood to some downriver reaches. In total, the overall watershed processes are important to sustaining viability of coho salmon. The Part 4(C) ODFW Habitat Report emphasizes the importance of lowland, high intrinsic potential habitat to coho salmon.

Defining stream complexity.

Several reviewers suggested that Oregon had not adequately described the term *stream complexity* and recommended that this risk factor be separated as several distinct risk factors, each with quantifiable parameters, e.g., large wood, occurrence of off-channel habitat, beaver dams, etc. The term stream complexity refers to any multivariate set of habitat conditions that create shelter for rearing juvenile coho salmon, especially habitat conditions that create shelter during the overwinter rearing period that is thought to be the primary bottleneck for 13 of 21 coho populations.

The State is particularly concerned with habitat of such quality that it provides overwinter survival at rates high enough to produce a positive recruits-per-spawner relationship during periods of extremely adverse ocean conditions. Habitat conditions that create sufficient shelter for overwintering juveniles may be characterized by the presence of one or more features including the following: large wood, a lot of wood, pools, connected off-channel alcoves, beaver ponds, pasture trenches, lakes, reservoirs, connected wetlands, and other conditions.

Response – The State has decided to continue using the term *stream complexity* to refer to any of the various combinations of conditions that result in overwinter shelter conditions sufficient to support sustainable populations through especially adverse periods of ocean survival. This decision is based on a perception that habitats with higher levels of complexity (more wood, more large wood, more braided channels, etc) will provide sufficient levels of overwinter survival, although we also believe that coho may be experiencing sufficient overwinter survival in some relatively less complex habitats like pools, pasture trenches, etc.

Importance of gravel removal to coho salmon.
Some review comments suggested the need for additional analyses regarding the status of gravel mining including mapping gravel resources in the ESU and modeling gravel recruitment and extraction. Oregon recognizes that recruitment and availability of gravel is an environmental quality that is essential at various stages of the coho life cycle and that availability of gravel is important to other aquatic species and watershed function. However, Oregon's judgment is that a shortage of suitable spawning gravel is a primary risk factor bottleneck in only 1 of 21 populations, and that specific population currently meets viability criteria (*see* also Part 4(G) DSL Wetlands, Estuaries, Dredge, Fill and Inwater Construction Report).

Response – Therefore, conducting additional mapping and analysis of gravel resources, gravel recruitment, and gravel removal (which is a permitted activity) would not affect Oregon's overall conclusions regarding viability of the ESU. Oregon's judgment remains that (at the spatial scale of the population) immediate increases in the availability of suitable overwinter rearing habitat would immediately increase the production and viability of a coho population, but immediate increases in gravel availability would not increase population viability.

Importance of estuaries to coho salmon.
Several reviewers expressed a concern that the State was unreasonably dismissing the importance of estuarine habitat to coho salmon. Oregon recognizes that estuaries provide important migratory corridors for adult and juvenile coho and that freshwater reaches of estuary habitats – especially small tributaries and connected wetlands – may provide significant over-winter rearing opportunity for juvenile coho. The State also recognizes that loss of estuary and adjacent wetland habitat has been significant prior to 1970s (*see* Part 4(G) DSL Wetlands, Estuaries, Dredge, Fill and Inwater Construction Report).

Response – Oregon's judgment remains that (at the spatial scale of the population) immediate increases in the availability of suitable overwinter rearing habitat would immediately increase the production and viability of a coho population, but immediate improvements in the amount or quality of estuary habitat would not increase population viability – *unless the increase in estuary habitat provided suitable overwintering habitat.* This determination in no way implies a disregard for estuary habitat relative to overall watershed function, or the importance of estuary habitat to other species including

perhaps chinook and chum salmon. Therefore, the State has limited its response to the review concern by clarification of the State's interpretation rather than by conducting new analyses.

Impact of predation on coho salmon.
Some review comments indicated that the impact of predators, especially protected-status predators, on coho salmon.

Response. Oregon recognizes that predation, including predation by species with protected status, may have significant impact on specific fish populations (*see* Part 4(C) ODFW 5 Predation Report). However, Oregon concludes that such predation, per se, was not responsible for the very poor survival and returns of coho salmon in the ESU during the 1990s. Further, Oregon concludes that whatever levels of predation that may have occurred during the 1990s did not cause any of the 21 populations in the ESU to fail viability criteria. Thus, predation effects on coho salmon are more relevant to consider in the context of future conservation management and recovery planning.

Impact of hatchery coho on natural production of coho salmon.
Some review comments suggested that Oregon was unreasonably downplaying the adverse impact of hatchery fish, especially releases of coho in the Columbia River and releases of chinook and steelhead in coastal rivers, on coho salmon.

Response. Oregon recognizes that interactions between hatchery and naturally produced salmonids can occur at broad scales and that these interactions may have adverse effects on coho populations (*see* Part 4(C) ODFW (1) Hatchery Management Report). However, Oregon concludes that any such (out-of-basin or other-species) hatchery effects are far less significant than are releases of hatchery coho within each population. Oregon concludes that the relatively higher levels of hatchery coho releases that characterized the decades up to the 1990s did adversely affect viability of several populations in the ESU. Further, Oregon believes that recent reductions in the number of hatchery coho released in individual basins, plus other hatchery management changes, will have positive effects on population viability that have not been observed yet.

Oregon Coastal Coho Assessment

Part 2: Viability Criteria and Status Assessment of Oregon Coastal Coho

State of Oregon[1]

May 6, 2005

[1] For reference purposes, primary authors are Mark Chilcote, Tom Nickelson and Kelly Moore, Oregon Department of Fish and Wildlife, Salem, Oregon.

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I. Introduction

Populations of coho salmon (*Oncorhynchus kisutch*) that occur in coastal watersheds between Cape Blanco and the mouth of the Columbia River are being evaluated by NOAA Fisheries for listing under the federal Endangered Species Act (ESA). These populations are designated as a single Evolutionary Significant Unit (ESU) (Weitkamp et al. 1995).

Oregon, in partnership with NOAA Fisheries, initiated a collaborative project to address the conservation of coastal coho. Assessing the status of coastal coho relative to viability criteria is a vital step in this process, and the focus of Part 2 of this report. Where possible and when available, technical products for the viability assessment were used from the Oregon Coastal Coho Technical Recovery Team (TRT), which is in the process of developing technical products for a recovery plan. Other technical products were developed internally by Oregon.

There are five primary components of the viability analysis, which also serve as the primary organizational structure of this report:

1. Determination of the ESU, strata and population structure;
2. Description of attributes used to define viability and assess fish status;
3. Development of specific criteria for each attribute used to define population viability;
4. Development of specific criteria for strata and ESU viability based on roll-up of population criteria; and,
5. Assessment of current status of coastal coho relative to population, strata and ESU viability criteria based on the key attributes described in 2.

II. Population and ESU Structure

The conceptual foundation for the biological criteria drew heavily from conservation principles for salmon and steelhead presented by McElhany et al. (2000) in their publication entitled *Viable Salmonid Populations* (VSP). This approach is based on the idea that the overall conservation condition of an ESU can be stated in terms of the distribution and frequency of viable populations within the ESU. Essentially, the viability of individual populations becomes the basic unit of salmon conservation. Therefore, to initiate this type of assessment it is necessary to first breakup the ESU into individual populations. For this assessment, population definitions and associated geographical boundaries were the same as those developed by the Oregon Working Group of the Coastal Coho Technical Recovery Team (OTRT). The OTRT's rationale for population boundary delineation is described by Lawson et al. (2004). However, the list of populations has been recently modified by the OTRT primarily to incorporate new information about the Umpqua basin. These recent modifications are included in the Oregon Plan assessment and are reflected in the list of populations provided in Table 1.

Table 1. List of populations and associated strata for that constitute the Oregon coastal coho ESU.

Geographical Strata	Functionally Independent Populations	Potentially Independent Populations	Dependent Populations		
North Coast	Nehalem Nestucca Tillamook	Necanicum	Arch Cape Ecola Neskowin	Netarts Rover Sand	Short Sand Spring Watseco
Mid-Coast	Alsea Siletz Siuslaw Yaquina	Beaver Salmon	Berry Big (Alsea) Big (Siuslaw) Big (Yaquina) Bob Cape China Coal	Cummins Depoe Bay Devils Lake Fogarty Moolack Rock Rocky	Johnson (Siletz) Schoolhouse Spencer Tenmile Creek Thiel Vingie Wade Yachats
Lakes		Siltcoos Tahkenitch Tenmile	Sutton		
Umpqua	Lower Umpqua South Umpqua	Middle Umpqua North Umpqua			
Mid-South Coast	Coquille	Coos Floras Sixes	Johnson (Coquille) Threemile Twomile		

In the most recent iteration, the OTRT has identified 57 populations of Oregon coastal coho. Thirty-six of these populations are classified as dependent, meaning they likely have been too small to persist for long periods (i.e., 100 years) without substantial reproductive support provided by strays from larger and more stable adjacent populations (Lawson et al. 2004). As such, these dependent populations were not used for development of viable criteria and the population and ESU assessment.

The remaining 21 populations are larger and, at least historically, were more likely to persist over the long-term. These larger populations are referred to as independent populations and their location within the ESU illustrated in Figure 1. However, within this classification a further distinction is made between a "functionally independent" population and a "potentially independent" population. A "functionally independent" population is one that is so dominating (generally in the largest basins) that their population demographics are acting in manner that is functionally independent from all other populations. A "potentially independent" population is one that, if isolated, would

be expected to persist on its own; however, because of its location next to one or more large functionally independent populations, likely receives too many strays to be truly functioning in a demographically independent manner. Functionally independent and potentially independent populations are critical to survival of the ESU and provide the basis for this viability assessment.

These independent populations are grouped into five strata (Table 1 and Figure 1). These strata are intended to represent clusters of populations that share ecological or geographic similarities. Healthy strata are important in maintaining genetic and life history diversity in Oregon coastal coho.

Figure 1. Geographic strata and independent populations of the Oregon coast coho salmon ESU.

III. Population Attributes of Fish Performance

A key aspect from the VSP document incorporated in developing the biological criteria was the list of primary attributes that should be considered in determining whether or not a population is viable. These attributes are:

1. Abundance – the number of naturally-produced spawners.
2. Productivity –the number of recruits (progeny) produced per spawner (parent).
3. Distribution – the distribution of spawners among habitats within a population's home range
4. Diversity – indices of genetic variability related to a population's ability to adequately respond to unpredictable natural variations in the environment and retain those adaptive genetic characteristics that promote optimum survival in basin specific habitats.

The Native Fish Conservation Policy (NFCP) adopted by the Oregon Fish and Wildlife Commission (OAR 635-07-0502 through 0509) includes these same attributes of population viability plus the attribute of *persistence*. Persistence is a forecast of future population health, stated in terms of the probability of extirpation. Because a forecast of extirpation risk is critical to understanding the present condition of a population, a fifth attribute was added to the assessment process to address the persistence question.

5. Persistence – the forecast likelihood that the population will become extirpated in the future must be very low,

The OTRT has also included a persistence attribute in their draft viability criteria for coastal coho (P. Lawson, personal communication). In addition, ODFW's recovery plan for lower Columbia River coho contains biological criteria for the persistence attribute (Chilcote 2001).

IV. Considerations for Criteria Development

ESU Status and Focus of Criteria

The status of a species can range from pristine to extinct. Although, a species' descent from pristine to extinct is not necessarily a discontinuous, step by step process, partitioning this range into separate classifications allows development of specific criteria for status assessments. An example of a stepwise classification scheme for ESU status is illustrated in Table 2. This status assessment of Oregon coastal coho is relative to viability criteria, providing a high likelihood of persistence of the ESU into the foreseeable future (e.g. viable definition in Table 2).

The State of Oregon and NOAA both have mandated goals beyond the basic issue of managing extinction risk for fish and wildlife species. Although the focus of present

effort is on the listing/delisting question under the ESA, achieving delisting will generally not meet these other mandated goals. Regardless of the current ESA listing decision, Oregon and NOAA will continue an ongoing scientific and public process to develop a full conservation plan to help meet these broader objectives.

Table 2. Conceptual steps of biological status for a species from pristine to extinct and associated definitions.

Classification	Definition
Pristine	All historical populations within the ESU are healthy and adverse impacts from human activities are insignificant at the population and ESU scale.
Broad-sense recovery, or Oregon Plan recovery	Populations of naturally produced fish comprising the ESU are sufficiently abundant, productive, and diverse (in terms of life histories and geographic distribution) that the ESU as a whole will: a) be self-sustaining, and b) provide environmental, cultural, and economic benefits.
Viable	Populations of naturally produced fish comprising the ESU are sufficiently abundant, productive, and diverse (in terms of life histories and geographic distribution) that the ESU as a whole will persist into the foreseeable future.
Threatened	The ESU is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
Endangered	The ESU is likely to become extinct within the foreseeable future throughout all or significant portion of its range.
Extinct	Means an ESU contains so few members that there is no chance their evolutionary legacy will ever re-establish itself within its native range.

Criteria Development Objectives

Success in the development of viability criteria for coastal coho was framed in terms of addressing four critical considerations: 1) the criteria must be scientifically defensible and tied to the most recent thinking on salmonid viability; 2) the criteria must be stated in quantifiable units and utilize data that are readily available; 3) the criteria must be relatively easy to understand; and, 4) the application of the criteria to the status of coastal coho must yield consistent results that can be independently confirmed by others.

Fish Performance Based

Population viability criteria were developed for each attribute of fish performance. The measures of fish performance incorporated the collective effects of natural and anthropogenic factors, such as ocean conditions, harvest, hatcheries, habitat quality and quantity, predators, etc., to the extent these factors are influencing observed abundance and distribution.

The underlying concept used in development of the biological criteria for coastal coho was to rely on metrics related to fish performance rather than a more indirect approach of relying on 'habitat-based' metrics. Therefore, the population attributes proposed for use in this evaluation exclude the use of measured characteristics of a population's habitat. This does not imply that habitat issues are inconsequential for coastal coho. It is merely a reflection of a viewpoint that biological criteria need to be related to the performance of the fish. The impact of degraded habitat should be reflected in population metrics, such as abundance, productivity, and distribution.

For some species, population data are unavailable and habitat-based criteria must be used as a surrogate for the population performance indicators. In these cases inferences are drawn between habitat and a population trait such as abundance or productivity and then expanded across the range of the species. A benefit of habitat-based criteria is that the raw data necessary to perform the evaluation are frequently available, and if they are not available can be readily obtained. In contrast, population data spanning a sufficient length of time and proportion of an ESU are rarely available. However, in the case of coastal coho in Oregon abundance, productivity, and distribution data are available for nearly all populations within the ESU, from 1958 to present. Therefore, given the availability of these data it was logical to craft 'fish-based' metrics for the viability criteria.

Again it is emphasized that taking this approach does not mean habitat related issues are ignored. Rather, habitat is treated as a primary factor that needs to be considered in explaining the performance of the various populations belonging to this ESU. Habitat, and similarly fisheries and hatcheries, are treated as potential causes for the condition of the population. Conservation strategies have been developed to improve habitat as a means to help rebuild coastal coho. However, the measure of whether these strategies have been successful is the response of the fish to these improvements, not the habitat improvements themselves. It is also recognized that in many cases corrective measures directed at habitat problems take a longer time to bear fruit and therefore monitoring of fish performance of a corresponding duration is necessary to demonstrate their effectiveness. In this context, habitat improvements to address limiting factors rarely receive immediate credit through fish performance metrics.

Effects of Marine Survival

Survival conditions for coho in the marine phase of their life history can cause wide fluctuations in subsequent adult returns and spawner abundance (Nickelson 1986). Smolt to adult survival rates between a high year and a low year are typically in the range of ten-fold. For example, if a basin consistently produces 100,000 coho smolts each year, the return of adults when ocean conditions are good may be 10,000 fish, whereas when ocean conditions are bad the same smolt number may produce a return of only 1,000 fish. This order of magnitude difference, which should be expected for a normally functioning natural coho population, complicates the development of viability criteria for coho.

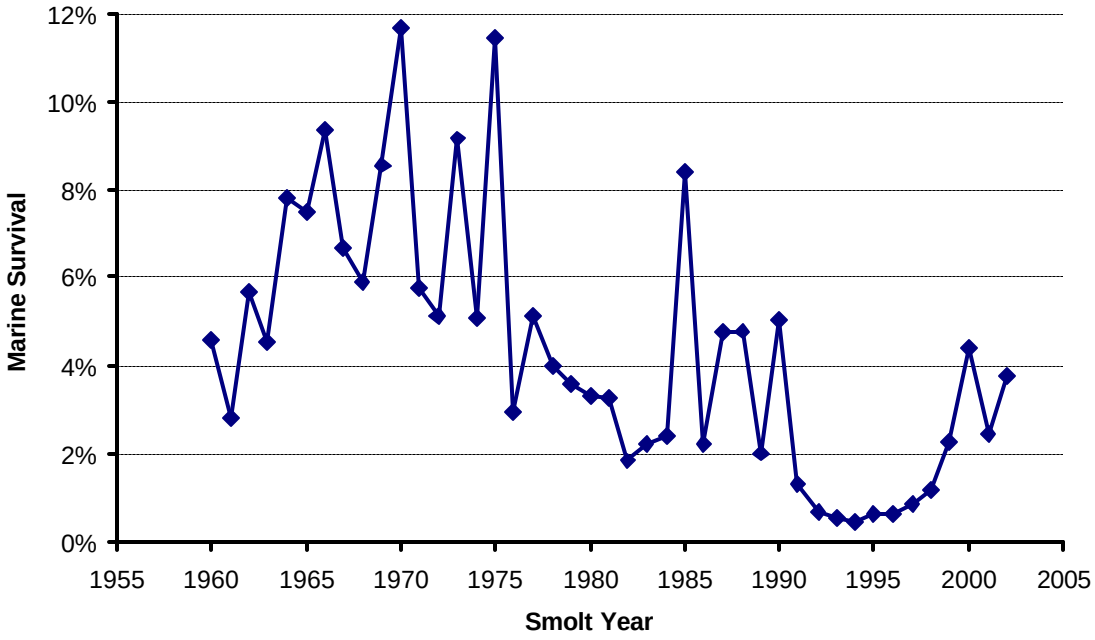
This effect is magnified by the basic life history of coho. Coho, unlike most other salmon and steelhead species, have a greatly simplified age structure, with about 80-90% of the

fish returning to spawn as 3-year olds and the remaining 10-20% returning as 2-year olds, the latter almost entirely being males (jacks) (ODFW, unpublished data). Therefore, the effect of marine survival conditions is dramatic because each year's return is comprised of individuals that all entered the ocean one year previously and experienced the same conditions. In contrast, for a species like steelhead the effect of variable marine conditions is dampened by the fact that the return of individuals from a particular smolt out-migration typically is divided among at least 3 different years. Therefore, large annual swings in abundance that would be cause for alarm with respect to steelhead populations should be less worrisome with respect to coho populations. For coho, large swings in abundance should be expected as a normal dynamic of the species. Therefore, coho have both an inherent higher risk of cohort collapse than other species, but they also have a greater capacity to quickly bounce back when survival conditions improve.

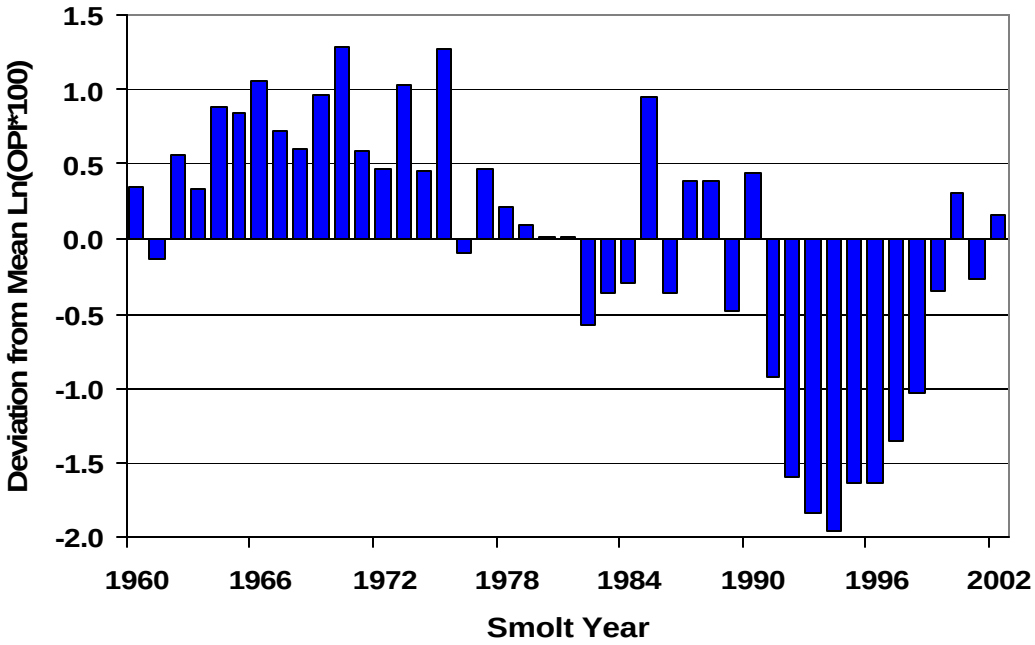
Marine survival rates for coho are known to fluctuate widely with annual variations in ocean temperature and upwelling (Nickelson 1986; Logerwell et al. 2003) as well as decadal scale cycles associated with broader climatic conditions (Beamish and Bouillon 1993; Beamish et al. 2000). Collectively these annual and decadal variations in ocean condition are expressed in terms of a pattern of smolt to adult survival rates which, for coastal coho from 1958 to present are provided in Appendix 1, and illustrated in Figure 2. Because the low survival periods appear to correspond with climatic periods of warmer ocean temperatures, it has been speculated that global warming may adversely impact the long-term marine survival of Oregon coho. It is not clear whether the variations in marine survival are cycling about a steady mean, or if they are cycling about a declining trend-line as proposed by Lawson (1993). Regardless, this uncertainty makes the forecast of extirpation risk for coastal coho over the long-term conditional upon the assumption for marine survival.

Density Dependent Recruitment – Resilience at Low Spawner Abundance

Evidence from coho populations in Oregon, as well as from other locations, suggests the relationship between the number of spawners and subsequent production of offspring (recruits) is density dependent (Beidler et al. 1980, Nickelson and Lawson 1998, and Nickelson 2003). It appears that when the number of spawners is high, the smolt capacity of the habitat is saturated and the number of recruits produced per spawner will be low. Conversely, when the number of spawners is low, there is very little competition among rearing juveniles for food and space and therefore a higher percentage of them survive to become smolts. Under these conditions the number of recruits produced per spawner will be high. An example of the evidence for this relationship is illustrated in Figure 3 which shows spawner abundance and recruitment rate data observed for the Middle Umpqua River population collected by ODFW and described later in this report. Further, the likelihood that much of this density dependent response occurs during the early portion of the freshwater rearing cycle is further supported by Nickelson and Lawson (1998) as summarized in Figure 4.



2a)



2b)

Figure 2. Estimated survival of Oregon Production Area hatchery coho salmon smolts plotted by the year the smolts entered the ocean, expressed as percent smolt to adult survival (2a) and as the deviation from the mean survival transformed to the natural log of marine survival x 100 (2b).

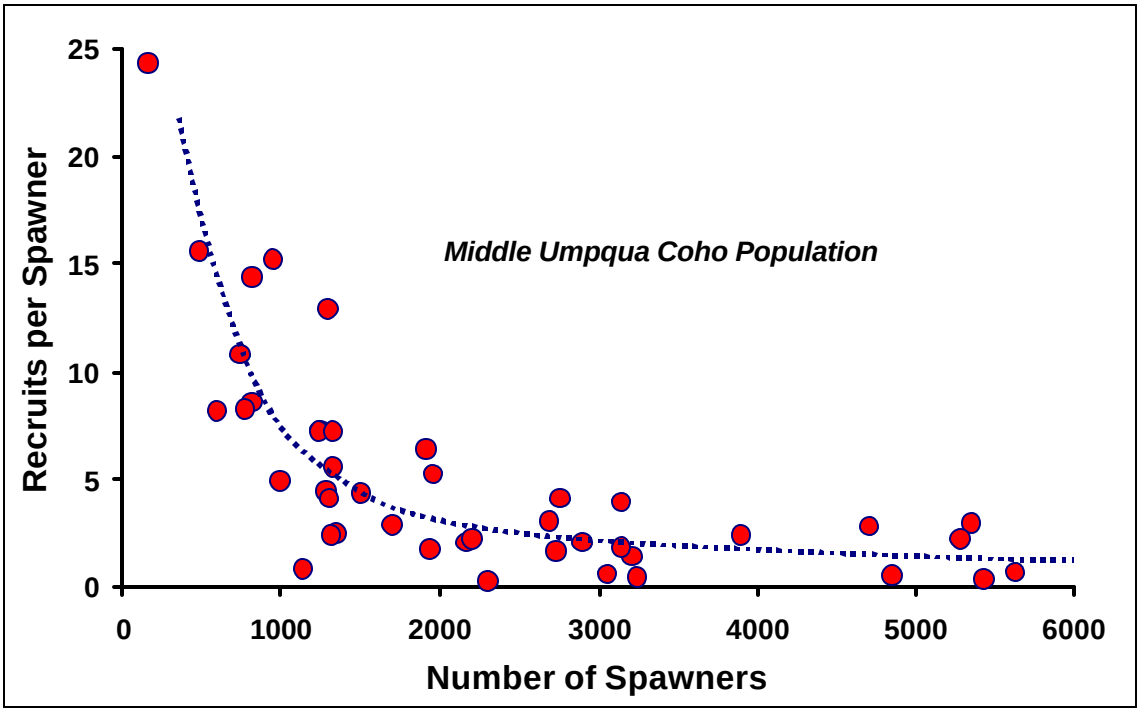


Figure 3. Relationship between recruits/spawner and spawners for Middle Umpqua River coho population (1958 -2000 brood years).

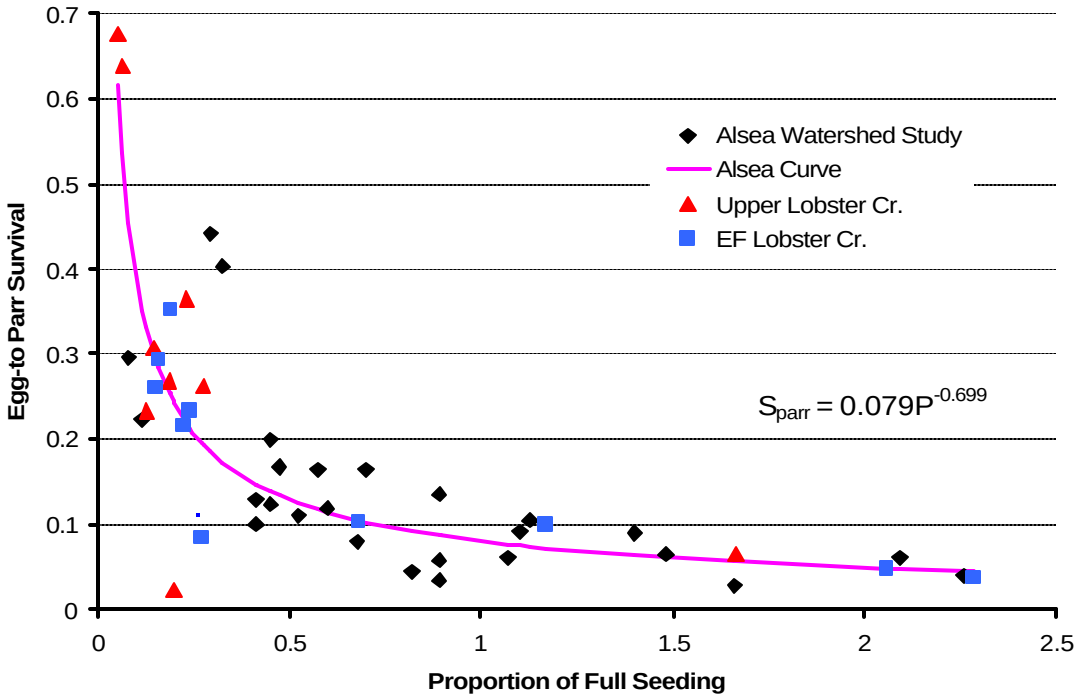


Figure 4. Relationship between survival from egg to parr and seeding density of coho expressed as proportion of spawners needed to seed habitat to full production; data include two points (located within the dotted circle) whose survival values that were likely reduced due to a 50-year flood event that occurred in February 1996.

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One expectation for a salmon species whose recruitment behavior is strongly density dependent is that relatively few adults can produce a relatively large number of juvenile offspring. Although the total number of juveniles produced will be less than the number produced when the parents were more numerous, the juveniles produced per parent will be higher, and the overall juvenile production will be sufficient to yield a substantial adult return should they experience good marine survival conditions. Hence, populations can demonstrate resiliency at low spawner densities by resisting further declines during poor marine survival conditions, and with improved marine survival conditions can display a notable one generation rebound in abundance to healthy levels. It was exactly this type of response that was observed for most populations of Oregon coho during the period of poor marine survival and afterward as marine survival conditions changed from poor to good in the late 1990s (Appendix 1). For example, although all populations declined as a result of poor marine survival conditions, most populations demonstrated resilience against declining below a spawner density of five fish per mile. When the marine survival conditions improved, the 675 coho that spawned in the Siuslaw in 1997, for example, produced sufficient smolts to yield a return three years later in 2000 of 7,047 adults. Likewise, the 1998 spawner escapement of 238 fish into the Nestucca River produced a return of 4,497 adults in 2001. A similar recruitment response was observed for the Lower Umpqua population, rebounding from a relatively low abundance of 2,708 fish in 1999 to an offspring return in 2002 of 21,531 adults.

In terms of assessing the status of coastal coho, probably the most important implication of this apparent resilience and rebound capacity is that it helps buffer extinction risk at low abundance and it reduces the number of generations a population is at low abundance as it climbs out of a period of poor survival conditions. Minimizing the amount of time at low abundance is a strategy that lowers extinction risk Burgman et al.(1993). When the sequence of survival conditions is reversed, going from good to poor, density dependence provides a natural mechanism to resist precipitous declines in abundance. It appears that for coastal coho, resistance to a continuing decline becomes stronger as the number of spawners becomes smaller. This is not to say that because of this resilience coho populations are essentially immune from extinction risk. In tributaries to the Lower Columbia, for example, wild coho are thought to have declined and become extinct in a number of instances (Chilcote 1999). In the case of Lower Columbia coho the cumulative effect of high fishery impact rates, poor marine survival conditions, the adverse impact of hatchery fish, and the degraded state of some habitats caused a decrease in life history survival sufficient to overcome the populations' resistance to extinction. However, local extirpations would have likely occurred quicker and more extensively if density dependent recruitment behavior had not been a feature of these populations.

Coho under Stress – Marine Survival Conditions of the 1990s

The marine conditions encountered by the offspring of coho that spawned from 1990 to 1996 were very unfavorable and at levels previously unrecorded, as has been earlier noted and illustrated in Figure 2. During this period, marine survival rates were 1/5 of the 1958 to 2003 average. This resulted in a significant reduction in total spawner abundance and provided a natural experiment to observe the response of these populations under an extended period of significant stress (approximately 2 generations).

The extensive monitoring program associated with the Oregon Plan provided the basis for these observations which are an important component of this status assessment. They provided specific information on recruitment, distribution, and abundance during a period of high stress. Further, inferences as to how these populations might respond to future survival downturns of this magnitude and duration were also used to assess the present viability of these populations. In fact, two of the five population criteria (abundance criterion and productivity) used to assess the viability were based solely upon performance data collected during this low survival period (1990-97).

V. Description of Population Spawner Abundance Data

Spawner abundance estimates for wild and naturally spawning hatchery fish were developed for all 21 independent populations of Oregon coastal coho. Annual estimates of fishery mortality impacts and values for a marine survival index were also made. However, unlike the abundance data these estimates were made at the ESU level, as it was not possible to provide this information at the individual population level.

Spawner abundance of wild coho salmon in Oregon coastal streams has been estimated annually since 1990 using stratified random surveys (Jacobs and Nickelson 1998). Surveys were originally designed to estimate abundance at the ESU-wide level. Therefore, when the results from these surveys were used to estimate spawner abundance at the level of individual populations, the confidence levels associated with these estimates become much wider than those for the entire ESU considered as a single unit. With advent of the Oregon Plan for Salmon and Watersheds in 1997, the sampling rate for survey sites was doubled from 240 to 480 sites surveyed to help remove some of the uncertainty associated with the population-level estimates. Further implementation of the Oregon Plan monitoring in 1998 resulted in the adoption of an integrated rotating panel sampling design developed by Stevens (1997) implemented as EPA's GIS-based Environmental Monitoring and Assessment Program (EMAP) site selection procedure (Jacobs et al. 2002).

Prior to 1998, the number of hatchery fish on the spawning grounds was estimated from the proportion of recovered carcasses found to have "hatchery" scale patterns. The scale analysis was not a perfect method for making hatchery/wild classifications for a variety of reasons, including the problem of obtaining an adequate number of reference samples from known wild fish. It is possible for wild fish, particularly those from a lake system,

to have scale patterns similar to hatchery fish. However, beginning with adults returning in 1998, almost all hatchery fish had been marked prior to their release with adipose fin clips. Therefore, the potential for misclassification error was reduced significantly. Regardless, there were some cases (e.g., Nehalem) where estimating the percentage of hatchery fish for the entire population was confounded by their non-random distribution within the basin (i.e., large number of hatchery fish were often found in a geographically confined portion of the watershed). In such cases, an attempt was made to sub-divide the basin into smaller units, determine the proportion of hatchery and wild fish for each of these smaller units and then recombine these estimates in manner that was proportional to the number of stream miles for each sub-unit represented. This recombined value was then used to represent the percentage of stray hatchery fish for the entire population. Population by population details of the methodology used to estimate the proportion of hatchery fish and thereby the numbers of naturally spawning hatchery fish are provided in Appendix 2.

Population abundance estimates were also made for the period from 1958 to 1989. These estimates were based largely upon spawner survey data collected for fixed stream index areas and applying a variety of methods to convert these data into total abundance estimates for each population. The methodology used to make these conversions and the resulting abundance estimates are also presented in Appendix 2.

VI. Modeling Population Recruitment

Background

The number of naturally produced coho returning to a given population is a quantity that fluctuates widely on both annual and decadal scales as the data presented in Appendix 1 confirm. Such variation makes the development of viability criteria challenging. This variation also makes the assessment of population and ESU status relative to such viability criteria a difficult endeavor. As discussed earlier, two factors that may be responsible for a portion of this variation are marine survival and parental spawner abundance. The objective of the work described in this report section was to construct a population recruitment model that incorporated these two factors (marine survival and parental abundance). It was hoped that such a model would be able to explain at least 50% of the observed variation in the abundance of naturally produced coho. Further, if this objective was met it was assumed that it would lend greater confidence in the accuracy of the viability assessment and the relevancy of the viability criteria themselves.

A density dependent recruitment model, based on the Ricker recruitment function (Ricker 1954), was used as the primary means to quantitatively describe recruitment in Oregon coastal coho populations. However, an alternative recruitment model was also developed that did not rely on an assumption of density dependent population regulation. The alternative approach basically assumed recruitment was independent of spawner density and that population growth rate was a constant at all spawner densities until the habitat capacity is achieved. This alternative model was developed primarily to evaluate

whether different ESU assessment results would be obtained if density dependent population regulation was not incorporated into the analyses.

Recruitment Model – Density Dependent Population Growth Rate

The Model - The Ricker population recruitment function was chosen as the basis from which a density dependent model was developed for Oregon coho. In the most basic form of this model the number of spawners is used to predict the number of offspring (recruits) in the next generation. For example, for coho if 1,500 fish spawned in 2002 then the recruitment model uses this information to predict how many recruits will be produced and return as adults in 2005. The mathematical formula used makes such predictions (and as illustrated in Figure 5) is described by:

$$R = S * \exp(\mathbf{a} + \mathbf{B}S) \quad (1)$$

Where R = the total number of adults (pre-harvest) produced from the spawners 3 years previously, S = number of spawners, **a** = parameter for intrinsic population growth rate, and **B** = parameter inversely proportional to habitat capacity.

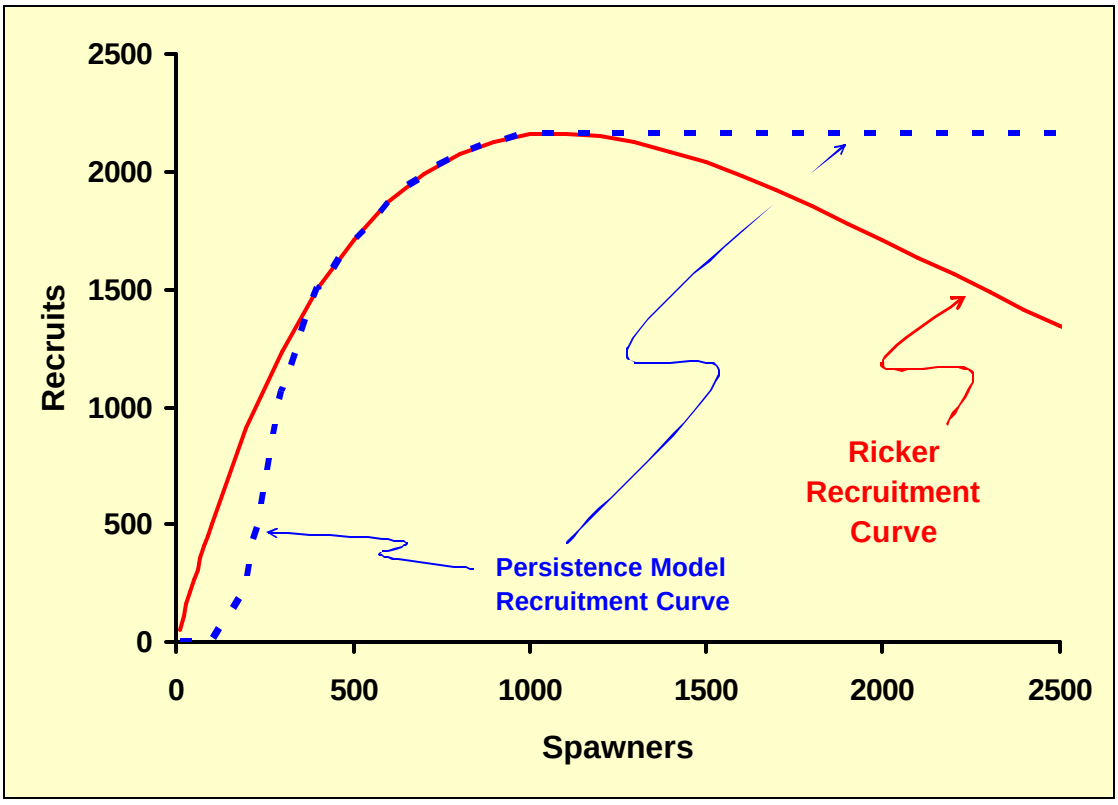

Figure 5. Generic example of Ricker recruitment curve and the modified version of this curve used to simulate recruitment in the persistence model (see text).

The Ricker model is one of several alterative recruitment models commonly used by fish conservationists. The Beverton-Holt (Beverton and Holt 1957) and hockey stick (Barrowman and Myers 2000) recruitment models also see frequent use. The decision in this case to use the Ricker model was based upon an ad hoc assessment that it fit the data as well as either of the two alternatives and that it seemed most consistent with the observed performance of Oregon coast coho when the density of spawners was low. As information presented earlier suggest, the R/S values obtained for Oregon coast coho populations show an inverse relationship with spawner abundance (i.e., as spawner abundance trends down, R/S trends upward). This pattern is inconsistent the fixed R/S assumption of the hockey stick model for spawner abundance less than full seeding. Therefore, one would expect that at low spawner density the hockey stick model would under predict recruitment performance (negative recruitment bias). In contrast, preliminary scoping with the Beverton-Holt recruitment model suggested that if may over predict recruitment at lower spawner abundance (positive recruitment bias). In addition, earlier work by Zhou (2000) suggested the Ricker was preferable to the Beverton-Holt for modeling recruitment in populations of Oregon coast coho.

Some have suggested that when population recruitment data containing substantial measurement error are fit to the Ricker model the resulting recruitment curve will be biased and overestimate R/S at low spawner density (Caputi 1988; Quinn and Deriso 1999). However, Kehler et al. (2002) found that, in general, low density R/S was not over-estimated in the fitting of 'noisy' data to the Ricker recruitment model.

However, one potential weakness of using the Ricker model for coho salmon is that it predicts that a reduction in the number of recruits produced will occur when the parental spawner abundance is high (see Figure 5). Most populations of Oregon coho do not show a strong decrease in recruits when the spawner escapement level is high. The right-hand, descending limb of the Ricker model does not seem to match these observations. However, for evaluating populations with respect to the question of vulnerability to extinction, the recruitment performance of populations at high spawner abundance is of less concern. The function of population recruitment at high spawner abundance is a more critical question to fishery management than to assessing the risk of extinction. For conservation purposes, it is more important that the recruitment predictions are as accurate as possible when the spawner levels are low. In this respect, the Ricker function was judged to have this advantage.

One shortcoming on the use of any model that forecasts recruits solely on the basis of parental abundance is that it ignores one of the key factors that influence coho abundance, ocean survival conditions. As discussed earlier, variation in marine survival has a strong influence on the number of coho returning to spawn in any particular year. As a consequence, the relationship between spawners and recruits will be heavily modified by variations in marine survival. To account for this important factor a marine survival variable was added to the recruitment model, modifying Equation 1 to the resulting form:

$$R = S * \exp(\mathbf{a} + \mathbf{B}S + \mathbf{c}O) \qquad (2)$$

where **c** = additional parameter for marine survival and O = a standardized index of annual smolt to adult survival rates for ocean conditions from 1960 to 2002 based upon

the Oregon Production Index (OPI). The value for each year's index was expressed in terms of its deviation from the 1960 to 2002 natural log transformed mean of smolt to adult survivals. This standardized index was calculated from the equation:

$$O_{yr} = Ln(OPI_{yr}) - Ln(OPI_{1960\text{-}2002mean}) \quad (3)$$

As noted earlier, the OPI is based on the smolt to adult survival of hatchery coho, primarily originating from the Columbia River. As such it is not a direct measurement of wild coho survival; rather it is an observable indicator likely to have a correlation with the annual variations in the marine survival of wild coho.

Parameter Estimation – The values for the parameters '**a**', '**B**', and '**c**' of Equation 2 must be estimated for each population in order to fit the recruitment model. The data used to make these fits (i.e., estimate the recruitment model parameters) were derived from spawner and recruit data presented in Appendix 2. The number of recruits corresponding to each brood year was calculated by dividing the spawner abundance observed three years later by one minus the fishery mortality rate. For example, the number of recruits produced by the fish that spawned in 1996 was calculated as the spawner abundance observed in 1999 divided by one minus the fishery mortality rate observed for 1999. Fishery related impact rates for wild coastal coho are presented in Appendix 1 and are based upon information provided by ODFW (Curt Melcher, ODFW, personal communication).

To estimate R/S for each brood year, both wild and naturally spawning hatchery fish were counted as spawners (combined for the denominator, S), whereas only wild fish were counted as recruits (the numerator, R). For each population a data table was constructed having a row for each brood year from 1958 to 2000 and three columns with data for Ln(Recruits/Spawner), the number parental Spawners, and the index of marine survival for the Recruits corresponding to each brood year. Recruitment model parameters were estimated via multiple regression using the following equation:

$$Ln(R/S) = \mathbf{a} + \mathbf{B}(\text{Spawners}) + \mathbf{c}(\text{marine survival index}) \quad (4)$$

Where **a** = multiple regression intercept, **B** and **c** = partial regression coefficients. However, rather than estimate these parameters from a single multiple regression analysis, Monte Carlo bootstrapping methodology was used. This methodology is considered to be a more reliable means of estimating model parameters (Efron and Tibshirani 1993). The bootstrapping approach is based on a successive series of random re-samplings of observed data that results in the generation of a large number of pseudo data sets. In the case of Oregon coho data, a computer program was written to randomly select brood years from the 43 years of data, drawing a specific value for Ln(R/S), spawner abundance, and marine survival index with each brood year sampled. The sampling protocol was done with replacement and continued until 43 brood years of data were obtained. Because the sampling was done with replacement, it was nearly certain that data for a single brood year could be drawn more than once. Likewise, it was nearly certain that at least some of the brood years in the original data set would not be drawn at all. Once 43 selections were made, these data were stored in an array for future computations. The computer program then repeated the selection process until 2,000

pseudo data sets (each having 43 brood years of data) were generated. Following this step, a multiple regression, based upon Equation 4 was performed on each of the 2,000 pseudo data sets and results recorded. The mean values from these multiple regression analyses for **a**, **B**, and **c** were used as the estimate recruitment equation parameters for each population.

Population Parameters – Using the bootstrap method as described, recruitment equation parameters were estimated for all populations. The average R^2 value for the multiple regressions across all of the populations was 0.54 and indicative that for most populations the combination of the two variables spawner abundance and marine survival may account for a substantial amount of the observed variation in population recruitment (Table 3). However, for the Salmon, Floras, and Sixes populations the parameter estimates were obtained from multiple regression analyses that involved 11 or fewer points (n = 11). As cautioned by Burgman et al. (1991), estimation of recruitment parameters from data sets where n < 15 is likely to give inaccurate results. Therefore, for these three populations the density dependent (DD) recruitment equations may describe a population recruitment behavior that is substantially different from the true manner in which these populations function. Only with additional years of data will the accuracy of the present parameter estimates for these populations be known.

Table 3. Estimated density dependent (DD) recruitment model parameters and associated information for 21 populations of Oregon coast coho.

Population	**a**	**B**	**c**	SD	R^2	n
Necanicum	1.694	-0.000925	0.876	0.634	0.61	43
Nehalem	1.871	-0.000110	1.271	0.634	0.76	43
Tillamook	1.219	-0.000117	0.963	0.884	0.39	43
Nestucca	1.723	-0.000223	0.882	0.883	0.36	43
Salmon[a]	-0.126	-0.002565	0.310	0.936	0.68	11
Siletz	1.550	-0.000535	0.782	0.724	0.53	43
Yaquina	1.821	-0.000185	0.852	1.156	0.36	43
Beaver	1.694	-0.000831	0.573	0.701	0.54	35
Alsea	1.526	-0.000304	0.772	0.741	0.54	43
Suislaw	2.325	-0.000153	0.882	0.827	0.55	41
LoUmpqua	1.956	-0.000163	0.578	0.617	0.56	43
MidUmpqua	2.115	-0.000433	0.318	0.749	0.52	43
NUmpqua	0.861	-0.000257	0.721	0.896	0.54	43
SUmpqua	1.933	-0.000479	0.260	0.796	0.48	43
Siltcoos	2.123	-0.000383	0.388	0.664	0.53	41
Tahkenitch	1.991	-0.000558	0.473	0.761	0.51	41
Tenmile	1.447	-0.000064	0.465	0.656	0.27	43
Coos	2.432	-0.000181	0.368	0.710	0.59	43
Coquille	1.564	-0.000078	0.603	0.681	0.45	43
Floras[a]	2.087	-0.001649	0.675	0.455	0.89	7
Sixes[a]	1.724	-0.007369	-0.183	0.702	0.71	11

[a]Parameter estimates and associated statistics may be unreliable because of the small number of data records available from which to make these estimates.

Alternate Recruitment Model – Density Independent Growth Rate

The Model – As has been discussed earlier, observations for Oregon coho suggest that population growth rate is dependent on spawner density; with the ratio of R/S increasing steadily as the number of spawners in the population lessens. However, the statistical ability to unequivocally confirm this observation was questioned by several reviewers of an earlier version of this report. In addition, it was not clear how sensitive the status assessment of coho populations might be to the assumption of density dependent growth rates. Therefore, a second approach to modeling population recruitment was developed based on the idea that population growth rate (i.e., R/S) was constant until some habitat capacity ceiling is reached. The mathematical representation of this model is basically the same as the density dependent (DD) model with the density dependent term, **B**S, removed. Therefore, the density independent (DI) recruitment model is described by:

$$R = S * \exp(\mathbf{a}_{di} + \mathbf{c}_{di}O) \quad (5)$$

where all of the terms are essentially the same as those described for Equation 2. However, an important contingency was placed on this relationship in terms of recruits. If the recruits predicted from Equation 5 exceeded a recruit production ceiling for the population, then the number of recruits would default to this production ceiling. In other words: If $R > R_{ceiling}$, Then $R = R_{ceiling}$.

Parameter Estimation – The recruitment model parameters $\mathbf{a}_{di}$ and $\mathbf{c}_{di}$ where estimated from via linear regression, but in this case for only for one independent variable, marine survival. The regression analysis evaluated the relationship described by:

$$\text{Ln}(R/S) = \mathbf{a}_{di} + \mathbf{c}_{di}(\text{marine survival index}) \quad (6)$$

where $\mathbf{a}_{di}$ is the intercept and $\mathbf{c}_{di}$ is the slope from the regression analysis. Estimation of these parameters for each population was done using the same type of bootstrapping procedures described previously to estimate parameters for the DD recruitment model.

To estimate the recruitment production ceiling for each population ($R_{ceiling}$) the following procedure was taken. First, the recruit estimates for each population were ordered from largest to smallest observation. The upper half (the larger numbers) were then selected and an average of these values calculated. However, before this average was computed, a log transformation was made to each data point in order that this sub-set of data would not be as positively skewed as otherwise would be the case without the transformation.

Population parameters – For the DI recruitment model the regression of Ln(R/S) on the marine survival index yielded variable results among the populations (Table 4). In the case of four populations, the Salmon, Beaver, Yaquina, Floras, and Sixes, the regression was statistically not significant (P = 0.05). For these populations a_{di} was estimated by taking a simple average of all Ln(R/S) points, the value for c_{di} was set to 0.0 (i.e., no relationship assumed between marine survival and Ln(R/S)) and the standard deviation of the Ln(R/S) points used in place of the $SD_{regress}$ estimate. For the remaining populations, the regression analyses suggested that an average of 22% of the variation in Ln(R/S) may

be accounted for by the marine survival index (mean of R^2 values = 0.22). The $R_{ceiling}$ estimates ranged widely, with those determined for the Salmon, Floras, and Sixes populations likely inaccurate because so few data point were available from which to make the estimates (n = 6).

Table 4. Estimated density independent (DI) recruitment model parameters and associated information for 21 populations of Oregon coast coho.

Population	a_{di}	c_{di}	$SD_{regress}$	R^2	n	$R_{ceiling}$	$SD_{ceiling}$	n
Necanicum	0.695	0.540	0.893	0.22	43	3731	0.37	21
Nehalem	0.785	1.008	0.926	0.46	43	43922	0.38	21
Tillamook	0.734	0.673	0.948	0.28	43	20505	0.58	21
Nestucca	0.924	0.454	1.020	0.14	43	18241	0.37	21
Salmon[a]	***-0.512***	***0.0***	***2.029***	--	11	202	0.72	5
Siletz	0.636	0.547	0.924	0.22	43	5792	0.36	21
Yaquina[a]	***0.869***	***0.0***	***1.439***	--	43	25153	0.58	21
Beaver[a]	***0.690***	***0.0***	***1.026***	--	35	3760	0.53	19
Alsea	0.605	0.593	0.955	0.23	43	10339	0.35	21
Suislaw	1.098	0.652	1.059	0.24	41	42672	0.45	21
LoUmpqua	1.152	0.400	0.843	0.16	43	11601	0.43	21
MidUmpqua	1.062	0.368	0.889	0.15	43	7572	0.62	21
NUmpqua	0.347	0.922	1.039	0.37	43	29841	0.66	21
SUmpqua	1.080	0.452	1.011	0.15	43	24283	0.40	21
Siltcoos	1.051	0.325	0.905	0.11	41	9976	0.29	21
Tahkenitch	1.077	0.585	0.966	0.22	41	3111	0.30	21
Tenmile	1.036	0.260	0.725	0.10	43	6955	0.35	21
Coos	1.132	0.606	0.968	0.23	43	37260	0.42	21
Coquille	0.985	0.497	0.806	0.22	43	29444	0.40	21
Floras[a]	***0.177***	***0.0***	***1.352***	--	7	2522	0.78	4
Sixes[a]	***0.192***	***0.0***	***1.288***	--	11	301	0.55	5

[a] Regression of analyses yielded statistically insignificant results therefore the value for a_{di} was estimated as the simple average of the Ln(R/S) points, the c_{di} value was set to 0.00 (no relationship to a_{di}) and the standard deviation of the Ln(R/S) points was used for $SD_{regress}$.

VII. Population Criteria Description and Rationale

Criteria 1 – Spawner Abundance

Developing a meaningful abundance criterion for coastal coho was difficult because of the confounding effect of variations in marine survival. For example, an observation of 600 spawners during a period of unfavorable ocean conditions could represent a more 'healthy' state than an observation of 1,200 spawners for the same population during a period of highly favorable ocean conditions.

In addition to this complication, the simple identification of a critical abundance threshold, assuming marine survival could be standardized, was evasive. This was because population abundance does not appear to be a very good predictor of extinction risk for coho populations. For example, Nickelson and Lawson (1998), in reporting their

results from modeling the viability of Oregon coast coho populations, suggested that spawner abundance has a minor impact on extinction risk, unless the abundance is at exceptionally low levels.

The relative insensitivity of extinction risk to moderately low levels of spawner abundance is explained in part because coho salmon exhibit a strong density dependent recruitment behavior during the freshwater portion of the life history. In other words, the number of smolts produced per female increases dramatically at low spawner density and this compensates somewhat for fewer spawners

As an alternative to using viability modeling to determine critical abundance levels, some have suggested that by inspecting spawner – recruit data sets it may be possible to identify a threshold spawner abundance, below which the underlying recruitment performance of the population starts to fail because spawners can not find mates or other reasons that are not understood (Myers 2001). This breakdown of the recruitment function at extremely low spawner densities is commonly referred to as depensation. The spawner density corresponding to onset of this depensation behavior could be used as a reference from which to establish conservation criteria. The underlying concept being that if populations drop to levels below this assumed depensation threshold their recruitment performance may begin to fail. Should this occur they could continue downward until they are extinct. This scenario has been referred to by some as the "extinction vortex".

However, the statistical challenge of actually demonstrating the spawner density level at which depensation starts to occur is daunting (Shelton and Healey 1999). Barrowman (2000), examining recruitment data for coho populations primarily in British Columbia, suggested that depensation may become a factor for coho population when spawner densities are less than 1 female per kilometer of stream length. Assuming a 50/50 sex ratio and converting from kilometers to miles, this equates to a spawner density of 3.2 fish per mile. Chilcote (1999) observed that for several populations of coho in the Lower Columbia River that likely went extinct in the 1990s, once spawner densities dropped below 3.9 fish per mile, the ability to rebound and recover was unlikely. This may have been the effect of depensation in conjunction with other factors, such as the out-planting of hatchery fish in an ineffective attempt to restore these depressed wild populations and high fishery impact rates.

For coastal populations of coho in Oregon, densities in this range have rarely been observed, with the exception of the very low marine survival period of the 1990s. To determine if there was any evidence of depensation during this period of lowest spawner abundance, a pooled analysis of data from all populations in the ESU was undertaken. However, even at the lowest range of the observed spawner densities, there was no clear evidence that the ratio of recruits per spawner began declining at some critical spawner density (Figure 6). In fact, the data were more supportive of continued density dependent recruitment even at densities as low as one fish per mile.

Without a clear empirical pathway to identify the depensation threshold for coastal coho, an alternate approach was taken. The logic for this was as follows. Spawner densities

less than approximately one fish per mile have almost never been observed for coho population on the coast of Oregon. However, as a precautionary measure, it was assumed

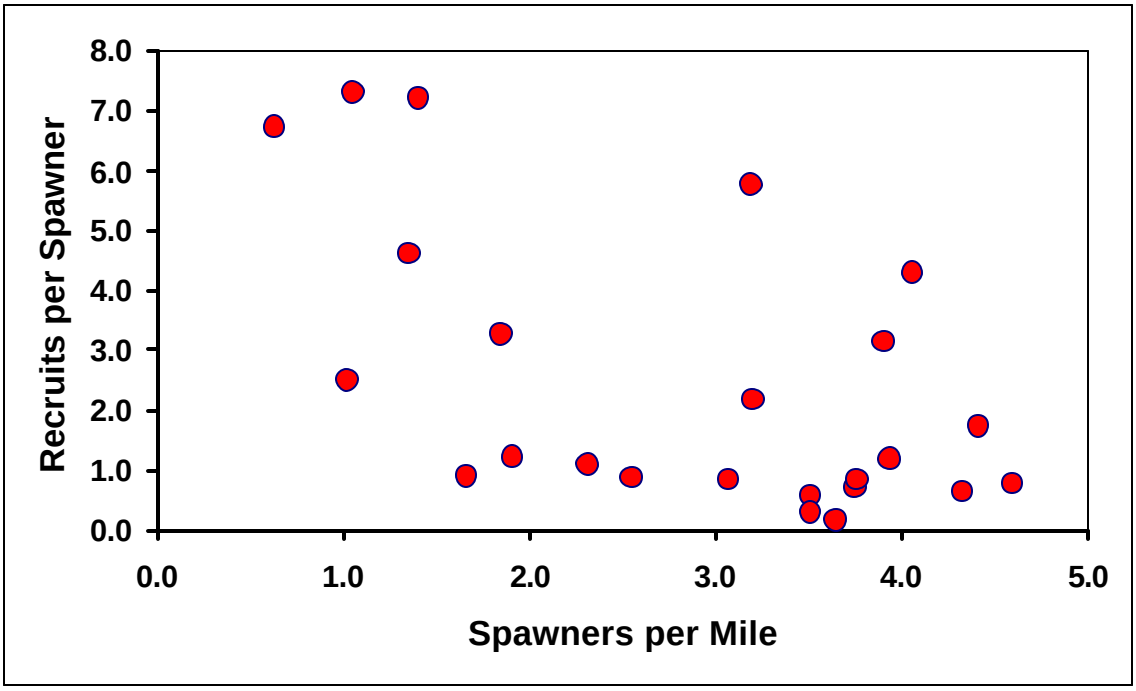

Figure 6. Plot of recruits produced per spawner for those observations when spawner densities were less than five fish per mile in Oregon coastal coho populations spawning in the period from 1990 to 1996.

depensation will exert a strong influence at these levels, possibly resulting in complete recruitment failure. As another precautionary measure, it was assumed populations may decline up to 50% per generation at low densities (< 5 fish/mile) although this rate of decline at low densities was rarely observed. Thus a population starting at five spawners per mile would have three generations to reverse this decline before dropping below the one fish per mile threshold (i.e., 5.0, 2.5, and 1.25 fish per mile). Using this logic, a critical abundance threshold for each population equivalent to a spawner density of five fish per mile was selected as the critical abundance threshold for viability.

The metric for the abundance criterion focused on the performance of coastal coho populations during the period of lowest abundance, the 1990s. The average observed abundance of wild spawners for the years 1993 to 1999 was calculated for each population and subtracted from the critical abundance threshold to obtain the test metric. A positive value for this test metric meant the population 'passed' (i.e., the observed abundance was greater than the critical threshold) and a negative meant the population 'failed'.

Criteria 2 – Productivity

As discussed previously, Oregon coastal coho demonstrated the ability to survive a period of adverse marine survival conditions and rebound dramatically when these

survival conditions improved. The productivity criterion was designed as a test to confirm that individual populations were performing in accordance with this expectation. For a coho population to resist further decline in numbers once low levels of abundance have occurred, the number of progeny (recruits) must be equal to, or greater than, the number of parents (spawners) that produced them. In other words, when abundance is low, the ratio of recruits to spawners must average greater than or equal to one (i.e., replacement).

The basic data used to test this criterion were the observed ratios of recruits per spawner (R/S) during the period when marine survival conditions were at their worst in the 1990s.. As with the problems faced in developing the abundance criterion, marine survival conditions can have a strong influence on the values measured for population productivity (R/S). However, by restricting the evaluation to recruitment performance of coho that spawned from 1990 to 1996, this variable could be somewhat controlled because the index of marine survival during this period, in addition to being very low, was also relatively stable and therefore reduced confounding variation (Figure 2).

However, in addition to marine survival, a second factor must be considered – spawner density. As discussed earlier R/S varies widely and in a manner that generally appears related to spawner abundance. Therefore, to predict how a coho population might behave as critically low levels of abundance are approached, it was imperative that this factor be considered. Population recruitment during periods of high spawner density is unlikely to be informative and, if relied upon for viability assessment, may yield predictions that overstate extinction risk.

In addition to the problem of standardizing the R/S values for spawner density, there were complications associated with the presence of naturally spawning hatchery fish in several populations and the variable mortality rates imposed on wild coho as a result of sport and commercial fisheries.

The potential impact of hatchery-produced fish was greatest in those areas where they were most numerous because of an associated hatchery program. In recent years the populations with the greatest potential for impact have been the Nehalem, Salmon, and Umpqua. It is unknown how effective these hatchery fish are relative to wild fish in producing surviving progeny under natural conditions. However, a number of studies suggest that hatchery produced fish spawning in the wild are less likely to produce as many surviving offspring as wild spawners (Leider et al. 1990; Reisenbichler and Rubin 1999; Kostow et al. 2003; and McLean et al. 2003). Further, Nickelson (2003) provided evidence that even if naturally spawning hatchery fish produced no surviving offspring, the mere presence of hatchery smolts within the basin may attract predators and reduce the productivity of the wild population.

However, regardless of their reproductive success to the adult stage, Leider et al. 2003, and Kostow et al. 2003 found that if the relative proportion of hatchery fish in the natural spawning population was high enough, their offspring would be the major component of the subsequent cohort of naturally produced smolts. Essentially, the reproductive inefficiency of the hatchery fish was countered if their proportion on the spawning grounds relative to wild fish was high. This situation makes the assessment of

populations difficult because it is not clear if hatchery spawners are "propping up" the abundance of natural population. In addition, the fact that both the aforementioned authors found that naturally-produced smolts from hatchery parents survived poorer to the adult stage than offspring from wild parents suggests that conversion of natural spawners to returning adults is less efficient in basins where a large proportion of the spawners are hatchery fish.

Because of the uncertainty surrounding these issues all fish that spawned naturally were counted equally as spawners and used in the denominator for the R/S calculation. The R/S numerator, recruits, was based upon counts of naturally produced fish only. Therefore, if hatchery fish, either through genetic or ecological interactions, were responsible for an adverse impact on the overall natural population, this effect should be evident in the estimated R/S ratio. This approach lets the performance of the fish provide the index of hatchery fish impacts, not a particular assumption concerning the relative reproductive success of naturally spawning hatchery fish and their ecological interactions.

The complication posed by the presence of impacts from a sport and commercial fishery on the measurement of R/S is twofold.. First, fishery impact rates on wild coho vary by year. Although in recent years this overall impact has been relatively low (less than 15% mortality), in the past it has been much higher (Figure 7 and Appendix 1). The full biological potential of a population in terms of recruitment from any year's spawner escapement is the estimate of returning adults prior to fishery impacts. Because the estimation of adults for each population is done on the spawning grounds, it was necessary to estimate pre-fishery abundance by dividing each year's spawners estimate by the corresponding year's fishery survival rate (fishery survival rate = 1 minus the estimated fishery mortality rate). This calculation was used to produce the value for recruits for each brood year estimate of R/S.

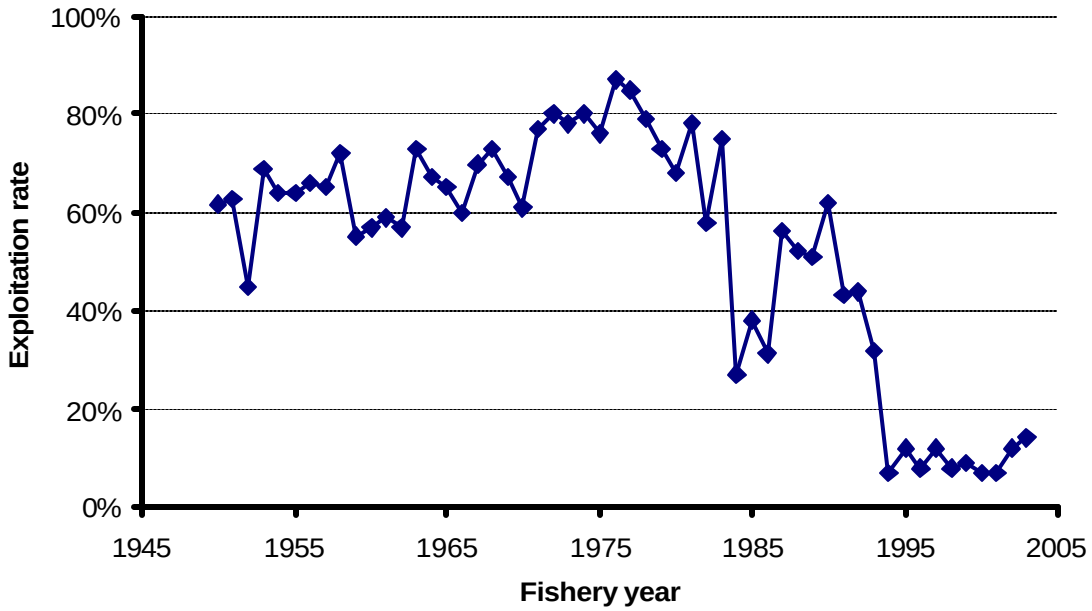

Figure 7. Estimated exploitation rates on naturally-produced Oregon coastal coho salmon in ocean fisheries, 1950-2003.

The second fishery issue was related to the current harvest management framework used by the Pacific Fisheries Management Council (PFMC). Even under the most aggressive fishery harvest restrictions, reducing the impact on wild coho to less than about 8% is very difficult because of incidental catches of coho in other fisheries (primarily Chinook) (Sharr et al. 2000). Therefore, if recruits are defined as "pre-harvest" abundance, a R/S measurement of 1.0, even when ocean fisheries are severely constrained would not mean the population is functioning at replacement, because a portion of the return would still be removed by the fishery. An estimated R/S value of 1.0 would translate into effective R/S on the spawning grounds of 0.92. To accommodate the reality of this situation and yet maintain a consistent definition of recruits as the "pre-harvest" abundance of wild fish, the replacement benchmark for the productivity metric was raised to 1.1 R/S. A value for R/S of 1.1 would ensure that up to 10% of the return could die as the result of sport and commercial fisheries and yet the population, in terms of the recruits that actually reached the spawning grounds would be replacing itself (i.e., R/S = 1.0).

As discussed earlier, to obtain a valid estimate of productivity during a period of poor marine survival conditions, it was necessary to develop a method that was standardized for the confounding effects of spawner density on productivity. The approach taken was to arrange the R/S data for the 1990 to 1996 brood years by parental spawner densities and then select those R/S data points that were associated with spawner densities less than a specific sorting threshold. The R/S values obtained from spawner densities less than this sorting threshold would then be averaged (geometric mean) to obtain a test metric for the productivity criterion. Averages greater than or equal to 1.1 R/S would 'pass' the criterion, R/S less than 1.1 would 'fail'.

To implement this approach it was necessary to identify an ESU-wide low spawner density sorting threshold as a tool to select R/S points for the analysis. The problem was that a threshold set too high runs the risk of picking spawner densities that do not reflect how a population will truly respond when the critically low spawner levels are observed. In contrast setting the sorting threshold too low may result in screening off all of the available data because there are no observed spawner densities less than the threshold. Such an outcome will make computation of the test metric impossible because there are no data to work with. After considering several alternatives, a sorting threshold of 10 spawners per mile was selected. The logic used to settle on this value was twofold. There were at least two populations in each stratum that had spawner abundance levels during the reference time period (1990 to 1996) that were less than 10 fish per mile and therefore could be used for evaluation. Secondly, the number of spawners needed to fully seed available habitat, was estimated using both the DD and DI recruitment models, averaged approximately 45 fish per mile. Therefore, 10 fish per mile represents a density that even during periods of very poor marine survival should result in R/S values greater than one if the population is healthy and the underlying recruitment character is density dependent. Even if the recruitment is governed by a density independent process, sorting the data for only those points less than 10 spawners per mile will still yield useful information about productivity, since the operating assumption is that the R/S values should be the same regardless of the spawner densities associated with the selected data points.

Although selecting the "low density" cutoff at 10 fish/mile will bias low density R/S calculations downward because of observed DD recruitment at these levels, this precautionary cutoff level was selected to ensure as many populations as possible had "low density" data to analyze for R/S calculations. Populations that did not drop below 10 fish/mile for at least three years during the worst of the poor marine survival conditions were judged to have adequate abundance and productivity to persist should these conditions return.

Criterion 3 – Long-term Persistence

A wide variety of viability models have been used by conservation biologists to estimate the vulnerability of populations to extinction (Shaffer 1981, 1990; Murphy et al. 1990; Nickelson and Lawson 1998). The viability analyses used in this assessment to estimate population persistence were based upon methods described by Burgman et al. (1993) and Morris and Doak (2002). In general, the approach combines a deterministic recruitment model and a Monte Carlo simulation of random fluctuations in environmental conditions to forecast future population abundance. The primary recruitment model used for this analyses was the one described earlier that is based upon the assumption that recruitment rates are influenced by the density of parental spawners. This was the density dependent (DD) model described in Section VI of this report. However, to examine how critical the assumption of density dependence was to these persistence simulations, the analyses were also performed using a density independent (DI) recruitment model, which is also is described in Section VI.

In general, one of the primary characteristics of population viability analyses (PVA) is that population abundance forecasts over a period of future time are generated more than once. The reason for this is the inclusion of random variation in the recruitment process which ensures that each forecast will differ slightly from another. It is not unusual in this type of analysis to perform 5,000 forecasts for each population. To summarize such results, the proportion of all of the forecasts that yield a prediction of extinction is calculated. This extinction proportion is then used as an estimate of the probability of extinction for the population. Populations with a low probability of extinction risk are viable.

Persistence Simulations with Density Dependent Reccruitment Model - , The PVA model used to estimate population persistence for Oregon coastal coho was a series of calculations implemented via a Excel Visual Basic program. For the DD recruitment model the mathematical protocol used to forecast recruits over a multi-generation time horizon was basically Equation 2 modified such that the value for the '**a**' parameter was randomly selected from a normal distribution having a mean equal to the parameter value. This change was represented by replacing '**a**' in Equation 3 with '$\mathbf{a}_{rand}$' as follows:

$$R = S * \exp (\mathbf{a_{rand}} + \mathbf{B}S + \mathbf{c}O_{yr}) \qquad (7)$$

Therefore, 'a_{rand}' signifies that the parameter is a randomly picked number from a normal distribution having a mean equal to the estimated value for the Ricker '**a**' parameter and a standard deviation equal to the standard deviation of the multiple regression estimated from the fitting of observed population data as reported in Table 3. For example, in the case of the Necanicum population, estimated value for the '**a**' parameter and the standard deviation for the multiple regression fit were 1.694 (**a**) and 0.634 (SD), respectively. In simulating recruitment, each time another forecast for recruits was made the computer would execute a routine to pick a new value for $\mathbf{a}_{rand}$ by randomly selecting a value from a normal distribution having a mean of 1.694 and standard deviation of 0.634.

The minor notation change from 'O' to 'O_{yr}' for marine survival in Equation 7, signifies that for each year of the model run a different value for marine survival was assumed. Since most of the model runs were made for a time period of 100 years (about 33 generations), it was necessary to select a sample of marine survival rates in order to model recruitment. This could have been done in manner similar to the process used to randomly pick values for the Ricker '**a**' parameter (i.e., randomly draw a number from a normal). However, this approach has problems in that marine survival does not occur in a random pattern (Figure 2). For example, if poor marine survival is observed in one year, the likelihood is that a poor marine survival will also occur in the next year. For a coho population the challenge of surviving poor marine survival conditions is not one of dealing with the occasional rare event, but rather facing these rare events in a block of years together. The latter situation results in a greater challenge to the survival of the population and it was this likely situation that the viability model was modified to simulate.

It is possible to correct for this problem of temporal autocorrelation with respect to annual environmental conditions with modifications to the structure of a viability model, using a variety of approaches including those proposed by Morris and Doak (2002). The approach used for coastal coho, however, was basically to make this modification using the observed marine survival rates, in the order that they occurred between 1960 and 2002, as a template for the future 100-year period modeled. Because the observation period covers only 43 years, it had to be replicated to provide enough points for the 100-year simulation of the model. Mechanically how the model prepared the sequence of marine survival rates for the recruitment calculations was to first artificially string together 4 replications of the marine survival rates observed from 1960 to 2002. Essentially replicating the pattern of Figure 2 four times to create a cyclic string of 172 values having 4 high and 4 low periods of marine survival. For each 100-year model test period a different starting place was randomly selected (from a uniform distribution) within the first 43 years of the 172-year string. The first 100 years after this starting point were then used as the marine survivals for the model run.

Another key element of the persistence simulation model was the assumption made about population recruitment when the number of spawners was extremely low, (i.e. depensation effects). As noted earlier in the abundance criterion discussion, Barrowman (2000) suggested that for natural coho populations, depensation may be a factor when spawner densities are less than the equivalent of 3.2 spawners per mile. For the purposes of the persistence model it was assumed that an abundance level equal to 3.2 spawners per mile was the depensation threshold, below which population recruitment would be

adversely impacted. The persistence simulation model was constructed to incorporate these depensation thresholds, with explicit protocol for how recruitment would function once the number of spawners had fallen below these thresholds. This protocol worked in the following manner. When the persistence simulation model yielded a spawner abundance less than the depensation threshold, the number of recruits forecast was adjusted downward as described by:

$$\text{If } S = 0.10S_{Depn} \text{ Then } R_{adj} = 0.0 \quad (8)$$

$$\text{If } S > 0.10S_{Depn} \text{ then } R_{adj} = R * S_{obs}/[S_{Depn} - (0.10S_{Depn})] \quad (10)$$

Where S_{Depn} is the depensation threshold for the population, R_{adj} = is the depensation adjusted number of recruits, R = the number of recruits forecast by the recruitment model without depensation adjustment, and S_{obs} = the observed number of spawners. This protocol essentially treats any spawner escapement less than 1/10 of the depensation value the same as if no recruitment had taken place. Between this zero recruitment level and the depensation threshold, the number of recruits is scaled up proportionally such that when the spawner level reaches the depensation threshold (and above), no depensation discounting is applied to the forecast number of recruits (i.e., $R_{adj} = R$).

As noted earlier, one possible shortcoming of using the Ricker function for the DD recruitment model is that it yields decreasing number of recruits as the number of spawners increase beyond the level needed to achieve maximum seeding. While this feature may be relatively unimportant for assessments that are focused on the performance of the population when the abundance is at low or moderate levels, such as this one, this characteristic can cause problems for PVA models. Within the model runs, if a very large spawner number is generated, mathematically, the Ricker function will forecast a very low number of recruits because of the descending shape of the recruitment curve at high spawner abundance (Figure 5). Particularly when the value for '**a**' parameter is greater than 2.0, this can set up extraneous oscillations in abundance that are an artifact of recruitment function and unlikely to be mimicked by a real populations (Sabo et al. 2004). Although, the '**a**' parameter values for most of the populations were less than 2.0 (Table 3) and theoretically less susceptible to this "pathological" oscillation problem, modifications to the recruitment function within the persistence simulation model were made to prevent this behavior from occurring. This consisted of a step inserted into the program code to check spawner abundance before each use of the recruitment equation. If this check revealed a spawner abundance value greater than the number of spawners to fully seed the habitat as estimated from: -1/**B** (i.e., Smax), then the spawner abundance was reset to a value equal Smax. The effective result of this change was to level out the recruitment curve at spawner densities greater than Smax. This modification in addition to the modification for a presumed depensation effect at extremely low spawner densities resulted in the population recruitment function used for PVA modeling to effectively assume more of a hockey stick appearance as illustrated in Figure 5.

Persistence Simulations with Density Independent Reccruitment Model – As noted earlier, the persistence simulations were also done using a density independent function

to forecast recruits. In most respects these supplemental persistence modeling exercises were executed in the same manner as those described for DD recruitment function. However, the primary difference was that the assumed recruitment curve was based on the DI model described by: $R = S * \exp(\mathbf{a}_{di} + \mathbf{c}_{di}O)$ (Equation 5). However, this equation was modified to simulate environmental variation as signified by the term '$\mathbf{a}rand_{di}$' in the equation:

$$R = S * \exp(\mathbf{a}rand_{di} + \mathbf{c}_{di}O_{yr}) \quad (10)$$

Therefore, each time recruits are calculated, a value for '$\mathbf{a}rand_{di}$' is selected by randomly picking a number from normal distribution having a mean equal to the value for '$\mathbf{a}_{di}$', and a standard deviation equal to the standard deviation of the regression ($SD_{regression}$) estimated from the fitting of observed population data as reported in Table 4. As described earlier, the DI recruitment function has a contingency step that limits the number of recruits to a maximum value, as represented in Table 4 as $R_{ceiling}$. In the persistence modeling this same limit was imposed, but it was not fixed as a constant. For each calculation of recruits, a value for $R_{ceiling}$ was randomly drawn from a normal distribution having a mean equal to $R_{ceiling}$ and a standard deviation equal to $SD_{ceiling}$.

The Mechanics of the Model Runs – To estimate the probability of extinction, 3,000 iterations of a 100-year recruitment simulation were completed for each population. . Upon completion, the sequence of spawner escapements generated for each 100-year trial were inspected to determine if at any point in this sequence there was a 3-year consecutive string of spawner abundance that averaged less than the test threshold. The test threshold was the population specific abundance that was equal to either 50 spawners or the equivalent of one fish per mile, which ever value was larger. This test threshold was intended to represent effective extinction of the population. This threshold is also being used as an effective extinction threshold by the Oregon Coast TRT Workgroup in a variety of different PVA models to estimate population persistence (P. Lawson, personal communication). However, it should be noted the TRT Workgroup is also running PVA models with the effective extinction threshold set at 50 and 0 spawners for each population. Therefore, the extinction threshold used here (1 fish/mile) is the most precautionary of these three extinction threshold alternatives.

After inspection, those trials with spawner abundance output that contained a 3-year average spawner abundance less than the test threshold were classified as extinction events. . After the results from all of the trials were inspected, the probability of extinction was calculated the number trials that were classified as extinction events divided by the total number of trials (i.e., 3,000).

Criterion 4 – Within Population Distribution

Within the freshwater portion of a population's home range the manner in which juveniles and adults (spawners) are distributed is an important consideration in assessing the conservation status of a population (McElhany et al. 2000, Bisson et al. 1997). For example, a chance catastrophic event in a tributary watershed of a larger basin would have less impact on a population whose members are uniformly distributed throughout the basin compared to population that had the misfortune of being concentrated in the

tributary where the catastrophic event took place. Populations that are well distributed across potential spawner habitats can also be expected to demonstrate a greater resilience to both spatial and temporal variability in habitat conditions (Williams and Reeves 2003). Both natural and anthropomorphic disturbances create a shifting mosaic of abiotic and biotic conditions across the range of salmon species that is reflected in patterns of distribution and life history attributes (Reeves et al. 1995). The approach used to developing criteria for diversity focuses on evaluating the spatial distribution of spawners within a population and their potential to maintain spatial structure during periods of poor ocean conditions.

In addition to the advantage of spreading risk, broad distribution of individuals throughout a basin is assumed to have benefits in terms of maintaining genetic adaptation and diversity. The genetic characteristics of a population are partially controlled by selective processes working to cause the adaptation to the local habitat conditions. Since the habitat conditions throughout a basin are not uniform it would be expected that a diversity of selection pressures and adaptation strategies potentially exist for coho throughout a basin. Therefore, a population that is widely distributed is most likely interacting with the greatest diversity of habitats and therefore may develop and maintain the greatest genetic diversity.

The utility of using distribution as diversity metric also has a practical advantage in that the genetic characteristics that are important to adaptation and survival are extremely difficult to directly assess. Essentially, genetic traits that are adaptive and important to survival are largely cryptic. Therefore, distribution becomes a proxy for these invisible traits under that assumption that if full interaction between the heterogeneous habitat of a basin and population members is ensured, then selection pressures will enable the process of genetic adaptation and evolution to proceed even though the process is not directly detectable or measurable.

Using information regarding the distribution of spawners and juveniles as a diversity metric also addresses the problem of developing quantitative metrics for life history diversity. By observing the varying use of habitats across a varying range of coho abundance, insight into the dynamic nature of coho life history strategies can be developed. Exhibiting the capacity for re-colonization of under-seeded habitats, through the mechanism of straying by adults and movement away from natal streams by juveniles, appears to be a highly adaptive life history characteristic. As a species faced with constantly changing environmental conditions in both ocean and freshwater habitats, straying for coho, as well as other salmon species, should be considered just as fundamental a life history attribute as homing (Quinn, 2005).

Another feature of the distribution that makes it a useful tool to assess the viability of coho populations is the synchronous response of this attribute to variations in marine survival and overall population abundance. As described by Nickelson and Lawson (1998), when marine survival conditions are poor, the distribution of spawners collapses to the better habitat within the basin. However, when marine survival rates are high, coho adults demonstrate the capacity to spread out and fill nearly 100% of the available habitat (Jacobs et al. 2002). Therefore, the dynamic contraction and expansion of coho distribution within a habitat is another good indicator of population function and status.

In developing a means to quantify coho distribution for use as a criterion, it was necessary to recognize that even healthy populations will experience periods when the distribution of spawners collapses and other times when this distribution expands. The challenge was to select a criterion that would identify when a collapse in distribution becomes greater than should be expected for a healthy population under poor marine survival conditions. Although the concepts important for describing diversity and distribution are well documented, neither specific nor general guidance for developing measurable criteria were found. The problem of identifying such criteria was described by Kareiva (1990) when he concluded that "simply saying that the spatial environment is important is to mouth a platitude". For coastal coho populations, distribution data obtained during the recent period of poor marine survival provided the opportunity to develop a metric that helps quantify the patterns of distribution and than can be established so as to be protective of overall population diversity.

It should be emphasized that this metric is built upon monitoring of statistically sampled, spatially balanced, survey reaches throughout the compete range of coho spawning habitat. Development of a measurable metric for the distribution criteria was possible because of the availability of comprehensive and spatially explicit spawner density information. These data represent approximately 250 survey reaches/ESU from 1989 to 1996 and approximately 475 survey reaches/ESU from 1997 to 2003. In recent years, about ten percent of the total spawning miles are sampled annually with multiple observations of coho spawners made for each surveyed sample reach each year. This sampling supports calculation of both peak counts of spawner abundance and estimates of total abundance for the season expressed as spawners/mile.

The sample reaches are selected from the complete distribution of spawning streams without regard to the quality of the habitat in a given reach. The sample design also features a rotating panel approach that includes an equal numbers of annual sites, three-year sites, six-year sites, nine-year sites, and new sites. This design strikes a balance between the power of trend detection and the ability to characterize the status of populations in a given year. Most important for the distribution metric, this design assures comprehensive representation spawning habitats within the sample universe. Figure 8 shows an example of the sampling locations and results for Coquille Population in 2003.

Although primarily designed to provide spawner abundance estimates at the ESU and Monitoring Strata levels, these data also support analysis of spawner abundance levels within each sub-watershed that comprises the habitat of each coho population. We developed viability criteria for coho distribution based on these observations combined with the following assumptions.

1. Coho populations are distributed across most of the available spawning habitat within the sub-watersheds that comprise the area occupied by the population.
2. Results from the ODFW spawner sampling protocols are good indicators of population distribution and are directly related to population diversity, spatial structure, and connectivity.

3. The diversity criteria, combined with analysis of the spatial pattern of distribution can be used to make inferences about coho life history diversity and inform discussions of genetic diversity.
4. The spatial pattern of areas with higher than average spawner densities within a population are appropriate for developing distribution criteria.

Our primary data set used to evaluate the distribution criterion was developed by Talabere and Jones (2002) in their analysis of the frequency of spawner occupancy within survey reaches throughout the coastal coho ESU from 1989 to 2000. The distribution criterion threshold was set at 50% occupancy of the spawning habitat. This was measured from observations of spawners in sample reaches during each year's surveys. The sample reaches were selected from a portion of the total watershed area likely used by coho for spawning. If less than 50% of the spawning habitat was occupied by spawning coho then the population would be classified as having a severe collapse in distribution. Such a population would be considered at risk for the distribution viability criterion.

However, the interpretation of a 50% threshold is highly dependent on how the term "occupied" is defined. Given the sampling protocol for stream surveys, how frequent and concentrated do observations of spawners need to be before a stream or watershed should be classified as occupied? Further, is this definition for occupied workable for both large and small basins?

The first part of a solution to this challenge was addressed by partitioning each population's habitat into areas defined by the USGS 5th field Hydrologic Unit Code (5th field HUC). The USGS HUC system provides a standardized, hierarchical classification of drainage networks. Most of the medium or larger coho populations exist in basins that are classified as single 4th field HUCs, such as the Nehalem or Alsea. These watersheds are in turn comprised of multiple 5th field and even smaller 6th field HUCs. For this analysis, which was 12-year retrospective look at spawner distribution, we used Talabere and Jones (2001) method to combine spawner data for each the 6th field HUC over a twelve year period. The number of 6th field HUCs within each population became the units by which the 50% determination was made. Only 6th field HUCs with spawning habitat were considered for this evaluation. For example, if a population existed in a basin containing 12 HUCs, then at least 6 of those had to be occupied in order to 'pass' the population distribution threshold. A 12-year time period was used because there were not sufficient data to reliably examine shorter periods of time. It should be noted, however, that in the future with the significantly expanded spawner survey efforts initiated in 1998, it will be possible to shorten the evaluation period to only 2 or 3 years. ODFW, working in conjunction with the OTRT is in the process of refining an approach to accomplish this for future coastal coho ESU monitoring, assessment, and recovery efforts.

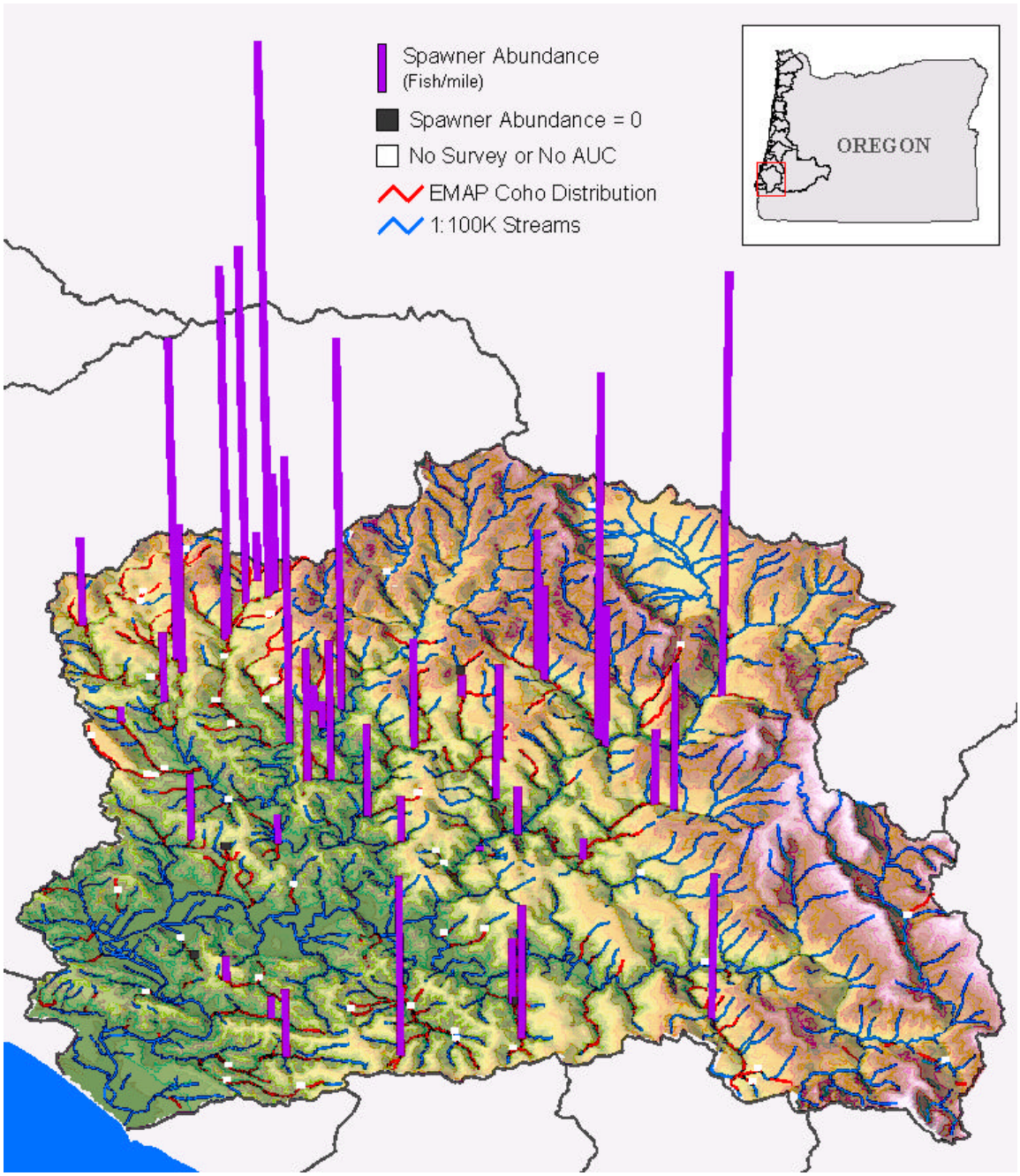

Figure 8: Spawner surveys for the Coquille Coho Population in 2003. The distribution of surveys is characteristic of the density of surveys in each of the coho populations, each year. Relative abundance is shown by the vertical bars that represent each site. The highest bars represent spawner densities of 200-250 spawners/mile.

Having defined the 6th field HUCs as the geographic unit to be measured, a definition of 'occupied' was needed to implement the use of the distribution criterion. In other words, the metric needed to address the question, "what qualifies as an occupied HUC?" It was decided that a feasible approach would be ODFW's existing EMAP survey sampling design as a means to systematically inspect a HUC for spawners. The EMAP sampling design is a protocol for selecting survey sites in a manner that is spatially balanced and drawn from within the known coho distribution. Based upon the data collected from

these selected surveys sites, a HUC was classified as occupied if for at least 50% of the sampling sites examined, the density of naturally produced coho was 4 fish/mile or greater. A minimum density of 4 fish/ mile was selected on the basis of the spawner frequency distributions developed by Talabere and Jones (2001), and by work conducted by Sharr et al. (2000) that suggested that at densities less than this level, the probability of each spawner finding a mate within a section of stream may decline.

Four fish per mile is a threshold for defining occupancy and is unrelated to population specific abundance criterion thresholds described earlier which essentially assumes that a low spawner density is spread out evenly across the entire likely habitat. The distribution criterion was designed under the opposite assumption that spawners are not distributed evenly and that spatial heterogeneity of spawning coho was informative with respect to the status of the population.

The occupancy threshold of 4 fish/mile had several nuances. First, only adult coho are counted towards the density threshold, jacks are excluded. Also excluded are naturally spawning hatchery fish. Excluding hatchery fish was done to keep the interpretation of fish distribution data consistent with the intent of the distribution criterion and the diversity criteria. Specifically, to ensure that distribution measurements were not confounded by breaking the closed loop between the natural habitat and the fish that had exclusively interacted with this natural habitat.

Although four adults/mile is not a high density, we believe that this number represents a threshold were spawning is likely to occur. The probability of "finding" a mate is reasonably high because of the behavior of the fish as they move through the reaches and a key into rare patches of holding and spawning habitat. The typical spawning stream reach is 1.6 km long, 6m wide with about 150m2 of spawning gravel and has about 8 deep pools with cover for holding habitat (ODFW Aquatic Inventory and Spawner Survey Project unpublished data). Within this small fraction of total stream area, there is a good probably of a male-female paring (87.5%) although this may be reduced in populations with unequal sex ratios.

Within reaches defined as occupied (at least four spawners per mile), the average number of spawners per mile is typically much greater than this minimum threshold. The frequency distribution of spawners per mile for all surveys during an interval of low abundance (1998-1999) is skewed toward a large number of unoccupied and low spawner density reaches with a scattering of reaches with higher spawners/mile (Figure 9). Nevertheless, the average abundance within reaches defined as occupied by this criteria was 24 spawners/mile. During intervals of higher abundance (2001-2003), average abundance in occupied reaches was 75 spawners/mile and the frequency distribution was much less skewed toward lower spawner densities. Only 50% of all reaches were occupied (> 4 fish/mile) during the 1998-1999 period. However, within four years the percentage of reaches occupied (2001 to 2003 observations) increased to 78%.

The selection of 50% as the threshold of for determining occupancy of HUC's for each population is somewhat arbitrary, and should be considered preliminary, pending further analysis. We regard this as a conservative criterion, as it is unlikely that spawners will be observed in all of the many reaches surveyed in each watershed, even in years when total

population abundance is high. Also, during periods of poor ocean survival and consequent low abundance, we would expect and have observed occupancy at much lower levels. This is consistent with landscape scale analysis for this ESU that suggests that just 30% to 50% of the spawning and rearing habitat is productive, even under historic conditions and disturbance cycles (Reeves et al. 1995).

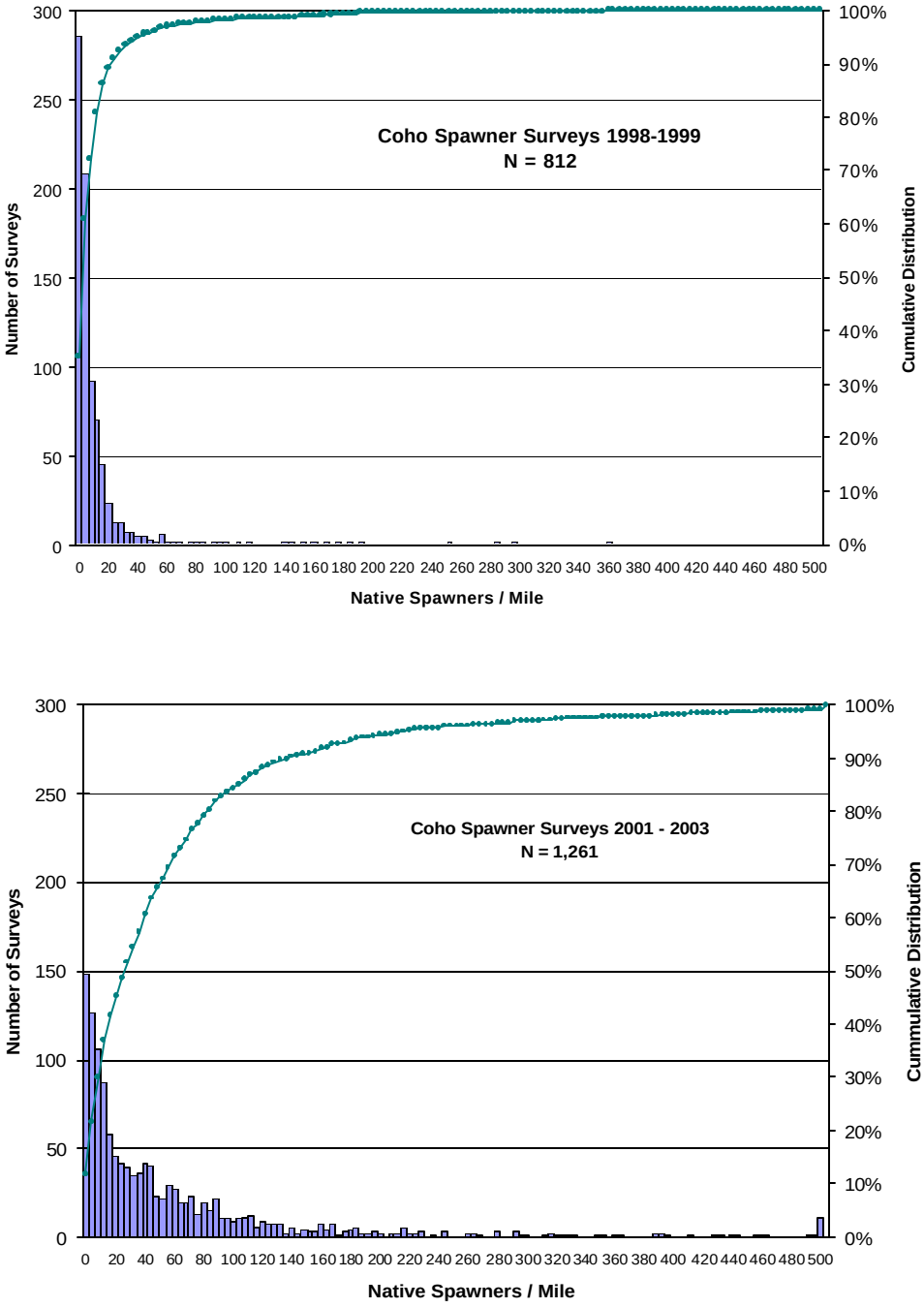

Figure 9: Distribution of coho spawners within survey reaches of the Oregon Coast ESU during 1998-1999 (poor ocean conditions) and 2001-2003 (good ocean conditions).

To augment the adult distribution information, ODFW and the OTRT are cooperatively working on the development of a within basin distribution metric and associated criterion for juvenile coho. A preliminary examination of the data generated as a result of the expanded monitoring effort of juvenile coho distribution that has been ongoing since 2001, suggests that the development of a distribution criterion for juvenile coho is feasible. It is hoped that in the near future a criterion for juvenile coho distribution will be available to further refine the assessment and recovery planning of this species.

The juvenile salmon monitoring efforts that generates the raw data necessary for this forthcoming distribution metric, follows the same sampling structure as adult spawner monitoring, but the range of habitat sampled is expanded to include rearing-only areas for coho, steelhead, and native trout. Late summer snorkel counts in rearing pools provide reliable documentation of presence or absence as well as additional information on trends in abundance (http://oregonstate.edu/Dept/pacrim/WORPAN0203.pdf).

Finally, these indicators will continue to be developed and refined. ODFW monitoring staff meet monthly with (Oregon Plan EPA stat group) and have enlisted the aid of spatial statisticians at Oregon State University and Colorado State University to test the applicability of this assessment approach, but based more directly on the spatial structure of river networks. This work is coordinated with ODFW's most recent analysis of the spatial structure of habitats and habitat-based carrying capacity. Preliminary results show a high correlation between carrying capacity models based on habitat metrics and the patterns of fluctuating abundance in the spawner survey reaches. Combining this data, we will be able to assess which habitats, and by inference which life history patterns, will be most influenced by future changes in environmental conditions. This information will contribute to the capacity to detect changes in distribution and population abundance relative to specific habitat conditions, and support timely management responses to factors that may limit future viability.

Criterion 5 – Within Population Diversity

Within population diversity is the result of phenotypic differences among individuals. These differences provide the flexibility of the population as a whole to respond successfully to short-term environmental variations. They also are the basis by which populations are able to adapt and evolve as conditions within their home range go through changes that are more permanent. Therefore, maintaining sufficient within population diversity is an issue of both short-term and long-term survival. The development of this criterion was based upon the importance of diversity as a factor in evaluating the conservation status of a population.

Within population diversity is controlled by a variety of forces including: evolutionary legacy, immigration from other populations, mutation, selection, and random loss of genetic variation due to small population size. However, it is this last factor that is most commonly recognized as a concern for species that are vulnerable to extinction. The genetic consequences of small population size and numerous approaches to defining minimum population abundance thresholds have been investigated widely (Soule 1980; Lande 1995; Franklin and Frankham 1998; Rieman and Allendorf 2001). In nearly all

cases, this becomes an exercise of identifying a rate at which genetic variation can be lost without causing a risk to a population's short or long-term persistence. The diversity criterion was developed around this concept.

After considerable review of the genetics and conservation biology literature, it was concluded that maintaining at least 95% (or losing no more than 5%) of a population's heterozygosity over a 100-year period as recommended by Allendorf and Ryman (2002) would be used as a conservation threshold. In this formulation, heterozygosity is used as the metric to represent genetic diversity. However, having defined the threshold in genetic terms it was then necessary to have a method to actually measure or forecast this loss rate for coastal coho populations. For this purpose we used a long known relationship between a theoretical population size and the rate at which heterozygosity is lost. This relationship developed in the early in the 20th century and as described by Wright (1969), can be described by the following equation:

$$?H = (-1/2Ne)(100\%) \quad (11)$$

where ?H = the expected amount of genetic variation lost in one generation (expressed percent of heterozygosity lost), and Ne is the number of adults in a population, where each member has equal probability of contributing offspring to the next generation (expressed as the effective population size). Based upon this equation the value for Ne necessary to retain 95% of the genetic variation after a certain number of generations (t = generations) can be expressed as:

$$Ne = 1/[2(1 - 0.95^{(1/t)})] \quad (12)$$

To solve the calculation of Ne in Equation 12 for coho, a value for the number of generations (t) expected for a coho population over a period of 100 years (the reference time period) is required. Although coho salmon spawn primarily at age 3, some precocious males (jacks) from each brood spawn at age 2. The proportion of jacks appears to vary among coastal populations, with stream populations averaging about 6% and lake populations averaging about 22% (ODFW, Unpublished data). The result is that average age at maturity for stream populations is 2.94 years (34.01 generations in 100 years). And for lake populations, is 2.78 years (35.97 generations in 100 years). Therefore, substituting these values for t into Equation 12, a Ne of 332 and 351 is obtained for stream and lake populations, respectively. So in other words if these values for Ne are obtained, no more than 5% of the population's heterozygosity will be lost over a period of 100 years.

Developing a Metric for Ne - The calculation of minimum values of Ne for coastal coho are mathematically valid only if coho populations meet the conditions of an "ideal" population. An "ideal" population, whose abundance is represented by the symbol Ne, must meet certain conditions such as: no overlapping generations, equal sex ratio, constant population size, and equal probability of reproductive success for all members of the population. The problem is that nearly all populations (regardless of the species) fail to meet these "ideal" constraints. Therefore, to estimate the rate of genetic loss based upon the number of spawners, a significant number of 'corrections' need to be made.

Essentially, the goal of these corrections is to build a metric that represents Ne but which can be applied to the species and data in question.

Typically, when these corrections are made, the number of individuals necessary to achieve the genetic behavior of an "ideal" population is greater than the size of the "ideal" population. By convention, Ne is used to represent the number adults in an ideal population and N the number of adults actually counted in the population. In most real life situations, Ne/N is less than 1.0, (i.e., N is greater than Ne). For salmonids, Allendorf et al. (1997) suggest that Ne/N ratios in the range of 0.20 may be typical. Likewise, McElhaney et al. (2000) suggest that a Ne/N ratio of 0.30 is a reasonable expectation.

One factor that can cause Ne to be less than N is if the probability of producing offspring is unequal among individual spawners. In some extreme examples only a few members of the spawning population produce all of the surviving offspring. In effect, the genetic contribution to the next generation comes from a much smaller number of individuals than a simple count of spawning individuals would suggest. Obviously, the challenge of estimating how many offspring each spawner in a wild population produces is a daunting proposition. However, several estimates of offspring produced per individual spawner have been made for salmonids in recent years (Simon et al 1986, Geiger et al. 1997, and Seamons et al. 2003). Results from these studies can be compared in a standardized manner by calculating V_K /K, where V_K = variance in offspring produced per spawner and K = mean number of offspring produced per spawner. Among these studies the values for V_K/K are confined to a surprisingly narrow range from 2.63 to 2.96, with a mean of 2.77.

An 'ideal' population represented by Ne is assumed to have a pattern of offspring per parent across all parents that follow a poisson distribution characterized by a ratio of Vk/K ˜ 1. With salmonid populations, apparently having a ratio that is much greater than 1 (for example 2.77 in the studies discussed above), there is a need to adjust Ne calculations to account for this difference. As described by Hartl (2000), the ratio of V_K/K can be used to adjust the calculation of Ne for unequal probabilities of reproductive success using the following equation

$$Ne = 2N/[1 + (V_K/K)] \qquad (13)$$

When a value of 2.77 (mean of three studies cited above) is substituted for V_K/K in Equation 13, the relationship between N and Ne becomes: Ne = 0.53N. In other words, to account for unequal reproductive success probabilities, N should be reduced by 0.53 in the computation of the effective population size, Ne.

Another factor that needs to be considered in the estimation of Ne is the effect of year-to-year variation in recruitment for species with overlapping generations. For example, Waples (2002) suggests that such variability in Chinook salmon results in a 40% to 60% reduction in the value calculated for Ne. Although compared to Chinook, coho have less variation in age of maturity; Van Doornik et al. (2002) demonstrated that jacks (2-year olds) contribute enough to gene flow between different age-classes that genetically, coho should be treated as a species with overlapping generations. Therefore, even though the majority of the reproduction comes from 3-year old fish, coho should not be treated as a

species without overlapping generations, for example such as pink salmon. Based upon a synthesis of these two studies (Waples 2002 and VanDoornik et al. 2002), an additional reduction of 60% was applied to the calculation of Ne for coastal coho. Although a 60% reduction is the upper portion of the range suggested by Waples (2002), his analysis was based upon Chinook which have a greater overlap in generations than do coho. Therefore, it seemed appropriate to use the higher reduction value (60%). The net result of the overlapping generation adjustment and the one for unequal reproductive contribution among families (Equation 13) is the following:

$$Ne = (0.53N)(1-0.60) = 0.212N \quad (14)$$

It is interesting that this level of reduction (Ne = 0.212N) is within the range of values suggested for salmonids by Allendorf et al. (1997) (Ne = 0.20N) and by McElhaney et al. (2000) (Ne = 0.30).

Spawner abundance estimates for salmon are typically collected on an annual basis. However, for a species with overlapping generations (such as salmon) the value for N, such as in Equation 14, needs to incorporate the fact that each year's spawning population is comprised of individuals from different year classes. Waples (1990) demonstrated that for Pacific salmon this problem of overlapping generations can be accounted for in the calculation of Ne using the relationship described below.

$$Ne = g\,(Nb) \quad (15)$$

Where g = the average age at maturity for the species and Nb is the harmonic mean of annual counts of spawners for the entire data set. As previously discussed the average age at maturity was g = 2.78 years for lake populations (i.e., Siltcoos, Tahkenitch, and Tenmile) and g = 2.94 years for all other populations (stream populations). The harmonic mean of annual spawner counts (Nb in Equation 15) is calculated from:

$$Nb = 1 / (1/t)(\,?\,(1/Ni)) \quad (16)$$

Where t = number of years counted and Ni = number of spawners counted for each year. It should also be noted that using a harmonic mean to characterize spawner abundance essentially gives greater weight to the smaller numbers in the data set. This approach is generally accepted as a way to incorporate the errors that will occur in estimating Ne if population abundance fluctuates widely, as is frequently the case for coho salmon. Finally, bringing together the previous adjustments described by Equation 14 for estimating Ne with those of Equation 15 to account for overlapping generations yields the following equation:

$$Ne = 0.212\,g\,(Nb) \quad (17)$$

Substituting the average maturity age for lake populations (g = 2.78) and stream population (g = 2.94), Equation 17 can be simplified to:

$$Ne = 0.589Nb \quad (18)$$

for lake populations and for stream populations,

$$Ne = 0.623Nb \quad (19)$$

As presented earlier (see Equation 12 discussion), Ne values of 351 for lake populations and 332 for stream populations were computed as the Ne that must be achieved to retain at least 95% of the population's heterozygosity over a 100-year time period. Equations 18 and 19 can be used to calculate Ne values directly from an easily measurable quantity – annual spawner abundance, expressed as a harmonic mean over several years. These equations can also be rearranged such that given a desired Ne; the harmonic mean necessary to achieve this Ne can be calculated. As previously stated, the minimum Ne values for coastal coho were 351 and 332 for lake and stream populations, respectively. Translating this to a harmonic mean yields an Nb for lake populations of 351 / 0.589 = 595 and an Nb for stream populations of 322 / 0.623 = 533.

The value for the abundance threshold for the diversity criterion was conservatively established by averaging the critical Nb values for the lake and stream populations (average = 564) and rounding this number upward to 600.

It is possible to use a retrospective or prospective approach to determine if a population meets this Nb abundance threshold. For the purposes of this criterion, only the prospective approach was considered. The output from the population viability model discussed in the persistence criterion section was used to estimate the harmonic mean for a period of time 100 years into the future. Mechanically, a harmonic mean of the spawner escapements was computed for each 100-year trial of the viability model. After all of the trials were completed (generally there were 3,000 trials per model run), the average of the harmonic means for the individual trials was determined. To 'pass' the diversity criterion the average of the harmonic means had to be greater than 600.

Summary of Population Criteria and Evaluation Thresholds

Population criteria were developed to assess the conservation status of Oregon coastal coho. A summary of each of these and the associated evaluation thresholds are presented in this section of the report.

Criterion 1 - Spawner Abundance

Metric

The average abundance of wild spawners for the years 1993 to 1999 minus the minimum viable abundance level for the population equivalent to a spawner density of five fish per stream mile.

Evaluation Thresholds

Pass - The test metric is a positive number

Fail – The test metric is a negative number.

Criterion 2 - Productivity

Metric

The geometric mean of recruits per spawner for those brood years between 1990 and 1996 when the parental spawner density was less than 10 fish per stream mile.

Evaluation Thresholds

Pass - The test metric is greater than or equal to 1.1 R/S.
Fail – The test metric is a less than 1.1 R/S.

Criterion 3 - Persistence.

Metric

The forecast probability of extinction based on results from a population viability simulation model.

Evaluation Thresholds

Pass – If probability of extinction is less than 0.05
Fail – If the probability of extinction is greater than or equal to 0.05

Criterion 4 – Spawner Distribution.

Metric

The percentage of the potential coho habitat, partitioned into 6th field HUCs, that was occupied from 1989 to 2000.

Evaluation Thresholds

Pass – Greater than 50% of the 6th field HUC sub-basins are occupied.
Fail – Less than or equal to 50% of the 6th field HUC sub-basins are occupied.

Criterion 5 - Diversity.

Metric

The average of the100-year harmonic means of spawner abundance as forecast from a population viability model is greater than the critical threshold of 600.

Evaluation Thresholds

Pass – If 100-year harmonic mean is greater than 600.
Fail – If 100-year harmonic mean is less or equal to than 600.

VIII. Integration of Population Criteria for ESU Evaluation

Five population level criteria were used to gauge the status of individual coho populations within the Oregon coast ESU. The process used to reduce the results from each criterion into a single determination for each population was strongly precautionary. A population was given an overall 'fail' classification if it failed any of the five population criteria (i.e. abundance, productivity, persistence, distribution, or diversity).

To obtain a determination of biological status for the entire Oregon coastal coho ESU it was necessary to combine the results from the individual population assessments in a manner to determine if the ESU was viable.

After considering several alternatives, the following simple test was developed:

Criteria for ESU Viability = At least 50% of all the populations within the ESU are classified as passing the viability criteria and each ESU stratum contains at least two of these passing populations.

In the case of the dependent populations, their contribution to establish criteria for ESU viability was assumed to be very small. Lawson et al (2004) estimate that the combined contribution of these dependent populations in terms of number of wild fish produced was historically less than 3% of the total for the entire Oregon coast ESU. In other words, 97% of the coho production originated from the 21 independent populations that are the primary focus of this assessment. Although these dependent populations may serve as part of a genetic conveyor belt in promoting gene flow up and down the coast, the existence of this role is mostly speculative and to date has not been demonstrated. However, in terms of a monitoring tool, the abundance of coho in dependent populations may be a valuable indicator as to overall abundance and connectivity within the ESU.

This test of viability does not address the role of populations classified as dependent (see Table 1) nor does it require independent populations that 'fail' the population criteria to meet some other lower conservation standard. However, independent populations that do not meet all of the population criteria are still assumed to be significant to the health of each stratum and the ESU overall. They may recover at some point in the future such that they will pass all the criteria and contribute fully to the viability of the ESU. The only exception to this potential would be populations that have become extinct, a classification which none of the 21 independent populations met. However, the present and future contribution of these 'no pass' populations to ESU viability is difficult to quantify. It was concluded that crafting another layer of criteria for such populations was a task of considerable complexity and one that would likely not yield much additional insight as to the overall status of the ESU. Therefore, in assessing the viability of this ESU, the presumed state of these 'no pass' populations was considered only as a qualifier to the quantitative determination obtained from the ESU evaluation process. It is anticipated this issue will become more relevant in the development of a conservation/recovery plan that establishes criteria for broad sense recovery goals and full realization of Oregon Plan objectives.

IX. Application of Criteria - Oregon Coastal Coho

Population Results

Following the methods described, data for Oregon coastal coho populations were analyzed to determine their status relative to the biological criteria. The results were mixed. In general, it appears that populations in the northern portion of the ESU are at

greater risk than those further to the south (Table 5). The failure rates for all criteria are higher for the North Coast and Mid Coast strata. It was also apparent that if a population failed one of the criteria it was likely to fail other criteria as well. All of the seven populations that were assigned the fail classification failed more than one of the criteria with the exception of the Nehalem. The fact these different and somewhat independent

Table 5. Results of an evaluation of 21 populations of Oregon coastal coho with respect to five biological criteria designed to assess conservation status. Cells that contain results that do not pass a particular criterion are shaded and the associated numbers presented in bold font type. The critical values for each criterion are noted in parenthesis in each column heading. The Criterion 3 results are stated in terms of the probability of effective extinction in 100 years. Criterion 4 results are the percentage of the 6th field HUCs within a basin that are occupied by spawners. Criterion 5 is the average harmonic mean of spawner abundance forecast for the next 100 years. For additional detail see text.

Population	Criterion 1 (Abundance) (+)	Criterion 2 (Productivity) (1.1)	Criterion 3 (Persistence) (0.050)	Criterion 4 (Distribution) (50%)	Criterion 5 (Diversity) (600)	Combined[c]
Necanicum	+76	1.25	0.002	100%	777	Pass
Nehalem	+149	--[a]	**0.081**	80%	2926	**Fail**
Tillamook	**-61**	**1.03**	**0.156**	100%	721	**Fail**
Nestucca	+259	1.59	0.001	100%	2850	Pass
Salmon	**-130**	**0.80**	**1.000**	**0%**	**1**	**Fail**
Siletz	**-387**	**0.74**	**0.251**	100%	**401**	**Fail**
Yaquina	+1589	5.59	0.005	100%	2591	Pass+
Beaver	+652	5.55[b]	0.000	100%	1389	Pass+
Alsea	**-209**	**0.61**	0.028	100%	1505	**Fail**
Siuslaw	+1351	1.51[b]	0.000	100%	10320	Pass+
Low Umpqua	+4013	12.91[b]	0.000	100%	10219	Pass+
Mid Umpqua	+1820	--[a]	0.000	100%	4477	Pass+
N. Umpqua	+726	--[a]	**0.137**	n.a.	**252**	**Fail**
S. Umpqua	+1731	7.46[b]	0.000	70%	3319	Pass+
Siltcoos	+2958	--[a]	0.000	100%	5448	Pass+
Tahkenitch	+1859	--[a]	0.000	100%	2786	Pass+
Tenmile	+5065	12.43[b]	0.000	100%	14891	Pass+
Coos	+7774	--[a]	0.000	100%	15241	Pass+
Coquille	+4687	1.17[b]	0.000	83%	12439	Pass
Floras	+909	--[a]	0.000	100%	1110	Pass
Sixes	**-83**	1.71	**0.994**	100%	**2**	**Fail**

[a]All spawner densities for the period were greater than the selection threshold for the productivity criterion of 10 fish per mile.

[b]Value represents either a single data point or an average of only 2 data points because all other spawner densities were greater than the selection threshold for the productivity criterion of 10 fish per mile.

[c]The "Pass+" designation is a simple qualitatively notation that these populations met the viability criteria by a greater margin that those that were classified as only "Pass"

measures of population health give consistent readings, reinforces the strength of the overall population assessment approach. Finally, the lakes stratum was the only one for

which all of the populations passed all of the criteria. This is consistent with the view that this stratum is probably the most robust and extinction resistant of the five strata that comprise the coastal coho ESU.

As noted earlier, one strength of this analysis is that intensive monitoring activities were tracking the performance of coastal coho during a period of adverse marine survival conditions that was probably the greatest viability challenge that these populations have experienced in the past 50 years. This allowed an empirical test of their productivity and resilience under extreme conditions. On the other hand, a weakness is that the data permit only one look in time at such a challenge. It begs the question as to whether one challenge is sufficient to demonstrate that a population will respond positively to the next occurrence of a similar period of poor marine survival rates. Is the proper interpretation of a population surviving one period of poor marine survival that it is healthy, or just lucky? Obviously, with the limited time series of available data this question can not be empirically tested. The problem of how many times can a population be challenged before it fails is not a question that lends itself to an empirical answer for a relatively long lived species like coho salmon. This type of question is better explored with prospective modeling exercises, such as the one used for the persistence criteria, where repetitive challenges can easily be generated. However, it is worth considering that the results for the abundance and productivity criteria, while performed on one population at a time; they were performed for the same environmental challenge. Therefore, if the results across all populations are considered together they could be viewed as pseudo-replicates for the same treatment. From this perspective, the fact that approximately 3/4 of the populations passed the criterion is a useful consideration.

ESU Results

Of the ESU's 21 populations, 14 passed all population criteria. In addition, at least two populations passed all criteria in each of the five strata. Therefore, the ESU met the quantitative standard for a classification of Viable. In general, populations in northern strata are at higher risk than those in the southern strata. This information coupled with the limiting factor analyses in Part 1, will be used to help guide ongoing conservation efforts for this species.

X. Additional Considerations

Although the direct application of the population criteria and analysis of available data yielded a viable classification for Oregon coast coho, additional considerations were factored into the assessment. These revolved around three general topics: 1) key assumptions associated with criteria development and analytical protocols, 2) issues of data quality and measurement error, 3) assumed range of future environmental conditions and fishery management scenarios including catastrophic events, and 4) interim and future procedures to detect changes in ESU status. This section is devoted to these topical areas and how they were weighed in finalizing a status assessment for this ESU.

Key Assumptions and Analytical Protocol for Population Criteria

Density Dependent Population Recruitment - The authors believe the evidence that supports density dependence population regulation in natural coho salmon populations is ubiquitous and compelling. Both the observations presented here and elsewhere (Beidler et al. 1980, Nickelson and Lawson 1998, and Nickelson 2003) support the notion that as the density of spawners declines the number of recruits produced per spawner increase. As such this assumption was incorporated into the development of population criteria. However, several reviewers of an earlier draft of this assessment have questioned this assumption. Their argument was centered not so much on whether density dependent population recruitment was a legitimate hypothesis for coho salmon, but rather that the statistical problems of demonstrating its existence from available data may be insurmountable. Further, it was implied that if the density dependent assumption were excluded from the evaluation methodology, the resulting assessment may suggest the ESU may not achieve a "viable" classification. The authors believe that such views overstate the problem of demonstrating density dependence. Further, that the alternative hypotheses to density dependence are neither plausible nor consistent with the underlying ecological and evolutionary characteristics of this species and available data.

However, rather than engage in a protracted analysis of this question, energy was instead devoted to an evaluation as to how critical the assumption of density dependence was to the outcome obtained by this assessment. The persistence and diversity criteria were the primary elements influenced by the density dependent recruitment assumption. This is because the metrics for these criteria were tied to the output from a computer generated simulation of recruitment processes which were assumed to be largely density dependent.

A recruitment model was developed that excluded the effect of spawner density on subsequent population recruitment. This was referred to as the density independent (DI) model and as represented by Equation 5. To evaluate sensitivity of the assessment results to the density dependent assumption, the persistence and diversity criteria were examined for each population using methodologies based upon the DI recruitment model rather than the DD model.

The result for the persistence and diversity criteria (Criteria 3 and 5) using the DI recruitment model was relatively similar to the result obtained for the DD model (Table 6). The exception were the dissimilar results for the Alsea, Tillamook and Floras populations although the Floras result may be suspect in either case because the data available to estimate model parameters were quite limited (n = 7 brood years). This may have resulted in significant errors in the parameter estimates, which may by chance lead to the dissimilar results. Regardless, if the DI model had been used to evaluate the persistence and diversity criteria instead of the DD model the result for the strata and the ESU would have been the same: all strata would have passed and the ESU would have been classified as meeting the criteria for viability.

The authors believe the evidence for density dependence population regulation in coho populations is compelling. However, whether or nor density dependence is assumed in

the models used for the persistence and diversity criteria seems to have little bearing on the outcome of the status assessment for Oregon coast coho. The ESU appears viable with or without the assumption of density dependence.

Table 6. Evaluation of 21 populations of Oregon coho with respect to viability criteria for persistence (Criterion 3), and diversity (Criterion 5) based on density independent (DI) and density dependent (DD) simulation models. Cells that contain results that fail criterion threshold are shaded and the associated numbers presented in bold font type.

	Criterion 3 (Persistence)		**Criterion 5** (Diversity)	
Population	**DD model**	**DI model**	**DD model**	**DI model**
Necanicum	0.002	0.011	777	930
Nehalem	**0.081**	**0.073**	2926	2816
Tillamook	**0.156**	0.017	721	3304
Nestucca	0.001	0.000	2850	7849
Salmon	**1.000**	**1.000**	**1**	**1**
Siletz	**0.251**	**0.156**	**401**	**465**
Yaquina	0.005	0.007	2591	3688
Beaver	0.000	0.001	1389	1220
Alsea	0.028	**0.101**	1505	850
Siuslaw	0.000	0.001	10320	13180
Low Umpqua	0.000	0.000	10219	7484
Mid Umpqua	0.000	0.000	4477	3876
N. Umpqua	**0.137**	**0.217**	**252**	**187**
S. Umpqua	0.000	0.000	3319	13135
Siltcoos	0.000	0.000	5448	6600
Tahkenitch	0.000	0.000	2786	1668
Tenmile	0.000	0.000	14891	5159
Coos	0.000	0.000	15241	19129
Coquille	0.000	0.000	12439	17615
Floras	0.000	**0.939**	1110	**2**
Sixes	**0.994**	**1.000**	**2**	**1**

Extinction Event Definition for Persistence Modeling - The results from modeling persistence were stated in terms of the probability of extinction. As discussed earlier, the definition of extinction was a critical abundance test threshold having a value greater than zero, considerably so for some of the larger populations (Table 7). This critical test threshold was the equivalent of approximately one spawner per mile. However, a less precautionary approach to forecasting extinction risk would have been to use a critical test threshold of zero fish. Although such approach was not taken, a sensitivity analysis was performed to determine how the use of zero abundance as a test threshold would change estimates of population persistence that were used in the status evaluation.

As expected, the use of an extinction event threshold of zero resulted in lower probabilities of extinction and fewer populations with non-viable results than with the higher test thresholds used to evaluate the persistence criterion. Overall the difference

between these two test thresholds does not appear great. Therefore, the results obtained for the persistence modeling are not overly sensitive to the whether the test threshold was zero or the equivalent of one fish per mile.

Table 7. Estimates of probability of extinction for 21 populations of Oregon coastal coho based upon a persistence simulation model under two test thresholds that defined what constituted extinction abundance.

Population	Persistence Criterion		Alternate Test Threshold	
	Probability	Test Threshold	Probability	Test Threshold
Necanicum	0.002	50	0.001	0
Nehalem	**0.081**	370	0.004	0
Tillamook	**0.156**	170	**0.064**	0
Nestucca	0.001	100	0.000	0
Salmon	**1.000**	50	**1.000**	0
Siletz	**0.251**	170	0.023	0
Yaquina	0.005	120	0.001	0
Beaver	0.000	50	0.000	0
Alsea	0.028	190	0.003	0
Siuslaw	0.000	460	0.000	0
Low Umpqua	0.000	280	0.000	0
Mid Umpqua	0.000	120	0.000	0
N. Umpqua	**0.137**	50	**0.053**	0
S. Umpqua	0.000	140	0.000	0
Siltcoos	0.000	50	0.000	0
Tahkenitch	0.000	50	0.000	0
Tenmile	0.000	50	0.000	0
Coos	0.000	180	0.000	0
Coquille	0.000	240	0.000	0
Floras	0.000	50	0.000	0
Sixes	**0.994**	50	**0.768**	0

Data Quality and Measurement Error

Abundance Estimates for Spawners and Recruits - For all but the distribution criterion, the basic data that went into the analyses were population specific spawner abundance estimates made for the years 1958 to 2003 (Appendix 2). The method used to derive these estimates was complex and potentially the source of substantial error. However, in general the confidence intervals for most population estimates were in the range of ± 50% of the number used in the subsequent assessment analyses, which for biological systems is fairly robust.

One obvious concern would be if the population estimation methodology consistently over-estimated the true population size (positive bias). Although more work needs to be done on this question, preliminary information from a study on the Smith River (tributary to the lower Umpqua) suggests that the reverse may be true. Data from an ODFW

research study shows that the number of coho spawning above Smith River Falls as estimated by mark-recapture techniques has been consistently larger than the population estimate for the same area based on the same survey methods used elsewhere on the Oregon coast. If these results are representative, it is possible that the present spawner abundance methodology tends to under-estimate rather than over-estimate the true escapement. Obviously, from a conservation assessment standpoint, utilizing a method that tends to under-estimate abundance is more acceptable because it is precautionary.

For those locations where naturally spawning hatchery fish were present, estimating their proportion in the natural spawning population introduced another source of error. As described in Appendix 2, these estimates were based upon a relatively small sub-sample of the fish within a spawning population. However, this source of error is primarily a problem for estimation of wild recruits produced by the population and not total spawners. Recruits are calculated from the population abundance estimates, but with the hatchery fish subtracted away. The resulting number is then expanded by the estimated fishery mortality rates (another source of error) to yield the pre-harvest population abundance of wild fish. Therefore, the potential for measurement error for recruits is higher than for total spawners, because the calculation of recruits requires more manipulation with estimates of additional factors (i.e., proportion of hatchery fish in spawning population and mortality rate from fisheries).

Clearly, overestimates of spawner abundance, if they are consistently large, have the potential to result in populations passing the abundance criterion, where they would fail if this positive bias was accounted for. The result of measurement errors and bias is more complicated with respect to evaluations for the productivity criterion. In one respect, if the primary problem is in the measurement of spawner abundance, then the productivity metric of recruits per spawner (R/S) would be relatively unaffected if there was a consistent positive or negative bias, since the metric is a ratio and not an absolute number. More problematic however, are the estimates of fishery related mortality rates. In particular if these mortalities are over-estimated then it would have the effect of inflating the number of recruits, especially in years when the fishery rates were high. This would increase the R/S ratio and result in a productivity estimate that was higher than the true productivity for the population.

However, with respect to the productivity criterion evaluations, the test period corresponds with adults that returned from 1993 to 1999. Unlike years prior to this period, the fishery impact rates were much reduced (Figure 7). Therefore, the potential for overestimation of fishery related mortality to cause a positive bias in R/S during this period was probably low.

More difficult to assess is the likelihood that the magnitude of error variance for the recruit estimates was greater than for the spawners. Additional evaluation is needed to fully evaluate the significance of this problem, specifically whether this resulted in overestimates of R/S.

Finally, for several populations with naturally spawning hatchery fish, estimating recruits requires that the ratio of wild to hatchery spawners be made with relative accuracy. In recent years, all returning hatchery fish were identifiable by fin clips. However, for most

of the data time period from 1958 to present, distinguishing hatchery and wild fish was less certain as the primary classification method was the examination of scales collected from spawned out fish for growth rings that characterized rearing in a hatchery environment. Although this method was less precise, as long as there was not a consistent bias one way or the other the primary shortcoming would be the introduction of more 'noise' to the data.

More difficult, however was to know whether the approach used to expand the estimates of hatchery to wild ratios for the entire population was bias free. The distribution of naturally spawning hatchery fish is rarely random, especially if there is a hatchery within the basin. If in accounting for this non-random distribution, expansion errors are made, then the estimate of wild recruits at the population level could be wrong and potentially introduce consistent bias. For example, if 100 spawned-out coho were sampled in a basin and 50 of them were found to be hatchery fish, a simple expansion of this proportion would result in converting the spawner abundance estimate for the entire population to 50% hatchery fish and 50% wild fish. However, if 45 of the hatchery fish that were recovered came from a small stream directly below the hatchery site that was also isolated from where the majority of the wild population spawned, then the true number of wild fish in the population across the entire basin would be much larger. The procedures used to estimate hatchery and wild fish for the purpose of this assessment were designed to avoid such problems, but it was unlikely this was entirely successful.

It should be recognized that for most of the populations of coho in this ESU hatchery coho are relatively rare and therefore the greatest potential for this problem occurs in those locations that are heavily influenced by hatchery fish, such as the Nehalem, Tillamook, Salmon, Alsea, and North Umpqua. Even in these locations, the scale of the hatchery program has been reduced and therefore in the future the data quality problems associated with dividing total spawner estimates between hatchery and wild fish will be lessened.

Finally, mistakes in estimating spawners and recruits have the potential to cause problems with respect to the persistence and diversity criteria since both are based on a recruitment model that is fit to data from each population. A discussion of this problem and associated sensitivity analyses are provided in the next section.

Estimation of Recruitment Model Parameters - Methodologies for several criteria were reliant on the DD recruitment model. The general model was fit to specific data for each population and parameters were estimated accordingly (Equation 4). Even though two factors thought to be important to population recruitment for coho, spawner abundance and marine survival, were integrated into the DD model, rarely could more than 60% of the variation in population recruitment be explained by the model. If nothing else this was a warning that even using the bootstrap estimation procedures, the likelihood of errors in estimating the correct values for the recruitment model parameters was likely.

However, for the purposes of this assessment the relevant question was how sensitive are the outcomes of population and ESU status assessments to different estimate of the model

parameters? Further, once it was understood how sensitive the assessment results were to errors in the estimation of the model parameters, was there evidence that errors of this magnitude occurred?

To test the first part of this question, the parameter values for each population were changed and the net impact on the persistence criterion evaluations and overall ESU assessment was determined. As a precautionary measure, this sensitivity analyses focused only on the concern that the risk of extinction determined for each population, and as used in evaluating the persistence criterion, was higher than reported because of errors in estimating model parameters. In other words, the sensitivity analyses examined the condition where the value for the recruitment parameter estimated was erroneous in a direction that if the true value would have been used in the modeling runs, the risk to extinction would have been higher.

Further, in the interests of brevity, the sensitivity analyses results presented here represents only a small portion of the full combination of possible parameter values that could have been tested. However, the parameter values tested were intended to represent the likely outward bounds of the magnitude of these errors. Finally, ODFW has an ongoing effort to further refine this sensitivity analysis to ultimately provide help to the future assessment, recovery planning and implementation activities related to the conservation of these populations.

For each population, persistence model runs were made under four different parameter error scenarios. The first evaluated the impact of turning down the value for the '**a**' parameter such that the R/S value used in the recruitment calculations was essentially reduced by 30%. Effectively, this gave the outcome from a scenario where the true values for the '**a**' parameter yielded a recruitment rate that was 30% lower than estimated and used to evaluate the persistence and diversity criteria. The second test focused on the value for the '**B**' recruitment equation parameter, adjusting it such that the maximum number of adults that could be produced by the population was reduced by 30%. In the third sensitivity test the value for the marine survival parameter '**c**' was turned up such that the weighting given to changes in the OPI marine survival index was increased by 30%. This was anticipated to cause a weaker recruitment potential when the population cycled through the period of poor marine survival in the persistence model simulations. Finally, a fourth simulation was run wherein all of the adjustments to individual parameters were the same as in test one through three, however rather than separate, all of these changes were combined for a 'perfect storm', scenario for recruitment parameter errors.

As illustrated in Table 8, the probability of extinction increased substantially for each of the parameter error scenarios. With the exception of the second sensitivity test involving the '**B**' parameter, a sufficient number of populations failed such that two strata failed. This would not have passed our criteria for viability. Among the populations there was a clear north to south pattern. The model output under any of the sensitivity test scenarios was more likely to yield a change from a pass to a fail for the persistence criterion for populations in the northern portion of the range.

The results for the fourth sensitivity test, which assumed the errors for each of the three parameters occurred together, were predictable given the outcomes for the analyses when these parameters were considered separately. In this 'perfect storm' scenario of parameter estimation bias and error, the model estimates of extinction were substantially larger than any of the first three scenarios. However, even in this case the north to south pattern of sensitivity to these errors was clearly evident.

Table 8. Probability of extinction estimates for 21 populations of Oregon coastal coho under different parameter error scenarios. Extinction probabilities for the 'Base' column are as those reported earlier in the status assessment for the persistence criterion. Probabilities given for test 1, 2, and 3, represent, respectively, a 30% reduction in R/S (**a**), a 30% effective reduction in the maximum number of recruits that can be produced (**B**), and a 30% increase in the sensitivity of population recruitment to changes in the OPI marine survival index (**c**). The results in the last column combine parameter changes of test 1 through 3 into a single, worst case scenario (**a + B + c**).

Population	Base	a sensitivity test 1	B sensitivity test 2	c sensitivity test 3	a + B + c sensitivity test 4
Necanicum	0.002	**0.125**	0.012	**0.124**	**0.962**
Nehalem	**0.081**	**0.649**	**0.323**	**0.718**	**1.000**
Tillamook	**0.156**	**0.713**	**0.358**	**0.608**	**0.987**
Nestucca	0.001	0.031	0.003	0.022	**0.575**
Salmon	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**
Siletz	**0.251**	**0.882**	**0.641**	**0.811**	**1.000**
Yaquina	0.005	**0.075**	0.011	**0.072**	**0.555**
Beaver	0.000	0.000	0.000	0.000	0.047
Alsea	0.028	**0.501**	**0.192**	**0.413**	**0.987**
Siuslaw	0.000	0.004	0.001	0.022	**0.557**
Low Umpqua	0.000	0.000	0.000	0.000	0.018
Mid Umpqua	0.000	0.000	0.000	0.000	0.000
N. Umpqua	**0.137**	**0.747**	**0.288**	**0.545**	**0.986**
S. Umpqua	0.000	0.000	0.000	0.000	0.043
Siltcoos	0.000	0.000	0.000	0.000	0.000
Tahkenitch	0.000	0.000	0.000	0.000	0.000
Tenmile	0.000	0.000	0.000	0.000	0.000
Coos	0.000	0.000	0.000	0.000	0.000
Coquille	0.000	0.000	0.000	0.000	0.046
Floras	0.000	0.000	0.000	0.000	**0.635**
Sixes	**0.994**	**1.000**	**1.000**	**0.995**	**1.000**

One interpretation of the results from these parameter sensitivity analyses might be that the persistence model forecasts are not reliable and may significantly underestimate risk. However, there are good reasons why such an interpretation is likely incorrect, at least at the ESU level. The sensitivity analyses examined parameter errors in a direction that were anticipated to increase extinction probabilities. Further, the magnitude of these 'one-way' errors was assumed to be at the upper end of what was plausible.

While the individual population results could be strongly influenced by estimation bias in one or more of the recruitment parameters, it is seems unlikely that this bias would occur equally for all 21 populations at the same time. Presumably, it is more likely that by chance, the errors would cause bias in the opposite direction for some of the populations and result in overestimates of risk, perhaps canceling the effect, at the ESU level, of underestimating risk for other populations.

The probabilities of extinction for many of the populations equal one or nearly so for several of scenarios tested, particularly for test 4. However, for such dire forecasts to be true it would be expected that many of the populations in the northerly portion of the range would have become extinct over the last 50 years; an outcome did not occur. Further, the results obtained for the other population viability criteria generally supported the conclusion that these populations were viable.

Regardless, the persistence model evaluations are clearly quite sensitive to errors in the estimation recruitment equation parameters. However, the one strength of the methodologies used assess the status of this ESU was the reliance on multiple, and to a certain degree independent, criteria to test viability. The results for the persistence criterion, which were based in part on the recruitment equation and associated parameters, were generally consistent with the results obtained from the other population viability criteria. This apparent consistency was interpreted as evidence that parameter estimation errors were not as great in their effect as the results portrayed in Table 8 suggest is possible.

As mentioned earlier, ODFW has an ongoing effort to complete a more comprehensive examination of the problems associated with data quality and parameter estimation. The finding from this effort will be used in future conservation/recovery planning and assessment efforts.

Distribution Criterion Considerations - Unlike the other criteria, the approach taken for distribution was not complicated by assumptions about predictive models and errors in the estimation of recruitment equation parameters. The problem of errors associated with the population abundance estimates were also avoided because the metric for the distribution criteria was the direct count of fish observed in the selected survey sections. Consequently, the distribution criterion was the least impacted by potential errors of estimation or measurement of all the criteria used in this evaluation. However, less clear was the precise biological meaning of the data collected to evaluate this metric. For example, an R/S value less than one for a population under the circumstance of low spawner density has a clear and negative implication for the future of the population. However, the biological consequences of less than 50% of a population's 6^{th} field HUCs being occupied are less obvious. Therefore, the selection of a 50% threshold is not a precisely determined value.

It is also not clear that the 6^{th} field HUCs provide the best means to stratify a basin to quantity the desired interaction between fish and local variations in the habitat. It is possible a more ecological based stratification scheme may be more appropriate. However, from the standpoint of connectedness of sub-units of a fish population within a watershed, the ecological overlay also has some shortcomings. Perhaps the best future

alternative would be a stratification scheme based on a double overlay of both watershed and ecotype classifications. For the present evaluation it was felt that the geographical approach used provided the most useful alternative for assessing distribution.

Diversity Criterion Considerations - The test metric for the diversity criterion is calculated for each population as the harmonic mean of wild spawners as forecast for the next 100 years from the persistence simulation model output. Because the persistence model only forecasts adults and not adults plus jacks, the harmonic means used to evaluate the diversity criterion are artificially low. For the purposes of estimating population abundance that relates to the rate at which genetic diversity may be lost, all ages of returning spawners should be included in the harmonic mean calculation. Therefore, the results obtained likely represent an overestimate of risk. Had jacks been included in the harmonic mean calculation, the resulting metric values would have probably been at least 10% greater than those used in the evaluation of this criterion.

The harmonic means used for the diversity metric are directly linked to the same simulation model used to provide the test metric for the persistence criterion metric. As such, there is chance that results for these two criteria have a degree of correlation with each other that is an artifact of the methodology. An alternate method to forecast the harmonic mean for the next 100 year test period, is to use the past spawner abundance data as a predictor of abundance for the next 100 years rather than the persistence simulation model output.

As shown in Table 9, the harmonic means for the number of wild spawners estimated for each population from 1958 to 2003 were generally in the same range as those forecast by

Table 9. Diversity criterion metric results (forecast harmonic mean of wild spawner abundance during next 100 years) and harmonic mean of wild spawners observed from 1958 to 2003 for 21 populations of Oregon coast coho salmon.

Population	Harmonic Mean Wild Spawners		Population	Harmonic Mean Wild Spawners	
	Diversity Criterion Results	Observed 1958-2003 Spawners		Diversity Criterion Results	Observed 1958-2003 Spawners
Necanicum	777	**427**	LoUmpqua	10219	3321
Nehalem	2926	3727	MidUmpqua	4477	1349
Tillamook	721	888	NUmpqua	**252**	**113**
Nestucca	2850	1091	SUmpqua	3319	935
Salmon	**1**	**22**	Siltcoos	5448	1989
Siletz	**401**	684	Tahkenitch	2786	1092
Yaquina	2591	**534**	Tenmile	14891	3162
Beaver	1389	**488**	Coos	15241	5191
Alsea	1505	1063	Coquille	12439	4568
Siuslaw	10320	4206	Floras	1110	1151
			Sixes	**2**	**94**

the simulation model. However, using the retrospective approach, the Necanicum, Yaquina, and Beaver populations were forecast to be less than the diversity criterion

threshold of 600 wild spawners. In contrast, the simulation model approach forecast that all of these populations would pass the 600 harmonic mean threshold.

The most likely reason for this difference is the impact of ocean fisheries. The fishery impact rate for a majority of the years in the retrospective data set exceeded 60%. However, in the persistence model runs, the assumed future fishery impact rate is 10%. If the spawner abundance data for the retrospective approach were adjusted upward to standardize the numbers to an assumed 10% fishery mortality rate, the harmonic means would increase substantially. At least in the case of the Necanicum, Yaquina, and Beaver populations, this increase would be enough for them to pass the diversity criterion test metric. Indeed, once the retrospective numbers are standardized to the same fishery mortality rate, the harmonic means forecast by the two, very different, methodologies would be quite similar.

Assumed Future Conditions and Impact on Assessment Findings

Sensitivity of Results to Reduced Life Cycle Survival in the Future - The model runs performed to estimate the probability of extinction for each of the 21 populations assumed that the pattern of marine survival rates experienced by the 1958-2000 broods was generally predictive of marine survival for the future 100 year period that was modeled. Likewise, the conditions of the freshwater habitat during the same time period were assumed to be representative of the condition of the habitat in future. However, one or both of these assumptions could be wrong. To examine the implications of alternative environmental freshwater and marine scenarios in the future to the ones modeled for this assessment, additional analyses using the PVA persistence model were performed. These "what if" analyses were structured to look at the primary factor would likely be impacted by changes in the freshwater and marine environment: life cycle survival.

In these analyses, a number of different "what if" scenarios were performed with the assumed life cycle survival ranging from one tenth to two times the survival rate that was observed over the last 43 years. As presented in Table 10, modest reductions in life cycle survival from the current status (last 43 years) resulted in a sharp increase in the extinction risk for populations in the northern portion of the ESU. When survival was reduced by an order of magnitude none of the populations within the ESU were forecast to persist. In contrast, the result from modeling an increase of the current survival rates by a factor of two was a viable classification for all populations except the Salmon.

The output from the simulation model that was used to forecast the persistence of these populations at different life cycle survivals was driven by the assumption that the recruitment process in coho is fundamentally density dependent. However, as described earlier, an alternative density independent (DI) recruitment model was also developed for the persistence simulations. When the full scenario of life cycle survival tests described above were repeated using the DI recruitment function the results did not differ appreciably from those obtained with the DD recruitment function. For populations from the Yaquina population north the results were essentially the same. However, for the more southerly populations, particularly those of belonging to the Lakes stratum, the viability threshold was exceeded for survival rates that were 50% or less of the current

level. As shown in Table 10, the viability threshold for these same populations as modeled using the DD recruitment function were for survival rates that were as low as 20% of the current level. Therefore, it appeared that the DI recruitment model results tended to lessen the north to south dissimilarly of populations to persist under different future survival rate scenarios

Table 10. Sensitivity of probability of extinction forecasts to changes in life cycle survival for 21 populations coastal coho.

Population	Life Cycle Survival Relative to 1958 – 2000 Average											
	0.10	**0.20**	**0.30**	**0.40**	**0.50**	**0.60**	**0.70**	**0.80**	**0.90**	**1.00**	**1.50**	**2.00**
Necanicum	1.00	1.00	1.00	0.98	0.80	0.40	0.14	0.03	0.00	0.00	0.00	0.00
Nehalem	1.00	1.00	1.00	1.00	0.99	0.89	0.65	0.42	0.19	0.10	0.00	0.00
Tillamook	1.00	1.00	1.00	1.00	0.99	0.89	0.72	0.47	0.25	0.15	0.00	0.00
Nestucca	1.00	1.00	0.98	0.76	0.37	0.15	0.04	0.00	0.00	0.00	0.00	0.00
Salmon	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Siletz	1.00	1.00	1.00	1.00	1.00	0.98	0.86	0.63	0.43	0.23	0.00	0.00
Yaquina	1.00	1.00	0.98	0.79	0.47	0.25	0.10	0.04	0.02	0.01	0.00	0.00
Beaver	1.00	1.00	0.73	0.09	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Alsea	1.00	1.00	1.00	1.00	0.98	0.82	0.58	0.28	0.11	0.03	0.00	0.00
Siuslaw	1.00	1.00	0.93	0.53	0.19	0.05	0.02	0.00	0.00	0.00	0.00	0.00
LoUmpqua	1.00	1.00	0.66	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MidUmpqua	1.00	0.97	0.16	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NUmpqua	1.00	1.00	1.00	1.00	0.99	0.92	0.73	0.48	0.26	0.11	0.00	0.00
SUmpqua	1.00	1.00	0.85	0.23	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Siltcoos	1.00	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tahkenitch	1.00	0.73	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tenmile	1.00	1.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coos	1.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coquille	1.00	1.00	0.92	0.27	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Floras	1.00	1.00	1.00	0.64	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sixes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.24	0.01

In general at least two populations pass the persistence viability criterion in each stratum as long as the decrease in relative survival rates remained less than 20%. Therefore, with respect to this criterion, long-term changes in habitat (or other sources of mortality) that result in a net survival decrease less than 20% would likely not cause the ESU as a whole to fail the viability threshold.

The one caveat to this conclusion is that it does not directly apply to survival decreases that impact coho between the egg incubation and late summer rearing life stages. As discussed earlier and illustrated in Figure 4, during this portion of the life history, a reduction in the number of juveniles by itself will trigger a compensatory increase in survival rate to the next life stage. Whether this compensation is great enough to neutralize the reduction of juveniles caused by an adverse impact is a question that requires a case by case analysis. Therefore, the dynamics of habitat changes that impact the survival of coho during this phase of their life history are more complicated and difficult to assess. However, in general the critical life stage for juvenile coho in terms of smolt yield for a population is over-wintering habitat prior to their out-migration as smolts the following spring. Therefore, in forecasting population persistence, the earlier life history stage is less critical the later life history stages that follow.

Impact of Hatchery Programs - Nickelson (2003) has suggested that the addition of hatchery reared coho smolts to a basin has a negative influence on the survival of wild coho smolts via the attraction of predators. Given that there were substantial reductions in hatchery smolt release numbers during the late 1990s for several coho populations in the Oregon coast coho ESU, it is possible that in the near future the effective survival rate for these populations could improve. In addition, given the likelihood that naturally spawning hatchery fish are less successful in producing offspring than wild fish (Leider et al. 1990; Reisenbichler and Rubin 1999; Kostow et al. 2003; and McLean et al. 2003) reducing the number of naturally spawning hatchery fish within a population would improve the conversion of spawners to recruits and thereby increase overall population productivity.

It will be several more years before the benefits of these reductions in hatchery programs are known. However it is possible the net effect may be to increase life history survival enough to lift several of the populations that currently do not pass the viability criteria into a pass classification. In particular the Nehalem, Tillamook, and Siletz populations that currently do not pass the criteria have experienced a dramatic decline in the proportion of hatchery fish in natural spawning areas. The average proportion of hatchery fish has declined from over 0.40 during most of the 1990s, to less than an average proportion of 0.10 in the last 6 years (Figure 10). This is largely the result of

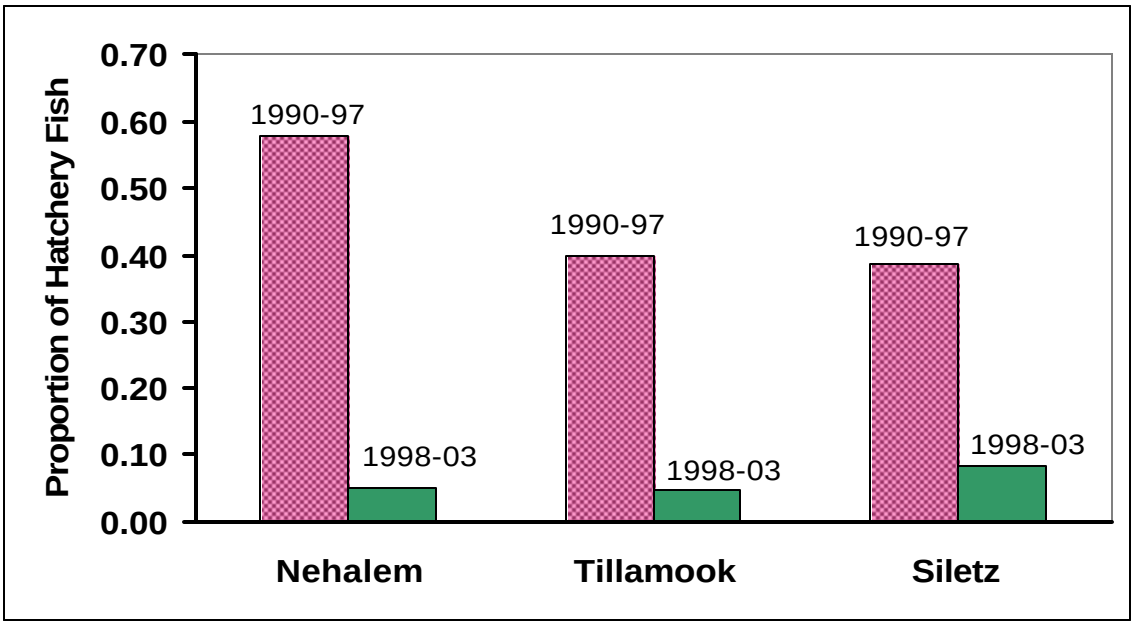

Figure 10. Proportion of naturally spawning coho that are hatchery fish in the Nehalem, Tillamook, and Siletz populations for two time periods, 1990-97 (cross-hatched bars) and 1998-03 (solid bars).

sharp reductions in smolt releases and other strategies that reduced the proportion of naturally spawning hatchery fish since 1998. Reductions of this magnitude are expected to increase the effective life cycle survival by at least 50% if the findings described by Nickelson (2003) apply. Such an increase in life cycle survival would be sufficient to

cause these three populations to pass the persistence criterion (Table 10), and most likely the productivity and abundance criteria as well.

Effect of Catastrophic Events - Risk of natural stochastic events exerting additional risk to population viability at low abundance was addressed in the persistence analysis, which incorporated natural and sample variability evident over the past 50 years. Risk of catastrophic events exerting additional risk to population viability was also considered in this evaluation. Possible catastrophic events could take shape in the form of a longer and deeper period of poor marine survival conditions, a large coast-wide flood, severe drought, or other climatic and large scale environmental calamities. Smaller scale catastrophes are also possible such as forest fire, landslides, chemical spills, and so forth. However, these would tend to be more population, or within population, specific and not events that would impact most of the ESU at once. Therefore, in terms of a synchronous impact on all of the populations within the ESU the best candidates would be adverse marine conditions, flood, and drought.

As noted earlier, coastal coho survived a 7-year period of very poor marine survival conditions in the 1990s. It is also of note that within this same time frame they were also exposed to a nearly coast-wide 50-yr flood event in 1996 and as well as several moderate drought periods. While the impact of the flood and drought are difficult to quantify, they undoubtedly added stress to populations of coast coho that were already impaired by poor marine survival conditions occurring at the same time. Whether or not this combination of events should be classified as a full scale catastrophe is perhaps a qualitative rather than a quantitative determination – however there is no doubt that these populations were highly stressed during this period. The fact that all populations, with possible exception of the Sixes, rebounded from this challenge when conditions improved indicates the sort of resilience one would expect from viable populations when faced with perhaps near catastrophic stress.

However, several reviewers of an earlier draft of this report suggested that a 7-year period was too short of time to qualify for a true catastrophe. The only way to explore the issue further was to use the persistence simulation model to perform some additional analyses of the life cycle survival rate 'what if' scenarios discussed earlier (Table 10). In this supplemental analyses, the lowest survival rates observed during the 7-year period in the 1990s (1990-96 brood years), were set as the mean survival rate within the persistence model and then model runs of successively longer periods of time were run to forecast how long populations would be able to sustain themselves.

It should also be noted that rather than turn down survival rates generically as was done earlier and presented in Table 10, it was the OPI marine survival index that was turned down to match the values obtained during the 1990s. Because the northerly populations appear to be more sensitive to the OPI values than those to the south, this approach likely yielded different results than the earlier analyses. However, since the question asked in the analysis was specific to the marine conditions of the 1990s, it was felt that the OPI was the best index to use.

The results from this analysis predicts that most populations would be able to sustain themselves through a period of very poor ocean conditions that lasted perhaps three times

longer than the 7-year period actually (Table 11). However, an extension of such survival rates longer than a period of about 24 years was too high of a stress on many of the populations and they dropped into the non-viable category (i.e., probability of extinction > 0.05). If such poor marine survival conditions were sustained for a period of 36 years or longer, nearly all of the populations in the northern portion of the ESU were forecast to be non-viable.

Interestingly, after 48 years, although the majority of the ESU populations were forecast to be non-viable, the remainder apparently had the capacity to sustain such adverse rates for at least 100 years (data to 60 years is only presented in Table 11). Therefore, in the face of what certainly would qualify as a catastrophic, semi-permanent large reduction in marine survival, 10 of the ESU's 21 populations were forecast to remain viable. Obviously, such predictions have much uncertainty, but the results are consistent with the theme that is apparent throughout this viability assessment in that the populations in the southern portion of the range are more robust than those in the northern portion.

Table 11. Forecast probabilities of extinction for 21 populations of Oregon coastal coho from a persistence modeling exercise that assumed a mean OPI marine survival index of 0.007 for a variety time periods.

Population	Modeled Number of Years at Low OPI Marine Survival Rates									
	6 yr	12 yr	18 yr	24 yr	30 yr	36 yr	42 yr	48 yr	54 yr	60 yr
Necanicum	0.00	0.00	0.00	0.02	**0.12**	**0.23**	**0.40**	**0.48**	**0.68**	**0.74**
Nehalem	0.00	0.00	0.01	0.44	**0.83**	**0.95**	**0.99**	**1.00**	**1.00**	**1.00**
Tillamook	0.00	0.00	0.03	0.36	**0.65**	**0.88**	**0.92**	**0.98**	**0.99**	**1.00**
Nestucca	0.00	0.00	0.00	0.01	0.03	**0.09**	**0.11**	**0.20**	**0.30**	**0.38**
Salmon	**0.12**	**0.83**	**0.96**	**0.96**	**0.96**	**0.96**	**0.96**	**0.96**	**0.96**	**0.96**
Siletz	0.00	0.00	**0.06**	**0.42**	**0.72**	**0.83**	**0.92**	**0.98**	**0.98**	**1.00**
Yaquina	0.00	0.00	0.00	0.02	**0.05**	**0.09**	**0.15**	**0.24**	**0.32**	**0.42**
Beaver	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Alsea	0.00	0.00	0.00	**0.10**	**0.28**	**0.51**	**0.74**	**0.83**	**0.88**	**0.93**
Siuslaw	0.00	0.00	0.00	0.00	0.00	0.02	0.03	**0.05**	**0.06**	**0.06**
LoUmpqua	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MidUmpqua	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NUmpqua	0.00	0.00	0.01	**0.20**	**0.45**	**0.70**	**0.82**	**0.94**	**0.96**	**0.99**
SUmpqua	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Siltcoos	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tahkenitch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tenmile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coos	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coquille	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Floras	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sixes	0.01	**0.10**	**0.14**	**0.19**	**0.22**	**0.26**	**0.29**	**0.33**	**0.35**	**0.38**

Future Detection of Adverse Changes in ESU Status

Several of the viability criteria are based solely on the performance of populations during the poor marine survival conditions of the 1990s. However, in the future knowing how populations of the ESU are performing relative to the observations during the 1990s will

be difficult. Having to wait until the marine survival conditions cycle back to the levels observed in the 1990s is an impractical as well as risky solution. Therefore, ODFW is currently developing additional metrics for abundance and productivity that can be real time applied standardized to the adverse conditions of the 1990s. These methodologies will permit regular updates of conservation status and progress moving towards broad sense recovery goals relative to the performance that was observed by these populations in the 1990s.

However, for the interim, it appears from this assessment there are several risk factors that can be easily monitored that would serve as an effective early warning system to track the conservation status of ESU. Primary among these is the OPI marine survival index. Values for the OPI that are similar or lower than those observed in the 1990s would be a clear cause for concern. Although modeling results suggest most populations can sustain perhaps 20 years of such poor ocean conditions, the margin of error for these forecasts is high. Strong reinforcement to the OPI data would be a simple 3-year running average of wild coho abundance for each population. Population abundance levels dropping below the equivalent of 5 fish per mile in more than one or two population per strata would also be a trigger of serious concern. Another warning signal would be R/S values less than replacement in those instances were spawner density is less than 10 fish per mile. Other early warning metrics could be constructed, however based on the results of this assessment; these three should provide a two or three generation lead time for management responses should ESU start slipping into a trajectory towards a non-viable condition.

Finally, unless the results for both recruitment simulation models are incorrect, the likelihood that most of these populations will persist over an extended length of time is high. By inference, it would seem improbable that a sudden and unexpected decline in the status of these populations will occur in the immediate future (e.g. next 20 years). Although, the forecasts from the persistence modeling could be incorrect, it should be noted that efforts currently underway by the OTRT using four, very different types of persistence models are giving preliminary results that are quite consistent with the ones reported in this assessment (P. Lawson, personal communication). Also one common thread of persistence modeling done in connection with this assessment as well as those preliminary efforts by the OTRT is that it would take a deterioration in environmental conditions, outside of the range observed in the last 50 years, to cause a substantial decrease in the probability of persistence for these populations.

XI. Synthesis and Summary of Evaluation Results

This evaluation benefited from the unusual circumstance of an intensive monitoring program functioning across the entire range of the ESU during a period of adverse environmental conditions that appears unprecedented in the past half century. The wealth of data that recorded the performance of these coho populations during this period, and their rebound when marine survival conditions moderated in the early 2000s, was important to understanding the conservation status of this species.

Several elements of both the criteria and how these criteria were integrated into an overall status assessment for the ESU were risk adverse and therefore precautionary. For example, the viability model used to forecast persistence used an extinction event abundance threshold equal to one spawner per mile and not the less precautionary definition of zero spawners. Further, the occurrence of a 3-year abundance level equal to this threshold had to occur only once in a 100-year simulation period for the model run to be classified as an extinction event. The recruitment simulations used for evaluating persistence incrementally decreased the ratio of recruits per spawner once spawner densities fell below the equivalent of 3.2 fish per mile. Although there was no empirical evidence that this low density depensation behavior existed for coastal coho, as a precautionary measure it was assumed to exist. In addition, the expected positive impact of reducing the number of hatchery smolts on the overall productivity of naturally reproducing populations was not included when testing to see if the population passed the persistence criterion. Finally, in combining individual population scores, a population was classified as "pass" only if all of the population criteria were met. Further, all five strata in the ESU had to achieve a "pass" classification for the ESU to pass criteria for viability.

In general, the results from application of these criteria to 21 independent populations belonging to the ESU produced corroborating results. For example, all criteria painted the same picture of the populations in the northerly portion of the ESU being more vulnerable than those in the south; the lake populations (Siltcoos, Tahkenitch, and Tenmile) the most robust populations in the entire ESU.

The application of the assessment protocol for individual populations and collectively the ESU yielded results that were consistent with a "viable" classification. However, this classification was based upon several key assumptions concerning the future condition of the marine and freshwater environment. Because of this, the evaluation also included a series of "what if" scenarios to examine the impact of long-term changes in life cycle survival with respect to the future status of the populations. From these analyses it was apparent that moderate and permanent declines in the condition of the marine or freshwater habitats could put populations at greater risk. However, several of the most vulnerable populations to this additional stress were also the ones that were expected to benefit from major reductions in the presence of hatchery coho and the associated improvement in life cycle survival. Therefore, it is possible that at the ESU level the adverse impact of any moderate declines in the marine and freshwater habitat could be offset by the expected benefit of changes in hatchery programs that impact the most vulnerable populations in the ESU.

If even greater declines in the marine or freshwater environments occur that reduce overall survival by more than 50% of what was experienced over the last 50 years, or if periods of extremely poor marine survival are longer than 30 years, then multiple population extinctions in the north and middle portion of the ESU and significant depression of the abundance of the remaining populations could occur. However, changes of this magnitude are unlikely to occur with such rapidity as to preclude a new assessment, status recommendation, and appropriate management action. Pending the completion of more detailed methods, three interim, real-time ESU tracking metrics

(marine survival indices, population abundance, and productivity) are suggested for an early warning system to detect any significant changes in the current ESU status.

In conclusion, based upon the analysis presented in this evaluation and plausible assumptions about the future condition of both the freshwater and marine environments, the Oregon coastal coho ESU passes criteria for viability and is likely to persist into foreseeable future.

XII. References

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Appendix 1 – Annual estimates for the OPI marine survival index and fishery mortality impact rates for Oregon coastal coho, for adults that returned in 1961 to 2003.

Return Year	OPI Marine Survival	Fishery Mortality Rate	Return Year	OPI Marine Survival	Fishery Mortality Rate
1961	0.0457	0.744	1983	0.0182	0.761
1962	0.0282	0.588	1984	0.0223	0.830
1963	0.0568	0.607	1985	0.0239	0.633
1964	0.0453	0.625	1986	0.0840	0.800
1965	0.0780	0.607	1987	0.0223	0.372
1966	0.0748	0.753	1988	0.0476	0.468
1967	0.0936	0.698	1989	0.0478	0.399
1968	0.0667	0.680	1990	0.0200	0.627
1969	0.0592	0.634	1991	0.0504	0.590
1970	0.0853	0.726	1992	0.0129	0.600
1971	0.1168	0.753	1993	0.0066	0.724
1972	0.0578	0.698	1994	0.0051	0.560
1973	0.0515	0.707	1995	0.0046	0.555
1974	0.0914	0.839	1996	0.0063	0.449
1975	0.0507	0.865	1997	0.0063	0.068
1976	0.1143	0.835	1998	0.0083	0.125
1977	0.0295	0.855	1999	0.0115	0.084
1978	0.0514	0.833	2000	0.0226	0.124
1979	0.0398	0.913	2001	0.0441	0.078
1980	0.0358	0.909	2002	0.0247	0.076
1981	0.0330	0.838	2003	0.0377	0.073
1982	0.0329	0.796			

Appendix 2. Methodology and resulting population estimates for wild and naturally spawning hatchery fish returning to 21 populations of Oregon coast coho.

Part 1 - Population estimates for 1990-2004

Estimation of Abundance Coho Salmon for Independent Populations.

Populations were estimated using expansion of area-under-the-curve estimates of spawner abundance in randomly selected survey sites (Jacobs and Nickelson 1998; Jacobs et al. 2002). Appendix 2 Table A-1 presents the abundance estimates used in analyses in this report. Notes on populations whose estimates differ from those originally published by Jacobs et al. (2002) follow.

Necanicum

In past estimates of spawner abundance, the Necanicum and Ecola populations have been combined into one estimate. For this assessment, the total abundance of adult coho spawners in the Necanicum population was estimated independently by multiplying mean spawners per mile in random surveys by a stream length of 59.8 miles of spawning habitat. The number of wild fish each year was estimated by multiplying the total population by one minus the proportion of hatchery fish observed on the spawning grounds.

Nehalem

Because the preponderance of stray hatchery fish are found in the North Fork Nehalem River (the location of Nehalem Hatchery), AUC estimates for individual random survey reaches were adjusted for the different percentage of hatchery fish observed above and below the mouth of the North Fork. Estimates of mean adult spawners per mile were made for total fish before making the hatchery adjustment and for wild fish after making the adjustment. In each case, the population was estimated by multiplying mean spawners per mile by a stream length of 434 miles of spawning habitat.

Tillamook

Because the preponderance of stray hatchery fish are found in the Trask River (the location of the hatchery), AUC estimates for individual random survey reaches were adjusted for the different percentage of hatchery fish observed in the Trask and the rest of the basin (i.e. Miami, Kilchis, Wilson, and Tillamook rivers combined). Estimates of mean adult spawners per mile were made for total fish before making the hatchery adjustment and for wild fish after making the adjustment. In each case, the population was estimated by multiplying mean spawners per mile by a stream length of 249 miles of spawning habitat.

Beaver

In past estimates of spawner abundance, the Beaver and Devils Lake populations have been combined into one estimate. For this assessment, the total abundance of adult coho spawners in the Beaver population was estimated independently by multiplying mean spawners per mile in random surveys (except in years with less than 3 samples when the standard survey was also used to calculate the mean) by a stream length of 22 miles of spawning habitat. The number of wild fish each year was estimated by multiplying the total population by one minus the proportion of hatchery fish observed on the spawning grounds.

Siuslaw

Because the preponderance of stray hatchery fish are found in the Lake Creek sub-basin (the location of hatchery releases) in 1990-98, AUC estimates for individual random survey reaches for those years were adjusted for the different percentage of hatchery fish observed in the Lake Creek sub-basin and the rest of the basin. Estimates of mean adult spawners per mile were made for total fish before making the hatchery adjustment and for wild fish after making the adjustment. In each case, the population was estimated by multiplying mean spawners per mile by a stream length of 502 miles of spawning habitat. For 1999-2003, the standard method was used to estimate total abundance, which was then adjusted for hatchery fish

Umpqua

Past estimates of spawner abundance have not divided the Umpqua basin into the same four populations that identified in this report: the Lower Umpqua, Middle Umpqua, North Umpqua, and South Umpqua. Therefore new estimates were made for these populations.

Lower Umpqua – Annual estimates of mean fish per mile in random surveys were multiplied by 335 miles of spawning habitat. The number of wild fish each year was estimated by multiplying the total population by one minus the proportion of hatchery fish observed on the spawning grounds.

Middle Umpqua – Annual estimates of mean fish per mile in random surveys were multiplied by 375 miles of spawning habitat. The number of wild fish each year was estimated by multiplying the total population by one minus the proportion of hatchery fish observed on the spawning grounds.

North Umpqua – Abundance estimates for the North Umpqua population are based on counts of fish at Winchester Dam. Marked hatchery fish counted at the dam were expanded by mark rates to estimate passage of hatchery fish. These estimates were subtracted from the total to estimate wild fish. Hatchery and wild fish removed by the hatchery and the fishery were subtracted from their respective totals in years where such data was available.

South Umpqua – Annual estimates of mean fish per mile in random surveys were multiplied by 612 miles of spawning habitat. The number of wild fish each year was estimated by multiplying the total population by one minus the proportion of hatchery fish observed on the spawning grounds.

The Lakes

Estimates of abundance of coho salmon for the Siltcoos, Tahkenitch, and Tenmile Lakes populations were calculated from standard spawner surveys following the methods described by Jacobs et al. (2002).

Floras

Spawning surveys for coho salmon were not conducted in the Floras/New/Fourmile basin until 1994, when supplemental surveys began in several stream reaches. These reaches have been surveyed since 1994 on a hit and miss basis. Beginning in 1997, three to four randomly selected reaches have been surveyed each year in addition to the supplemental reaches. AUC data from all survey reaches were used to calculate mean fish per mile, which was multiplied by 26.5 miles of spawning habitat to estimate the annual population. Since 1994, 16%-30% of the Floras population's spawning habitat that has been surveyed annually.

Sixes

Prior to 1994, when supplemental spawning surveys began, coho data is available from two standard Chinook surveys on Dry Creek that comprise 11% of the coho salmon spawning habitat in the basin. Since 1994, five supplemental surveys have been surveyed in most years. In addition, during 1997-2002, one to two random surveys were conducted in the Sixes Basin. AUC data from all survey reaches were used to calculate mean fish per mile, which was multiplied by 32 miles of spawning habitat to estimate the annual population. Since 1994, 24%-35% of the Floras population's spawning habitat that has been surveyed annually.

Estimation of the Proportion of Hatchery Spawners

The hatchery programs affecting the various populations went through changes in smolt releases of varying degrees midway through the 1990-2004 period. These changes affected the proportions of hatchery fish observed on the spawning grounds. Data on naturally spawning hatchery fish was collected from carcasses collected in random survey reaches. For 1990-97, estimates of hatchery fish were based on interpretation of scale patterns [e.g. Borgerson (1998)]. For 1998-2004, estimates of hatchery fish were based on the number of carcasses that were fin marked, adjusted by the mark rate of the nearest hatchery. A minimum of ten observations per population per year was used to estimate the proportion of hatchery spawners. For years with less than ten observations, an average based years with similar magnitude of smolt releases was applied. Details for each population follow.

Necanicum

Samples were inadequate to make an annual estimate of proportion hatchery spawners each year from 1990 to 2000. For 1990-1998, the proportion of all observations during the period was applied to each year. Because production from Nehalem Hatchery (the nearest coastal hatchery) was greatly reduce beginning with 1999 returns, the proportion of hatchery fish in all observations during 1999-2003 was applied

to 1999 and 2000. Marks observed in 1998-2003 were expanded for proportion of hatchery fish marked based on data from Nehalem Hatchery.

Nehalem

In the Lower Nehalem, sample sizes were inadequate in 1998-2000. As with the Necanicum, the proportion of hatchery fish in all observations during 1990-98 was used for 1998, and the proportion of hatchery fish in all observations during 1999-2003 was used for 1999 and 2000.

The Upper Nehalem was more complicated because in 1990, 1993, and 1996, hatchery fish returned to Fishhawk Lake. Scales determined to be hatchery fish that were found in the vicinity of Fishhawk Lake in other years were reclassified as wild fish because lake-reared fish can produce a scale pattern similar to hatchery fish. Sample sizes were inadequate in 1990 and 1994-96. The proportion of hatchery fish in all observations during 1990, 1993, and 1996 was used and for 1990 and 1996. The proportion of hatchery fish in all observations during 1991, 1992, 1994, 1995, 1997, and 1998 was used and for 1994 and 1995. Marks observed beginning in 1998 were expanded based on the proportion of hatchery fish marked at Nehalem Hatchery.

Tillamook

In the Trask subbasin, sample sizes were inadequate in 1990-92, 1998, 1999, and 2001. Because the Trask Pond production was eliminated after 1995 returns, the proportion of hatchery fish in all observations during 1990-95 was used for 1990-92, and the proportion of hatchery fish in all observations during 1996-2003 was used for 1998, 1999, and 2001. Marks observed beginning in 1998 were expanded based on the proportion of hatchery fish marked at Trask Hatchery.

In the remainder of the Tillamook Bay Basin, sample sizes were inadequate in all years from 1990 to 1998, except 1994 and 1996. As with the Trask subbasin, the proportion of hatchery fish in all observations during 1990-95 was used for 1990-93 and 1995 and the proportion of hatchery fish in all observations during 1996-2003 was used for 1997 and 1998. Marks observed beginning in 1998 were expanded based on the proportion of hatchery fish marked at Trask Hatchery.

Salmon

Samples sizes were inadequate to make an annual estimate of proportion hatchery spawners only in 1995 and 1999. The proportion of hatchery fish in all observations during 1990-99 was used for both years. Smolt releases into Salmon River from Salmon River Hatchery was reduce beginning with 2000 returns. Marks observed in 1998-2003 were expanded for proportion of hatchery fish marked based on data from Salmon River Hatchery.

Siletz

Sample sizes were inadequate in all years from 1990 to 1999, except 1991 and 1992. Because of changes in the release of hatchery coho into the Siletz River the proportion of hatchery fish in all observations during 1990-96 was used for 1990 and 1993-96, and the proportion of hatchery fish in all observations during 1997-2003 was used for 1997-99. Marks observed in 1998-2003 were expanded for proportion of hatchery fish marked based on data from fish released into the Siletz River.

Yaquina

Sample sizes were inadequate in all years from 1990 to 2000, except 1996. During this period, hatchery fish returned in 1996-98 from releases into Yaquina Bay. Because of changes in the release of hatchery coho into the Yaquina River the proportion of hatchery fish in all observations during 1990-95 was used for 1990-95, the proportion of hatchery fish in all observations during 1996-98 was used for 1997 and 1998, and the proportion of hatchery fish in all observations during 1999-2003 was used for 1999 and 2000. Marks observed in 1998-2003 were expanded for proportion of hatchery fish marked based on data from fish released into the Yaquina River (1998) or the Siletz River (2001).

Beaver

Returns of hatchery fish released in the Yaquina River influence the proportion of hatchery fish found in Beaver Creek. Sample sizes were inadequate in all years from 1990 to 2000, except 1996 and 1999. Because of changes in the release of hatchery coho into the Yaquina River the proportion of hatchery fish in all observations during 1990-95 was used for 1990-95, the proportion of hatchery fish in all observations during 1996-98 was used for 1997 and 1998, and the proportion of hatchery fish in all observations during 1999-2003 was used for 2000. Marks observed in 1998-2003 were expanded for proportion of hatchery fish marked based on data from fish released into the Yaquina River (1998) or the Siletz River (1999-2003).

Alsea

Sample sizes were inadequate in all years from 1990 to 1999, except 1992 and 1998. The release of hatchery coho into the Alsea River was greatly reduced with the 1998 brood and then terminated after the 1996 brood. Therefore, the proportion of hatchery fish in all observations during 1990-98 was used for 1991 and 1993-97. Marks observed in 1998-2003 were expanded for proportion of hatchery fish marked based on data from fish released into the Alsea River (1998-99) or the Siletz River (2000-03).

Siuslaw

In the Lake Creek sub-basin, sample sizes were inadequate in 1990-93, 1997, and 1998. Hatchery fish returned in 1991-98 from releases into Lake Creek. The proportion of hatchery fish in all observations during 1990-98 was used for 1990-93, 1997, and 1998.

In the remainder of the Siuslaw Basin, sample sizes were inadequate in from 1990 to 1998, except 1991 and 1996. The proportion of hatchery fish in all observations during 1990-98 was used for 1990, 1992-95, 1997, and 1998.

The percent hatchery spawners in 1999-2003 were based on recoveries of carcasses in the entire basin. Marks observed in 1998-2003 were expanded for proportion of hatchery fish marked based on the average mark rates for hatchery fish on the Oregon coast each year.

Lower Umpqua

Sample sizes were inadequate in 1990, 1994, and 1996. The proportion of hatchery fish in all observations during 1990-2001 was used for 1990, 1994, and 1996. Marks observed in 1998-2003 were expanded for proportion of hatchery fish marked based on data from fish released from Rock Creek Hatchery.

Middle Umpqua

Sample sizes were inadequate in all years from 1990 to 1997, except 1995. The proportion of hatchery fish in all observations during 1990-2001 was used for 1990-94, 1996, and 1997. Marks observed in 1998-2003 were expanded for proportion of hatchery fish marked based on data from fish released from Rock Creek Hatchery.

North Umpqua

See Middle Umpqua above.

South Umpqua

Sample sizes were inadequate in 1990, 1992, and 1993. The proportion of hatchery fish in all observations during 1990-2001 was used for 1990, 1992, and 1993. Marks observed in 1998-2003 were expanded for proportion of hatchery fish marked based on data from fish released from Rock Creek Hatchery.

The Lakes

Very few fish thought to be of hatchery origin have been observed in the lake populations and there is a strong possibility that some of those were actually wild fish with a scale pattern similar to hatchery fish. The proportion of hatchery fish in all observations during 1990-2003 in the Siltcoos Basin was used for 1992. The proportion of hatchery fish in all observations during 1990-2003 in the Tahkenitch Basin was used for 1992, 2000, 2001, and 2003. The proportion of hatchery fish in all observations during 1990-2003 in the Tenmile Lakes Basin was used for 1992 and 1993. Marks observed in 1998-2003 were expanded for proportion of hatchery fish marked based on the average mark rates for hatchery fish on the Oregon coast each year.

Coos

Sample sizes were inadequate in 1990, and 1997. The proportion of hatchery fish in all observations during 1990-2003 was used for 1990 and 1997. Marks observed in 1998-2003 were expanded for proportion of hatchery fish marked based on data from fish released from Noble Creek STEP Hatchery.

Coquille

Sample sizes were inadequate in 1992, and 1995. Releases of hatchery coho salmon were reduced beginning with the 1994 brood. Therefore, the proportion of hatchery fish in all observations during 1990-96 was used for 1992 and 1995. Marks observed in 1998-2003 were expanded for proportion of hatchery fish marked based on data from fish released in the Coquille River.

Floras

Sample sizes were inadequate in all years from 1990 to 2003, except 1995, 1996, 2000, and 2001. Because hatchery fish were not released in the basin during this period,

the proportion of hatchery fish in all observations during 1990-03 was used for 1990-94, 1997-99, 2002, and 2003. Marks observed in 1998-2003 were expanded for proportion of hatchery fish marked based on data from fish released in the Coquille River.

Sixes

Sample sizes were inadequate in all years from 1990 to 2003, except 2001. Because hatchery fish were not released in the basin during this period and the data is limited to the four most recent years, the proportion of hatchery fish in all observations in the Floras Basin during 1990-03 was used for all years except 2001, the only year hatchery fish were observed. Marks observed in 1998-2003 were expanded for proportion of hatchery fish marked based on data from fish released in the Coquille River.

Appendix 2 Table A-1. Population estimates for independent populations in the Oregon Coast ESU based on random spawning surveys.

	Necanicum		Nehalem		Tillamook		Nestucca	
Year	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery
1990	124	83	1,158	5,464	80	145	160	29
1991	742	494	6,837	3,012	1,577	1,498	618	110
1992	115	76	1,392	2,373	176	142	604	80
1993	490	327	3,049	14,014	571	1,146	340	61
1994	263	176	2,844	2,712	1,105	817	266	47
1995	119	80	1,700	2,118	341	755	1,537	274
1996	418	279	527	3,766	733	246	440	79
1997	97	64	1,187	1,351	437	44	230	41
1998	575	383	1,206	51	358	26	202	36
1999	336	18	3,555	600	1,831	147	2,357	0
2000	399	21	14,462	118	2,178	299	1,219	50
2001	4,418	256	21,928	414	1,944	175	4,164	207
2002	2,327	109	17,164	698	13,334	373	16,698	55
2003	2,398	160	32,517	284	13,008	121	10,194	109
	Salmon		**Siletz**		**Yaquina**		**Beaver**	
Year	**Wild**	**Hatchery**	**Wild**	**Hatchery**	**Wild**	**Hatchery**	**Wild**	**Hatchery**
1990	19	415	228	213	318	63	90	0
1991	5	34	410	575	317	63	484	0
1992	11	132	2,386	954	528	105	618	0
1993	13	351	207	193	458	91	275	0
1994	91	1,463	621	579	2,040	408	675	0
1995	105	1,220	314	293	4,723	945	308	0
1996	82	2,621	395	368	4,578	1,526	1,296	405
1997	16	401	298	38	419	110	497	147
1998	86	346	316	41	510	134	401	119
1999	14	159	1,209	155	2,563	4	1,511	0
2000	179	215	3,387	0	637	1	1,464	46
2001	225	652	1,595	859	3,589	171	1,832	282
2002	543	565	2,129	375	23,800	0	3,217	143
2003	42	1,696	8,038	383	16,484	0	5,552	0
	Alsea		**Siuslaw**		**Siltcoos**		**Tahkenitch**	
Year	**Wild**	**Hatchery**	**Wild**	**Hatchery**	**Wild**	**Hatchery**	**Wild**	**Hatchery**
1990	775	422	2,269	674	1,578	44	1,085	0
1991	1,011	550	2,808	1,434	2,868	27	1,215	0
1992	6,273	2,214	3,554	1,717	385	6	317	1
1993	694	377	4,600	1,278	3,569	53	954	0
1994	828	451	3,159	1,904	1,302	124	1,056	6
1995	441	240	6,161	1,406	4,415	82	1,577	50
1996	1,060	577	7,234	4,136	4,707	68	1,627	0
1997	601	327	501	174	2,653	0	1,842	16
1998	108	1,624	1,020	362	3,122	0	2,817	0
1999	1,341	730	2,980	213	2,756	63	3,664	105
2000	3,363	0	6,532	0	3,835	0	634	0
2001	3,228	692	10,606	0	5,104	0	3,510	16
2002	9,073	181	55,445	250	4,636	113	3,480	7
2003	10,281	0	29,003	56	6,628	0	3,188	15

Appendix 2 Table A-1. continued.

	Lower Umpqua		Middle Umpqua		North Umpqua		South Umpqua	
Year	**Wild**	**Hatchery**	**Wild**	**Hatchery**	**Wild**	**Hatchery**	**Wild**	**Hatchery**
1990	1,678	95	1222[a]	83[a]	355	1,258	2,215	400
1991	3,123	0	4546[a]	308[a]	1,301	2,430	1,545	687
1992	1,797	0	5275[a]	358[a]	1,579	3,170	329	59
1993	7,877	161	2947[a]	200[a]	906	1,513	1,597	289
1994	2,762	156	2,162	147	899	990	816	1,089
1995	10,854	0	3,250	0	1,293	1,756	4,220	496
1996	7,985	450	5,086	345	1,069	3,743	3,520	3,520
1997	1,257	188	563	38	577	1,379	780	156
1998	4,552	0	1,257	79	765	3,379	3,177	1,430
1999	2,623	85	1,748	166	1,194	1,979	3,011	198
2000	5,781	115	4,555	164	1,677	7,585	2,581	329
2001	11,639	1,233	8,940	877	2,634	14,094	11,871	1,554
2002	18,881	906	10,738	931	3,368	6,695	10,517	0
2003	16,494	35	11,090	0	2,862	8,884	4,337	0

	Tenmile		Coos		Coquille		Floras	
Year	**Wild**	**Hatchery**	**Wild**	**Hatchery**	**Wild**	**Hatchery**	**Wild**	**Hatchery**
1990	1,687	0	2,243	30	2,589	123		
1991	3,033	108	2,426	1,387	4,782	869		
1992	1,271	6	16,722	257	2,033	82		
1993	5,544	25	14,932	1,140	7,291	260		
1994	3,354	0	14,500	707	5,119	0	2,653	240
1995	5,092	0	10,302	145	2,034	82	1,351	400
1996	7,092	0	12,128	0	15,814	355	1,519	109
1997	4,092	0	1,112	15	5,720	0	482	43
1998	5,169	0	2,985	0	2,412	0	879	79
1999	6,123	0	4,818	0	2,667	0	670	60
2000	8,278	0	4,704	0	6,253	0	1,477	0
2001	10,990	49	33,595	664	13,833	1,832	5,664	88
2002	13,861	0	33,120	145	7,676	190	3,272	296
2003	6,260	0	25,761	189	22,403	162	952	86

	Sixes	
Year	**Wild**	**Hatchery**
1990	58	5
1991	35	3
1992	92	8
1993	253	23
1994	238	22
1995	77	7
1996	194	17
1997	143	13
1998	558	50
1999	56	5
2000	136	12
2001	95	182
2002	95	9
2003	86	8

[a] Estimate based on the relationship between Winchester dam counts and abundance in Middle Umpqua (see next section).

Part 2 – Population abundance estimates for 1958-1989

Estimation of Abundance Coho Salmon for Independent Populations.

Annual abundance during the period 1958-89 was estimated for 18 of the 21 independent populations that comprise the Oregon Coast ESU. Estimates were not made for the Salmon, Floras, and Sixes populations, as data were not available from which to make the estimates. It was not possible to make estimates for every year for some populations because of lack of data. The primary method of estimation was to calibrate the total abundance estimate for a population generated in Part 1 to the average peak counts in standard spawner surveys found in the range of the population by fitting a linear regression with a zero intercept (Appendix 2 Table A-1). The calibrations explained 38-92 percent of the variation in abundance during 1990-2003. In the case of the lake populations, the methods described by Jacobs et al. (2002) were used. Abundance of the North Umpqua population was based on counts at Winchester Dam. Abundance of the Middle Umpqua and South Umpqua populations were calibrated to the Winchester Dam counts. The proportion of hatchery fish in recent years was applied to the estimated total abundance each year by population as described below for each population. This likely resulted in an overestimate of the proportion of hatchery fish spawning naturally in coastal streams during the first few years, as hatchery production was not as successful prior to improvements in rearing procedures implemented in the early 1960s (ODFW 1982). Appendix 2 Table A-3 presents the abundance estimates used in analyses in this report. Notes on individual populations follow.

Necanicum

Standard spawning surveys have been conducted in the Necanicum Basin only since 1981 and these were used in the calibration that was used to estimate abundance during 1981-89. Estimates prior to 1981were based on a calibration between Necanicum abundance estimates and average peak counts in the Nehalem Basin for the years 1990-2003. However, these estimates are not very reliable because the calibration explained only 38% of the variation in abundance. The average proportion of hatchery fish observed during the period 1989-98, prior to reductions in hatchery programs was applied to the total abundance estimates prior to 1990.

Nehalem

The average proportion of hatchery fish observed in the upper Nehalem Basin (where the standard surveys are located) during the period 1989-98 (except for 1990, 1993, and 1996 when hatchery fish returned to Fishhawk Lake) was applied to the total abundance estimates prior to 1990.

Tillamook

The average proportion of hatchery fish observed in the all Tillamook Bay sub-basins except the Trask (no standard surveys are located in the Trask subbasin) during the period 1988-95 (a period when Trask Pond was in operation) was applied to the total abundance estimates prior to 1990.

Nestucca

The average proportion of hatchery fish observed during the period 1988-98, prior to reductions in coastal hatchery programs was applied to the total abundance estimates prior to 1990.

Siletz

Standard spawning surveys have been conducted in the Siletz Basin only since 1981. A calibration using this data (1 survey) was compared to a calibration using average peak count from the Alsea Basin (4 surveys). The Alsea calibration was used to estimate abundance for the Siletz population for all years prior to 1990 for three reasons: 1) the Alsea calibration was superior ($R^2 = 0.65$ compared to $R^2 = 0.45$), 2) estimates derived from the two calibrations for 1981-81 showed a similar trend, and; 3) when doing analyses of the abundances there is an advantage to using a consistent calibration factor for all years. Determination of the proportion of hatchery fish in the Siletz also presented a problem because it received strays from the private hatchery in Yaquina Bay and it had a state hatchery on a tributary during this period. Data from 1986-88 were used to compute an average proportion of hatchery fish that was applied to 1980-88. Since the state hatchery is no longer located in the basin, the proportion of hatchery fish in the Alsea Basin during 1990-98 (a similar situation with a state hatchery on a tributary) was applied to the Siletz estimates prior to 1980.

Yaquina

The estimation of hatchery strays in the Yaquina during 1958-89 is complicated by the private hatchery that was located in the basin for several years. Data from 1986-88 were used to compute an average proportion of hatchery fish that was applied to 1980-88. The average proportion of hatchery fish observed during the period 1990-2003, exclusive of hatchery return years 1996-98, was applied to the total abundance estimates prior to 1980.

Beaver

Determination of the proportion of hatchery fish in Beaver Creek presented a problem because it received strays from the private hatchery in Yaquina Bay. Data from 1986-88 were used to compute an average proportion of hatchery fish that was applied to 1980-88. The average proportion of hatchery fish observed during the period 1990-1995 was applied to the total abundance estimates prior to 1980.

Alsea

The Alsea is similar to the Siletz in that it was influenced by private hatchery strays and had a state hatchery located on a tributary for many years that was ultimately closed. Data from 1986-88 were used to compute an average proportion of hatchery fish that was applied to 1980-88. The average proportion of hatchery fish observed during the period 1990-98, prior to the closing of Fall Creek hatchery, was applied to the total abundance estimates prior to 1980.

Siuslaw

The average proportion of hatchery fish observed during the period 1988-2003, in non Lake Creek sub-basins was applied to the total abundance estimates prior to 1990.

This removes the influence of returns of hatchery smolts that were released in Lake Creek only in the mid 90s.

Lower Umpqua

The first significant return from the hatchery program in the Umpqua basin was in 1982. Therefore, the average proportion of hatchery fish observed during the period 1990-2001, prior to the reduction in the hatchery program, was applied to the total abundance estimates during 1982-89. Prior to 1982, hatchery strays were assumed to be insignificant.

Middle Umpqua

The first significant return from the hatchery program in the Umpqua basin was in 1982. Therefore, the average proportion of hatchery fish observed during the period 1990-2001, prior to the reduction in the hatchery program, was applied to the total abundance estimates during 1982-89. Prior to 1982, hatchery strays were assumed to be insignificant.

North Umpqua

Hatchery and wild fish were determined based on counts at Winchester Dam. Hatchery fish were first recorded in 1974 but did not exceed 214 until 1982, when 1,981 were counted.

South Umpqua

The first significant return from the hatchery program in the Umpqua basin was in 1982. Therefore, the average proportion of hatchery fish observed during the period 1990-2001, prior to the reduction in the hatchery program, was applied to the total abundance estimates during 1982-89. Prior to 1982, hatchery strays were assumed to be insignificant.

The Lakes

The average proportion of hatchery fish observed in each population during the period 1990-2003, was applied to the total abundance estimates prior to 1990.

Coos

The Coos population was also influenced by private hatchery fish in the 1980s and by a STEP hatchery in recent years. The average proportion of hatchery fish observed in each population during the period 1986-88, was applied to the total abundance in 1980-88. Prior to 1980, hatchery strays were assumed to be insignificant.

Coquille

The average proportion of hatchery fish observed during the period 1988-96, prior to reductions in Bandon Hatchery program was applied to the total abundance estimates prior to 1990.

Appendix 2 Table A-2. Regression equations used to estimate spawner abundance for the years 1958 to 1989.

Populaion	Period	Equation	R^2	p
Necanicum	1958-80	Total Necanicum = 72.915 * Nehalem peak ct.	0.38	0.015
	1981-89	Total Necanicum = 73.117 * Necanicum peak ct.	0.51	0.003
Nehalem	1958-89	Total Nehalem = 685.214 * Nehalem peak ct.	0.61	0.001
Tillamook	1958-89	Total Tillamook = 212.341 * Tillamook peak ct.	0.89	0.000
Nestucca	1958-89	Total Nestucca = 517.279 * Nestucca peak ct.	0.58	0.002
Siletz	1958-89	Total Siletz = 82.390 * Alsea peak ct.	0.65	0.000
Yaquina	1958-89	Total Yaquina = 134.350 * Yaquina peak ct.	0.92	0.000
Beaver	1958-89	Total Beaver = 50.952 * Beaver peak ct.	0.69	0.000
Alsea	1958-89	Total Alsea = 147.499 * Alsea peak ct.	0.88	0.000
Siuslaw	1958-89	Total Siuslaw = 751.435 * Siuslaw peak ct.	0.82	0.000
Lower Umpqua	1958-89	Total L. Umpqua = 104.266 * L. Umpqua peak ct.	0.71	0.000
Middle Umpqua	1958-89	Wild M. Umpqua =3.075 * Win. Dam Wild	0.89	0.000
South Umpqua	1958-89	Wild S. Umpqua =2.147 * Win. Dam Wild	0.49	0.004
Coos	1958-89	Total Coos = 340.616 * Coos peak ct.	0.65	0.001
Coquille	1958-89	Total Coquille = 320.995 * Coquille peak ct.	0.68	0.000

Appendix 2 Table A-3. Estimated abundance of 21 populations of the Oregon Coast coho, 1958-89.

	Necanicum		Nehalem		Tillamook		Nestucca	
Year	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery
1958	275	162	3,535	576	586	263	3,005	616
1959	983	577	12,611	2,053	1,904	856	2,576	528
1960	680	399	8,721	1,420	2,710	1,218	4,294	879
1961	1,433	842	18,386	2,993	6,007	2,699	7,299	1,495
1962	1,259	739	16,147	2,628	7,032	3,160	2,576	528
1963	808	475	10,372	1,688	4,249	1,909	5,582	1,143
1964	1,884	1,106	24,161	3,933	5,861	2,633	12,022	2,462
1965	1,461	858	18,739	3,051	3,663	1,646	6,011	1,231
1966	1,130	664	14,496	2,360	2,198	987	3,005	616
1967	845	497	10,843	1,765	9,597	4,311	4,294	879
1968	NA	NA	NA	NA	4,689	2,106	2,146	440
1969	652	383	8,368	1,362	2,710	1,218	1,717	352
1970	1,029	604	13,200	2,149	8,717	3,917	7,299	1,495
1971	1,644	966	21,097	3,434	6,447	2,896	5,582	1,143
1972	358	211	4,597	748	2,637	1,185	1,288	264
1973	597	351	7,661	1,247	7,472	3,357	4,723	967
1974	340	200	4,361	710	5,714	2,567	2,576	528
1975	NA	NA	NA	NA	6,740	3,028	3,435	703
1976	367	216	4,715	767	4,395	1,975	NA	NA
1977	459	270	5,893	959	293	132	859	176
1978	597	351	7,661	1,247	4,249	1,909	2,146	440
1979	367	216	4,715	767	4,103	1,843	3,864	792
1980	515	302	6,600	1,074	1,539	691	3,005	616
1981	231	135	3,418	556	1,392	625	2,290	469
1982	2,257	1,326	8,368	1,362	1,978	889	4,580	938
1983	323	189	1,296	211	403	181	4,007	821
1984	645	379	16,500	2,686	2,271	1,020	4,007	821
1985	599	352	6,600	1,074	1,575	708	6,154	1,260
1986	875	514	10,607	1,727	1,575	708	4,865	997
1987	599	352	2,946	480	879	395	1,002	205
1988	921	541	2,631	1,754	809	518	1,145	234
1989	737	433	8,469	5,646	1,145	235	2,004	410

Appendix 2 Table A-3.continued.

	Siletz		Yaquina		Beaver		Alsea	
Year	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery
1958	837	451	3,213	13	662		1,466	796
1959	1,765	951	7,564	30	1,580		3,090	1,679
1960	1,165	627	3,481	14	1,274		2,039	1,108
1961	2,621	1,411	20,616	83	917		4,588	2,492
1962	946	510	8,701	35	1,732		1,657	900
1963	2,220	1,196	5,421	22	764		3,887	2,111
1964	3,185	1,715	10,442	42	1,019		5,575	3,029
1965	1,547	833	10,843	44	1,070		2,708	1,471
1966	1,911	1,029	13,655	55	1,987		3,345	1,817
1967	1,620	872	5,020	20	510		2,836	1,540
1968	1,238	666	7,765	31	1,834		2,166	1,177
1969	400	216	3,347	13	713		701	381
1970	510	274	10,509	42	2,089		892	485
1971	2,239	1,205	16,801	67	2,497		3,918	2,129
1972	328	176	1,941	8	357		573	312
1973	710	382	4,016	16	560		1,242	675
1974	473	255	1,740	7	153		828	450
1975	1,201	647	NA	NA	NA	NA	2,103	1,142
1976	382	206	NA	NA	NA	NA	669	363
1977	655	353	2,142	9	NA	NA	1,147	623
1978	874	470	1,607	6	NA	NA	1,529	831
1979	764	412	11,111	45	NA	NA	1,338	727
1980	852	786	2,124	3,185	727	853	1,467	1,409
1981	906	837	1,559	2,339	258	302	1,561	1,500
1982	480	444	1,398	2,097	469	550	827	795
1983	328	302	457	685	258	302	564	542
1984	601	554	1,478	2,218	563	660	1,034	994
1985	2,173	2,006	4,140	6,209	1,336	1,568	3,742	3,596
1986	1,210	1,478	3,387	8,710	2,147	2,846	2,077	2,643
1987	871	557	2,837	1,397	141	165	2,081	426
1988	1,594	590	2,758	871	164	193	1,572	2,263
1989	1,976	61	2,064	423	662	0	3,362	215

Appendix 2 Table A-3.continued.

	Siuslaw		Siltcoos		Tahkenitch		Tenmile	
Year	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery
1958	NA	NA	NA	NA	NA	NA	12,043	61
1959	NA	NA	NA	NA	NA	NA	7,471	38
1960	1,104	23	1,768	27	912	5	5,464	28
1961	5,891	120	4,169	64	1,785	9	15,277	77
1962	4,050	83	4,492	68	1,783	9	17,619	89
1963	6,259	128	3,650	56	820	4	10,594	53
1964	11,414	233	9,059	138	2,221	11	18,734	94
1965	8,469	173	2,366	36	1,642	8	12,043	61
1966	9,205	188	5,351	82	1,381	7	12,713	63
1967	11,047	225	2,171	33	986	5	11,151	56
1968	10,678	218	2,224	34	714	4	7,248	37
1969	15,464	316	1,630	25	986	5	6,022	30
1970	13,255	271	3,889	60	1,692	9	14,726	74
1971	16,753	342	1,666	25	865	5	26,540	134
1972	4,419	90	1,931	30	573	3	7,471	38
1973	8,837	180	2,826	43	2,434	12	NA	NA
1974	3,498	71	1,497	23	699	4	4,143	21
1975	6,186	126	2,817	43	420	2	2,338	12
1976	13,991	286	NA	NA	NA	NA	1,486	7
1977	4,419	90	1,484	23	2,468	12	1,832	9
1978	2,946	60	634	9	NA	NA	957	5
1979	6,996	143	2,652	40	3,297	16	627	3
1980	11,783	240	1,719	26	1,099	5	1,816	9
1981	3,682	75	NA	NA	NA	NA	2,509	13
1982	8,101	165	1,214	18	3,991	20	2,685	14
1983	4,971	101	664	11	1,967	9	729	4
1984	7,916	162	6,219	95	4,531	23	3,866	19
1985	14,360	293	3,356	51	417	2	3,715	19
1986	19,331	394	4,164	64	3,074	15	4,444	23
1987	11,047	225	1,624	25	594	3	1,933	9
1988	10,596	676	2,579	39	540	2	2,627	13
1989	13,226	1,803	2,051	32	542	3	2,130	10

Appendix 2 Table A-3.continued.

	Lower Umpqua		Middle Umpqua		North Umpqua		South Umpqua	
Year	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery
1958	3,300	0	1,356	0	441		947	0
1959	3,648	0	1,937	0	630		1,353	0
1960	1,285	0	818	0	266		571	0
1961	3,509	0	1,258	0	409		878	0
1962	7,157	0	1,298	0	422		906	0
1963	3,926	0	2,906	0	945		2,029	0
1964	20,671	0	2,761	0	898		1,928	0
1965	14,314	0	5,357	0	1,742		3,740	0
1966	5,698	0	2,171	0	706		1,516	0
1967	9,693	0	3,066	0	997		2,141	0
1968	3,439	0	3,899	0	1,268		2,722	0
1969	7,365	0	1,335	0	434		932	0
1970	7,504	0	483	0	157		337	0
1971	4,933	0	1,510	0	491		1,054	0
1972	2,362	0	996	0	324	0	696	0
1973	6,254	0	1,242	0	404	0	867	0
1974	2,988	0	956	0	311	66	668	0
1975	3,231	0	821	0	267	214	573	0
1976	2,745	0	772	0	251	82	539	0
1977	1,459	0	1,319	0	429	7	921	0
1978	1,529	0	1,141	0	371	107	797	0
1979	6,254	0	1,292	0	420	0	902	0
1980	1,424	0	744	0	242	1	520	0
1981	1,320	0	166	0	54	0	116	0
1982	7,195	379	2,079	133	676	1,981	1,451	256
1983	1,585	83	NA	NA	7	1,196	NA	NA
1984	3,267	172	NA	NA	6	3,195	NA	NA
1985	4,720	248	2,577	164	838	4,023	1,799	317
1986	5,281	278	2,958	189	962	9,581	2,066	364
1987	2,971	156	3,023	193	983	2,165	2,111	373
1988	11,321	596	1,845	118	600	1,196	1,289	227
1989	3,927	207	4,975	318	1,618	2,734	3,474	613

Appendix 2 Table A-3.continued.

	Coos		Coquille	
Year	Wild	Hatchery	Wild	Hatchery
1958	3,403	0	6,195	466
1959	8,167	0	24,554	1,848
1960	2,155	0	3,060	230
1961	12,818	0	7,986	601
1962	13,498	0	14,429	1,086
1963	6,239	0	3,134	236
1964	11,003	0	15,464	1,164
1965	6,012	0	17,076	1,285
1966	7,146	0	7,284	548
1967	6,579	0	6,344	477
1968	4,424	0	5,015	378
1969	6,012	0	11,105	836
1970	4,197	0	7,762	584
1971	7,373	0	11,224	845
1972	4,991	0	6,866	517
1973	5,445	0	4,478	337
1974	9,868	0	6,448	485
1975	6,125	0	5,522	416
1976	10,549	0	24,031	1,809
1977	8,167	0	1,194	90
1978	2,892	0	3,508	264
1979	6,806	0	5,971	449
1980	6,431	715	4,080	307
1981	3,879	431	2,746	207
1982	9,188	1,021	3,940	297
1983	2,450	272	4,359	328
1984	4,389	488	11,224	845
1985	5,411	601	3,582	270
1986	5,819	647	3,582	270
1987	4,638	693	4,657	351
1988	10,880	1,484	4,475	982
1989	5,366	873	1,849	1,233