UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

Refer to NMFS No:
2005/03140

September 8, 2005

Linda Goodman
U.S. Forest Service, Pacific Northwest Region
333 SW First Ave
P.O. Box 3623
Portland, Oregon 97208

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Pacific Northwest Region Invasive Plant Program, Oregon and Washington

Dear Ms. Goodman:

The enclosed document contains a final biological and conference opinion prepared by the National Marine Fisheries Service (NMFS) pursuant to Section 7(a)(2) of the Endangered Species Act (ESA) on the effects of adopting the Pacific Northwest Region Invasive Plant Program desired future condition, goals, objectives, standards, and monitoring framework for national forest lands in Oregon and Washington. This action would amend all national forest land and resource management plans in the Pacific Northwest Region.

In this Opinion, NMFS concludes that the proposed action is not likely to jeopardize the continued existence of Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tschawytscha*), Upper Willamette River (UWR) spring-run Chinook salmon, Upper Columbia River (UCR) spring-run Chinook salmon, Snake River (SR) spring/summer run Chinook salmon, SR fall-run Chinook salmon, Puget Sound (PS) Chinook salmon, Hood Canal (HC) chum salmon (O. keta), Columbia River (CR) chum salmon, LCR coho salmon (*O. kisutch*), Southern Oregon/Northern California coho salmon, SR sockeye salmon (*O. nerka*), LCR steelhead (*O. mykiss*), UWR steelhead, Middle Columbia River steelhead, UCR steelhead, Snake River Basin (SRB) steelhead, or result in the destruction or adverse modification of critical habitat for SR spring/summer run Chinook, SR fall-run Chinook, SONC coho salmon, or SR sockeye salmon. Further, NMFS concludes that the action, as proposed, is not likely to jeopardize the continued existence of Oregon Coast (OC) coho salmon or the resident and hatchery portion of the LCR steelhead, UWR steelhead, MCR steelhead, UCR steelhead, SRB steelhead, ESUs that are proposed for listing, or result in the destruction or adverse modification of critical habitat that NMFS has proposed to designate for LCR Chinook salmon, UWR spring-run Chinook salmon, UCR spring-run Chinook salmon, PS Chinook salmon, HC chum salmon, CR chum salmon, LCR coho salmon, LCR steelhead, UWR steelhead, MCR steelhead, UCR steelhead, or SRB steelhead.

As required by Section 7 of the ESA, an incidental take statement prepared by NMFS is provided with this Draft Opinion. However, because the proposed action does not describe, approve, or compel any site-specific projects, all take from invasive plant control will occur at the site-specific level and not at the plan level. Thus, NMFS does not authorize any take in this Opinion. All take authorization will occur in site-specific consultations. ESUs proposed for listing will not be protected by take prohibitions of the ESA until they are listed and, if designated, protective regulations are in place.

This Opinion also includes the results of our analysis of the action's likely effects on essential fish habitat (EFH) pursuant to Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes sixteen (16) draft conservation recommendations to avoid, minimize, or otherwise offset potential adverse effects on EFH. Section 305(b)(4)(B) of the MSA requires Federal agencies to provide a detailed written response to NMFS within 30 days after receiving these recommendations. If the response is inconsistent with the recommendations, the U.S. Forest Service (USFS) must explain why the recommendations will not be followed, including the justification for any disagreements over the effects of the action and the recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the EFH portion of this consultation, we ask that you clearly identify the number of conservation recommendations accepted.

If you have questions regarding this consultation or need to request confirmation of a conference as a biological opinion, please contact Rick Golden, Fisheries Biologist, in the Oregon State Habitat Office in Portland, Oregon at 503.230.5406.

Sincerely,

for Michael R Crouse

D. Robert Lohn
Regional Administrator

cc: Doug Daoust
Shawna Bautista
Steve Landino
David Mabe
Michael Tehan
Rick Golden

Endangered Species Act – Section 7 Consultation
Biological and Conference Opinion

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Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat Consultation

Pacific Northwest Region Invasive Plant Program
National Forest of Oregon and Washington

Lead Action Agency:	U.S. Forest Service
Consultation Conducted By:	National Marine Fisheries Service Northwest Region
Date Issued:	September 8, 2005
Issued by:	D. Robert Lohn Regional Administrator

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NMFS No.: **2005/03140**

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INTRODUCTION

The biological opinion (Opinion) and incidental take statement portions of this consultation were prepared by the National Marine Fisheries Service (NMFS) in accordance with Section 7(b) of the Endangered Species Act (ESA) of 1973, as amended (16 USC 1531, *et seq*.), and implementing regulations at 50 CFR 402. With respect to critical habitat, the following analysis relied only on the statutory provisions of the ESA, and not on the regulatory definition of "destruction or adverse modification" at 50 CFR 402.02.

The essential fish habitat (EFH) consultation was prepared in accordance with Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 USC 1801, *et seq*.) and implementing regulations at 50 CFR 600. The administrative record for this consultation is on file at the Oregon State Habitat Office.

Background and Consultation History

The U.S. Forest Service (USFS) is proposing to amend all forest plans in USFS Region Six (Region, Region Six) to update management direction regarding the prevention and control of invasive plants. Invasive plant species disrupt natural ecosystems, and increase the potential loss of native plant communities, wildlife, and ecosystem functions. The USFS is proposing the action according to its authority under the Forest and Rangeland Renewable Resources Planning Act (1974), as amended by the National Forest Management Act (1976) and its implementing regulations.

The USFS initiated informal discussions with NMFS in early 2002, before initiating a formal request. A letter requesting appropriate contacts was sent to the Northwest Regional Office of NMFS on July 24, 2002. A species list request was sent to NMFS on September 24, 2002. In a letter dated October 2, 2002, the U.S. Fish and Wildlife Service (FWS) identified the Federally-listed, proposed, and candidate species and designated or proposed critical habitat within the Region. The FWS provided updates to the list in 2003 and 2004.

Discussions between NMFS and USFS personnel began August 8, 2002. A meeting on November 19, 2002 was attended by representatives from FWS, NMFS, and the USFS. Discussions at the meeting pertained to the type of consultation that would be conducted, how streamlined consultations teams from the USFS, FWS, and NMFS would be identified, and information about the Draft Environmental Impact Statement (DEIS) for the proposed action. In October, 2003, the USFS assigned a person to a long-term detail position with NMFS to foster an ongoing dialogue regarding consultation and technical issues.

On December 11, 2003, a meeting was held with both USFS and NMFS managers to discuss the overall consultation approach. On February 25, 2004, the consultation team members met to discuss the approach to effects analysis for herbicide use.

The DEIS was published in August, 2004. Comments on the DEIS were prepared by NMFS and sent to the USFS in November, 2004. In the comment letter, NMFS identified concerns and provided recommendations. The USFS response to NMFS' comments is described in the Final Environmental Impact Statement (FEIS). The FEIS was published in April 2005.

The USFS and FWS worked closely with NMFS to prepare the "status of the species" and environmental baseline descriptions included in this Opinion. The consultation team worked throughout 2004, and into 2005, to refine the effects analysis and agree on effects determinations. A draft of the biological assessment (BA) was received for review by NMFS on May 5, 2005. Discussions with the USFS regarding the content and structure of the draft BA began on May 9, 2005, and concluded on May 23, 2005. Formal consultation was initiated on June 13, 2005, upon receipt of the final BA from the USFS. On July 25, 2005, the USFS shared a document providing additional details of some of the invasive plant tools included in the proposed action.

Proposed Action

The following description of the proposed action was adapted from pages 131, 132, and 135-147 of the BA, and incorporates changes requested via e-mail by the USFS on September 2, 2005. The description of invasive plant tools was adapted from a document received by e-mail from Shawna Bautista (USFS Invasive Plant team wildlife biologist) on July 25, 2005. Conservation measures listed following the description of tools were summarized by NMFS from the description of the proposed action. Of the ten herbicides proposed for use, only triclopyr was mentioned in the January 22, 2004, court-ordered injunction in the pesticide litigation brought by Washington Toxics Coalition.

The proposed action is to amend all forest plans within Region Six[1] to increase the emphasis on consistency of invasive plant prevention across the Region and allow the use of a new and expanded set of invasive plant treatment tools. Existing direction will be replaced with new, updated, and more comprehensive direction for the prevention and management of invasive plants. The national forest lands administered by Region Six total about 24.9 million acres, and include approximately 15.5 million acres in Oregon, 9.2 million acres in Washington, 142,000 acres in Idaho, and 87,000 acres in California. Lands in Idaho and California are part of Region Six national forests.

An estimated 420,000 acres of national forest lands in the Region are currently infested with invasive plants. Currently 107 different species of invasive plants have been identified on national forest land in Region Six. Despite current management efforts, invasive plants continue to increase and invade previously uninfested areas, such as wilderness areas, research natural areas, and Hell's Canyon National Recreation Area.

[1] Region Six encompasses 24.9 million acres of national forest land in Oregon, Washington, and small portions of Western Idaho (Hell's Canyon) and Northern California. Region Six includes 19 National Forests, the Columbia Gorge National Scenic Area, portions of the Payette and Nez Perce National Forests (Hell's Canyon National Recreation Area) in Idaho, managed by the Wallowa Whitman National Forest, and portions of the Rogue River and Siskiyou National Forests that extend into California.

Current direction for the prevention and management of invasive plants on national forests in Region Six comes to a large degree, but not exclusively, from the 1988 EIS and 1988 Record of Decision (ROD) for Competing and Unwanted Vegetation, and the associated 1989 Mediated Agreement. These documents have been incorporated into the forest plans within the Region. These documents require consideration of invasive plant prevention, but specific direction on how to actually prevent the spread of invasive plants is not provided.[2] The 1988 ROD specified and limited the tools available for the treatment of competing and unwanted vegetation, but did not provide administrative mechanisms for adapting their requirements and adopting new technologies. Collectively, the forest plans, as currently written, do not provide sufficient direction, nor adequate tools for effectively responding to the invasive plant threat.

The proposed action responds to underlying needs that currently exist on all national forest system lands in Region Six for:

1. Forest plan direction that will reduce the extent and rate of spread of invasive plants and help prevent new infestations.
2. Release from forest plan direction established by the 1988 ROD and 1989 Mediated Agreement so that new practices, technologies, and chemical formulations of herbicides are available for use.
3. An updated list of herbicides available for use by the national forests.

The purpose of the new management direction is to facilitate subsequent actions to eliminate or control invasive plants so that: (1) The Desired Future Condition (DFC) of national forest system lands can be attained;[3] (2) Federal land managers' ability to provide goods and services from the national forest system lands is maintained; and (3) the USFS' ability to cooperate with similar efforts across other ownerships is improved.

The ROD for the Invasive Plant EIS would add new forest plan direction relating to invasive plants, and delete existing forest plan direction for invasive plants incorporated from the 1988 EIS, 1988 ROD, and the 1989 Mediated Agreement. Portions of the 1988 ROD and Mediated Agreement that involve management of other unwanted native vegetation would remain in place. The ROD will address transition between existing management direction and any new direction selected.

Management direction provided by the selected alternative would apply to future projects and activities. The selected alternative will not by itself change any permitted or authorized activity on national forest system land. Project-level analysis (National Environmental Policy Act [NEPA]) will still be required. The final decision for this EIS will influence the design and development of these projects.

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[2] A few national forests, most notably the Mt. Baker-Snoqualmie, have moved forward in recent years to amend their forest plan to include specific direction for the prevention of invasive plants; most Forests have not.

[3] Refer to Chapter 2.4 in the Invasive Plant EIS for more information on Desired Future Condition

The proposed action will not be retained as a Regional-scale decision; rather it will become part of the individual forest plans. Over time, decision makers for individual national forests may modify the decisions that result from this EIS in accordance with planning laws, policies and regulations. Therefore, this consultation will remain in effect on Region Six national forest units that retain the forest plan amendments contained in the proposed action. As Region Six national forest units modify the decisions contained in the proposed action, consultation will need to be reinitiated by those units.

The proposed action does not include invasive plants floating on, or submerged in, water. Floating and submerged invasive plants (aquatic invasives) are currently being addressed through other Federal actions in cooperation with the states. Nor does it include experimental trials of herbicides conducted by the U.S. Environmental Protection Agency (EPA) to test new products.

The action would revise only that portion of existing management direction that addresses prevention and treatment of invasive plants, along with associated restoration activities associated with the removal of invasive plants. It will not alter current management direction for competing and unwanted vegetation other than invasive plants, or other restoration not associated with invasive plant treatment.

Under the Wyden Amendment, Section 323 of the Fiscal Year 1999 Department of the Interior and Related Agencies Appropriations Act, and the Secure Rural Schools and Community Self-determination Act of 2000, Federal funding can be authorized for treatment of invasive plants on non-Federal lands. The forest plan amendments proposed in this document apply only to the identified national forest system land.

Existing Management Direction

The USFS is proposing the action according to its authority under the Forest and Rangeland Renewable Resources Planning Act (1974), as amended by the National Forest Management Act (1976) and its implementing regulations. This action would revise only that portion of existing management direction contained in individual forest Land and Resource Management Plans (LRMPs) that addresses prevention and management of invasive plants, as well as restoration activities associated with the removal of invasive plants. It will not alter current management direction for competing and unwanted vegetation other than invasive plants, or other restoration not associated with invasive plant treatment.

Forest Service Manual 2080.2 directs the USFS to use an integrated weed management (IWM) approach to control and contain the spread of noxious weeds on national forest system lands and from national forest system lands to adjacent lands.

Forest Service Manual 2080.5 defines IWM as: “an interdisciplinary pest management approach for selecting methods for preventing, containing, and controlling noxious weeds in coordination with other resource management activities to achieve optimum management goals and objectives. Methods include: education, preventive measures, herbicides, cultural, physical or mechanical methods, biological control agents, and general land management practices, such as manipulation of livestock or wildlife grazing strategies that accomplish vegetation management objectives."

Specific objectives to be achieved through integrated weed management include:

1. Prevention of the introduction and establishment of noxious weed infestations.
2. Containment and suppression of existing noxious weed infestations.
3. Formal and informal cooperation with state agencies, local landowners, weed control districts and boards, Native American tribes and other Federal agencies in the management and control of noxious weeds.
4. Education and awareness of employees, users of national forest system lands, adjacent landowners, and state agencies about noxious weed threats to native plant communities and ecosystems.

The existing directions and requirements contained in PACFISH (USDA-FS 1995), INFISH (USDA and USDI 1995a),[4] and the Northwest Forest Plan (NWFP) (USDI 1994) are not being changed.

Numerous Federal and state laws, regulations, and policies also regulate management on national forest land. The EIS is being prepared in compliance with the NEPA guidelines as set by the Council of Environmental Quality in 40 CFR 1500-1508 and Forest Service Handbook 1909.15. The Forest Service Manual and Handbook system codifies the agency's policy, practice, and procedure and serves as the primary administrative basis for the internal management and control of all programs. The proposed action will not change any direction contained in the Forest Service Manual or handbooks.

Management Direction Associated with the Proposed Action

The proposed action emphasizes invasive plant prevention, early detection, early treatment, and restoration of affected habitat, monitoring and long-term site management. A key feature of the proposed action is the requirement to develop long-term site goals for all invasive plant sites before treatment. Long-term site goals provide the mechanism which link treatment to prevention, revegetation/restoration, and monitoring in an integrated and adaptive process for management of invasive plants.

The overall approach includes adaptive management, with increased emphasis on prevention, updated treatment tools, restoration and long-term site management. The proposed action includes all effective treatment methods and authorizes the consideration of ten herbicides (as listed in Standard 16). It establishes an objective to reduce the use of herbicides over time. The proposed action only includes the use of combinations of these ten herbicides as evaluated in the Syracuse Environmental Research Associates, Inc. (SERA) risk assessments, and only adjuvants evaluated by USFS hazard and risk assessments.

Five kinds of new management direction would be added to forest plans in Region Six under the proposed action: (1) Desired future condition statements, (2) goals, (3) objectives, (4) prevention and treatment/restoration standards, and (5) an inventory and monitoring plan framework.

[4] Reference citation not provided in BA.

Desired Future Condition (DFC). DFC statements describe how national forests should look and function in the future in relation to invasive plants, as opposed to dwelling on past problems. The description is optimistic, but attainable. The DFC represents a positive depiction of what would result from successful forest plan implementation.

Goals. Goals are broad, general terms describing how to achieve the DFC, with no specific time frames by which the goals are to be achieved. Goal statements form the basis from which objectives are developed.

Objectives. Objectives are specific statements of actions or results designed to help achieve goals. Objectives break down goals into components, and form the basis for project-level actions or proposals to help achieve forest goals. The rate of achieving objectives is dependent on budgets and other variables. The time frame for achieving objectives is generally considered to be the planning period, or the next 10 to 15 years. Not all objectives are associated with specific proposed standards. In many cases, objectives would be met through adherence to existing standards, policies, and laws.

Standards. Standards are binding limitations placed on management actions, designed to contribute to the attainment of objectives. Standards must be within the authority and ability of the USFS to enforce. A project or action that varies from a relevant standard may not be authorized unless the forest plan is amended to modify, remove, or waive application of the standard. The proposed action contains a unique suite of standards developed so that projects will contribute to meeting goals, objectives and desired conditions.

The following DFCs, goals and objectives would be added to the already existing sets of DFCs, goals and objectives in forest plans across the Region.

Desired Future Condition. In national forest lands across Region Six, healthy native plant communities remain diverse and resilient, and damaged ecosystems are being restored. High quality habitat is provided for native organisms throughout the region. Invasive plants do not jeopardize the ability of the national forests to provide goods and services communities expect. The need for invasive plant treatment is reduced due to the effectiveness and habitual nature of preventative actions, and the success of restoration efforts.

Goal 1. Protect ecosystems from the impacts of invasive plants through an integrated approach that emphasizes prevention, early detection, and early treatment. All employees and users of the national forest recognize that they play an important role in preventing and detecting invasive plants.

> ***Objective 1.1*** Implement appropriate invasive plant prevention practices to help reduce the introduction, establishment and spread of invasive plants associated with management actions and land use activities.
> ***Objective 1.2*** Educate the workforce and the public to help identify, report, and prevent invasive plants.

Objective 1.3 Detect new infestations of invasive plants promptly by creating and maintaining complete, up-to-date inventories of infested areas, and proactively identifying and inspecting susceptible areas not infested with invasive plants.
Objective 1.4 Use an integrated approach to treating areas infested with invasive plants. Use a combination of available tools including manual, cultural, mechanical, herbicides, biological control.
Objective 1.5 Control new invasive plant infestations promptly, suppress or contain expansion of infestations where control is not practical, conduct follow up inspection of treated sites to prevent reestablishment.

Goal 2. Minimize the creation of conditions that favor invasive plant introduction, establishment and spread during land management actions and land use activities. Continually review and adjust land management practices to help reduce the creation of conditions that favor invasive plant communities.

Objective 2.1 Reduce soil disturbance while achieving project objectives through timber harvest, fuel treatments, and other activities that potentially produce large amounts of bare ground.
Objective 2.2 Retain native vegetation consistent with site capability and integrated resource management objectives to suppress invasive plants and prevent their establishment and growth.
Objective 2.3 Reduce the introduction, establishment and spread of invasive plants during fire suppression and fire rehabilitation activities by minimizing the conditions that promote invasive plant germination and establishment.
Objective 2.4 Incorporate invasive plant prevention as an important consideration in all recreational land use and access decisions.
Objective 2.5 Place greater emphasis on managing previously "unmanaged recreation" (OHVs, dispersed recreation, etc.) to help reduce creation of soil conditions that favor invasive plants, and reduce transport of invasive plant seeds and propagules.

Goal 3. Protect the health of people who work, visit, or live in or near national forests, while effectively treating invasive plants. Identify, avoid, or mitigate potential human health effects from invasive plants and treatments.

Objective 3.1 Avoid or minimize public exposure to herbicides, fertilizer, and smoke.
Objective 3.2 Reduce reliance on herbicide use over time in Region Six.

Goal 4. Implement invasive plant treatment strategies that protect sensitive ecosystem components, and maintain biological diversity and function within ecosystems. Reduce loss or degradation of native habitat from invasive plants while minimizing adverse effects from treatment projects.

Objective 4.1 Maintain water quality while implementing invasive plant treatments.
Objective 4.2 Protect non-target plants and animals from negative effects of both invasive plants and applied herbicides. Where herbicide treatment of invasive plants is necessary within the riparian zone, select treatment methods and chemicals so that

herbicide application is consistent with riparian management direction, contained in PACFISH, INFISH, and the Aquatic Conservation Strategies of the NWFP.
Objective 4.3 Protect threatened, endangered, and sensitive species habitat threatened by invasive plants. Design treatment projects to protect threatened, endangered, and sensitive species and maintain species viability.

Goal 5. Expand collaborative efforts between the USFS, our partners, and the public to share learning experiences regarding the prevention and control of invasive plants, and the protection and restoration of native plant communities.

Objective 5.1 Use an adaptive management approach to invasive plant management that emphasizes monitoring, learning, and adjusting management techniques. Evaluate treatment effectiveness and adjust future treatment actions based on the results of these evaluations.
Objective 5.2 Collaborate with Tribal, other Federal, state, local and private land managers to increase availability and use of appropriate native plants for all land ownerships.
Objective 5.3 Work effectively with neighbors in all aspects of invasive plant management: share information and resources, support cooperative weed management, and work together to reduce the inappropriate use of invasive plants (landscaping, erosion control, etc.).

Inventory and Monitoring Plan Framework

In addition to the monitoring already required under various forest plans, an inventory and monitoring plan framework is part of the proposed action. The approach included in the framework was developed via interagency discussions with NMFS and FWS personnel. A measure included within the monitoring framework that will improve the forest's ability to detect, respond rapidly to new infestations is the requirement to maintaining an invasive plant inventory consistent with nationally accepted (*e.g.,* NRIS/Terra) protocols.

Contents of the Inventory and Monitoring Plan Framework are as follows:

It is assumed every forest in Region Six has an invasive plants coordinator and is maintaining an up-to-date invasive plant inventory using NRIS/Terra, the nationally accepted protocol. The inventory will be the primary means to plan and prioritize treatments. The inventory will be used as the main vehicle for tracking treatment effectiveness both regionally and on a site-specific basis.

In addition to the monitoring that is already required under various forest plans, this inventory and monitoring plan framework is part of all action alternatives in this EIS. The framework would guide the development of detailed monitoring plans at the site-specific project scale. Invasive plant treatment and restoration actions are likely to be complex, involve multiple land ownerships and will take years to implement, due to the nature of invasive plant problems. It is likely that a site will be treated multiple times over the years. Tracking these efforts and subsequent progress will be crucial to determining success.

A good monitoring program will be well thought out and have a high probability of detecting change in the resource being monitored (NPS, 2002).[5] The Field Guide to Invasive Plant Inventory, Monitoring and Mapping (USDA FS, 2002)[6] has been developed to guide monitoring efforts in conjunction with NRIS TERRA. It suggests a monitoring regime may start with annual monitoring for the first three to five years, decreasing in frequency to every other year for the next 5-10 years and further decreasing monitoring frequency to every three years for the next ten years until the seed source has been exhausted (*i.e.* no new germination taking place).

Monitoring regimes may vary in time and space depending on the species; for example, those that reproduce vegetatively may require a longer span of annual monitoring. The monitoring categories described in this framework (implementation/compliance, and effectiveness (of treatments in meeting project objectives, and effectiveness of protection measures) can be used to implement a long-term adaptive management strategy. By implementing an adaptive management approach, managers will identify and respond to changing conditions and new information on an ongoing basis, and assess the need to make changes to treatment and restoration strategies.

Implementation/Compliance Monitoring

Implementation/compliance monitoring answers the question, "Did we do what we said we would do?" This question needs to be answered on a Regional scale, because adaptive management strategies require determination that actions are taking place as described in the Invasive Plants EIS.

If an action alternative is selected, each forest supervisor will be directed to assess compliance with the Invasive Plant Program EIS Record of Decision as a part of forest plan implementation monitoring. Regional Office staff will periodically aggregate this information as a part of program oversight.

An implementation/compliance checklist database, such as the PACFISH/INFISH Biological Opinion Implementation Monitoring module database for the eastside, could be used as a template to input and analyze implementation/compliance monitoring data. The use of a consistent reporting format will allow for aggregation of information at various scales.

ESA-Listed Species. An implementation/compliance monitoring database would track invasive plant treatment projects that are the subject of Section 7 consultations under the ESA generate annual reporting of compliance for use by the Services (NMFS, FWS) and USFS, and allow for common reporting of data on individual projects. As a minimum, on each project requiring consultation, reporting will be required on compliance with Standards 16, 18, 19, and 20 in the Invasive Plant EIS. Additional standards could be included, as appropriate, for the individual ecoregions, forests, or projects. For example, NWFP riparian standards relevant to herbicide use or invasive plant control projects could be included in the database for those forests in the NWFP-covered areas.

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[5] Reference citation not provided in BA.
[6] Reference citation not provided in BA.

Effectiveness Monitoring

Effectiveness monitoring, relative to project objectives, answers the question, "Were treatment and restoration projects effective?" This question could be answered on either a regional or a project-level scale. Invasive plant infestations require pre-project inventories to determine how, when, and where treatments are to be applied, and post-treatment monitoring to assess the effectiveness (treatment) in meeting project objectives (*e.g.* restoring structure and composition of native vegetation).

A goal of the Effectiveness Monitoring component in the Regional Invasive Plant Program is to answer the following questions:

- Have the number of new invasive plant infestations increased or decreased in the Region or at the project level?
- What changes in distribution, amount and proportion of invasive plant infestations have resulted due to treatment activities in the region or at the project level?
- Has the infestation size for a targeted invasive plant species been reduced regionally or at the project level?
- Which treatment methods, separate or in combination, are most successful for specific invasive species?
- Which treatment methods have not been successful for specific invasive species?

The nationwide NRIS/Terra and the upcoming FACTS databases provide common reporting formats to input information and provide a mechanism for addressing the above questions. In addition, current long-term ecological monitoring networks will assist the USFS in determining trends of invasive plant infestations at the Regional level.

The NRIS/Terra database could be sorted to answer the above questions because it tracks size and species of infestations as well as treatment methods. The Forest Inventory and Analysis Network (FIA) or the forest health monitoring plots associated with the FIA network could be used to follow invasion trends. Such networks could be used to track trends in the spread or reduction in spread of the more dominant invasive plants in the region. Monitoring programs developed at the forest level would answer more project specific questions.

ESA-Listed Species. Monitoring that addresses the effectiveness of various measures designed to reduce potential adverse effects from the project, including standards in the EIS, "project design criteria," "design features," and "protection measures" may also need to be conducted. This type of monitoring will only be required for invasive plant treatment projects that pose a "high risk" to Federally-listed species. "High risk" projects are defined as:
Any project involving aerial application of herbicide.

Projects involving the use of heavy equipment or broadcast application of herbicide (*e.g.* boom spray or backpack spraying that is not limited to spot sprays) that occur in: (1) Riparian areas (as defined in NWFP, PACFISH, or INFISH, as applicable), ditches or water corridors connected to habitat for ESA-listed fish; or (2) proximity to Federally-listed plants or butterfly habitat.

For the purposes of determining the need for protection measure effectiveness monitoring, invasive plant treatment methods that are not considered "high risk" can include, but are not limited to, the following:

1. Broadcast application of herbicide and use of heavy equipment that occurs outside of: (1) Riparian areas, ditches or water corridors connected to waterbodies, or (2) areas in proximity to Federally-listed plants or butterfly habitat.
2. Manual methods including hand-pulling, grubbing, stabbing, pruning, cutting, *etc.*
3. Mechanical methods using small equipment like chainsaws, or equipment rarely used and not often in proximity to ESA-listed fish habitat, like flamers, foamers, hot steam, *etc.*
4. Prescribed fire used expressly for invasive plant control and which occurs outside of riparian areas or habitat for Federally-listed plants or butterflies.
5. Herbicide applications using spot spray (used with a shield near ESA-listed plant locations) with a backpack sprayer, cut stump, injection, wicking wiping, basal bark applications, or other highly selective methods.
6. Minor uses of fertilizer to encourage native plant competition or growth.
7. Biological controls used in habitat areas for terrestrial wildlife or fish. Use in proximity to ESA-listed plants or butterflies should be evaluated on a case-by-case basis.
8. Broadcast applications (except aerial) using clopyralid, imazapic, and metsulfuron methyl in proximity to habitat for listed fish or listed terrestrial wildlife.
9. A collection of several of these low risk projects in close proximity to each other and in proximity to habitat for listed species may constitute a "high risk" project, but this should be evaluated on a case-by-case basis.

Monitoring for "high risk" invasive plant treatments that may affect ESA-listed species or designated critical habitat should determine if standards and/or protection measures were effective at reducing potential effect pathways (*e.g.* disturbance, sedimentation, exposure to herbicides) and results should be applicable elsewhere. Unique, individual monitoring efforts and protocols have not provided information that is applicable to other areas or projects. Therefore, a Regional, interagency ("interagency" includes, but is not limited to, the USFS, FWS, and NMFS) approach is outlined in this framework that will help address the needs for protection measure effectiveness at a broader scale. For example, Japanese knotweed is a serious invader of riparian areas and has the potential to alter ecosystems upon which ESA-listed salmon depend. The Region may have several Japanese knotweed treatment projects over the next several years and each one may have the potential to adversely affect listed salmon or designated critical habitat if adequate measures are not part of the treatment plan or are not complied with during implementation. Designing consistent monitoring protocol will allow a more efficient and effective evaluation of the project protection measures.

To meet the objective of being able to evaluate standards and measures applied at the Regional, sub-Regional, and project level for protection of ESA-listed species and/or designated critical habitat in "high risk" projects, an interagency monitoring protocol and reporting schedule will be developed by 2007. This protocol would be applied to high risk projects to determine the effectiveness of Regional EIS standards, and additional standards or protection measures applied at finer scales, in reducing potential effect pathways (*e.g.* disturbance, sedimentation, exposure to herbicides) for ESA-listed species.

In the interim, information obtained from implementation/compliance monitoring reports for "high risk" projects will be reviewed in 2005 and 2006 to inform the development of a consistent monitoring protocol for ensuring that standards and protection measures were effective. This two to three year lag time before protocol are developed and effectiveness monitoring is implemented does not apply to aerial application of herbicides. All projects with aerial applied herbicide will include a monitoring plan to assess the effectiveness of measures in protecting ESA-listed species and/or designated critical habitat.

Until a Regional, interagency effectiveness monitoring protocol for ESA-listed species and/or designated critical habitat is developed (2007), the need for effectiveness monitoring on "high risk" projects will be evaluated by Level 1 or other interagency technical teams during Section 7 consultation. Recommendations for additional effectiveness monitoring beyond that described in this framework will require that Level 2 teams or other appropriate interagency management team agree to the recommendations of the technical or Level 1 team for the project. This process will help lead the Region toward efficient and reliable data collection and allow statistical analysis of the data gathered.

Standards

In addition to the DFCs, goals, objectives, and the Inventory and Monitoring Framework, the proposed action contains a suite of new forest plan standards. These standards were designed in cooperation with USFS staff, to ensure that long-term multiple use goals and objectives would not be significantly altered through the alternatives developed (Forest Service Manual 1922.51/52). Table 1 displays the forest plan standards associated with the proposed action.

Table 1. Standards to be added to existing LRMPs in Region Six by Implementing the Proposed Action

Standard Number	Proposed Action
	Prevention Standards
1. (Objectives 1.1, 1.2, 2.3, 2.4, 2.5)	Prevention of invasive plant introduction, establishment and spread will be addressed in watershed analysis; roads analysis; fire and fuels management plans, Burned Area Emergency Recovery Plans; emergency wildfire situation analysis; wildland fire implementation plans; grazing allotment management plans, recreation management plans, vegetation management plans, and other land management assessments.
2. (Objectives 1.1, 1.2, 2.3)	Actions conducted or authorized by written permit by the USFS that will operate outside the limits of the road prism (including public works and service contracts), require the cleaning of all heavy equipment (bulldozers, skidders, graders, backhoes, dump trucks, etc.) before entering national forest system lands. This standard does not apply to initial attack of wildland fires, and other emergency situations where cleaning would delay response time.
3. (Objectives 1.1, 2.3)	Use weed-free straw and mulch for all projects, conducted or authorized by the USFS, on national forest system lands. If state certified straw and/or mulch is not available, individual forests should require sources certified to be weed free using the North American Weed Free Forage Program standards (see Appendix O of EIS) or a similar certification process. This standard may need to be phased in as a certification process is established.

Standard Number	Proposed Action
	Prevention Standards
4. (Objectives 1.1, 2.5)	Use only pelletized or certified weed free feed on all national forest system lands. If state certified weed free feed is not available, individual Forests should require feed certified to be weed free using North American Weed Free Forage Program standards or a similar certification process. This standard may need to be phased in as a certification processes is established.
5.	From other alternatives in the EIS; no corollary standard for proposed action. (Addressed as Objective 2.2 and in the USDA Forest Service Guide to Noxious Weed Prevention Practices)
6. (Objectives 1.1, 5.1, 5.3)	Through annual operating instructions, and the revision of grazing allotment management plans, incorporate invasive plant prevention practices that reduce the spread of invasive plants. Plan and implement practices in cooperation with the grazing permit holder.
7. (Objectives 1.1, 1.2, 1.3)	Inspect active gravel, fill, sand stockpiles, quarry sites, and borrow material for invasive plants before use and transport. Treat or require treatment of infested sources before any use of pit material. Use only gravel, fill, sand, and rock that is judged to be weed free by district or forest weed specialists.
8. (Objectives 1.1, 1.2, 5.1)	Conduct road blading, brushing and ditch cleaning in areas with high concentrations of invasive plants in consultation with district or forest-level invasive plant specialists, incorporate invasive plant prevention practices as appropriate.
9.	From other alternatives in the EIS; no corollary standard for proposed action. (Addressed as Objectives 1.1 and 2.4)
	Treatment Standards
11. (Objectives 1.5, 5.1)	Prioritize infestations of invasive plants for treatment at the landscape, watershed or larger multiple forest/multiple owner scale.
12. (Objectives 1.1, 5.1)	Develop a long-term site strategy for restoring/revegetating invasive plant sites before treatment.
13. (Objectives 1.1, 1.4)	Native plant materials are the first choice in revegetation for restoration and rehabilitation where timely natural regeneration of the native plant community is not likely to occur. Non-native, non-invasive plant species may be used in any of the following situations: 1) when needed in emergency conditions to protect basic resource values (e.g., soil stability, water quality and to help prevent the establishment of invasive species), 2) as an interim, non-persistent measure designed to aid in the re-establishment of native plants, 3) if native plant materials are not available, or 4) in permanently altered plant communities. Under no circumstances will non-native invasive plant species be used for revegetation.
14. (Objectives 1.4, 4.1, 4.2)	Use only APHIS and state-approved biological control agents. Agents demonstrated to have direct negative impacts on non-target organisms would not be released.

Standard Number	Proposed Action
	Treatment Standards
15. (Objectives 1.4, 3.1, 4.1, 4.2)	Application of any herbicides to treat invasive plants will be performed or directly supervised by a state or Federally licensed applicator. All treatment projects that involve the use of herbicides will develop and implement an herbicide transportation and handling safety plan.
16. (Objectives 1.4, 3.1, 4.1, 4.2)	Select from herbicide formulations containing one or more of the following 10 active ingredients: chlorsulfuron, clopyralid, glyphosate, imazapic, imazapyr, metsulfuron methyl, picloram, sethoxydim, sulfometuron methyl, and triclopyr. Mixtures of herbicide formulations containing 3 or less of these active ingredients may be applied where the sum of all individual Hazard Quotients[7] for the relevant application scenarios is less than 1.0.[a] All herbicide application methods are allowed including wicking, wiping, injection, spot, broadcast and aerial, as permitted by the product label. Chlorsulfuron, metsulfuron methyl, and sulfometuron methyl will not be applied aerially. The use of triclopyr is limited to selective application techniques only (e.g., spot spraying, wiping, basal bark, cut stump, injection). Additional herbicides and herbicide mixtures may be added in the future at either the forest plan or project level through appropriate risk analysis and NEPA/ESA procedures.
18. (Objectives 3.1, 4.1, 4.2)	Use only adjuvants (*e.g.* surfactants, dyes) and inert ingredients reviewed in USFS hazard and risk assessment documents such as SERA, 1997a, 1997b, and Bakke 2002.
19. (Objective 4.1)	To minimize or eliminate direct or indirect negative effects to non-target plants, terrestrial animals, water quality and aquatic biota (including amphibians) from the application of herbicide, use site-specific soil characteristics, proximity to surface water and local water table depth to determine herbicide formulation, size of buffers needed, if any, and application method and timing. Consider those herbicides and herbicide mixtures registered for aquatic use when evaluating herbicide use near streams or surface water.
20. (Objectives 4.1, 4.2, 4.3)	Design invasive plant treatments to minimize or eliminate adverse effects to species and critical habitats proposed and/or listed under the Endangered Species Act. This may involve surveying for listed or proposed plants before implementing actions within unsurveyed habitat if the action has a reasonable potential to adversely affect the plant species. Use site-specific project design (e.g. application rate and method, timing, wind speed and direction, nozzle type and size, buffers, etc.) to mitigate the potential for adverse disturbance and/or contaminant exposure.
21. (Objectives 3.1, 4.2)	Provide a minimum buffer of 300 feet for aerial application of herbicides near developed campgrounds, recreation residences and private land (unless otherwise authorized by adjacent private landowners).

[7] Hazard Quotient (HQ) represents the environmentally expected concentration (EEC) divided by an appropriate toxicity metric. In the BA analysis, toxicity metrics used were the lowest value of either 1/20th of the LC_{50}, the measured chronic "no observable effect concentration" (NOEC), or the measured acute NOEC.

Standard Number	Proposed Action
	Treatment Standards
22. (Objectives 4.1)	Prohibit aerial application of herbicides within legally designated municipal watersheds.
23. (Objective 3.1)	Prior to implementation of herbicide treatment projects, National Forest staff will ensure timely public notification. Treatment areas will be posted to inform the public and forest workers of herbicide application dates and herbicides used. If requested, individuals may be notified in advance of spray dates.

a. ATSDR, 2004. Guidance Manual for the Assessment of Joint Toxic Action of Chemical Mixtures. U.S. Department Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry.

Description of Treatment Tools

Manual and Mechanical. Manual and mechanical techniques such as pulling, cutting, and otherwise damaging plants, may be used to control some invasive plants, particularly if the population is relatively small. These techniques can be extremely specific, minimizing damage to desirable plants and animals, but they are generally labor and time intensive. Treatments must typically be administered several times to prevent the weed from re-establishing, and in the process, laborers and machines may severely trample vegetation and disturb soil, providing prime conditions for re-invasion by the same or other invasive species.

1. Weed Pulling. Pulling or uprooting plants can be effective against some shrubs, tree saplings, and herbaceous and floating weeds. Annuals and tap-rooted plants are particularly susceptible to control by hand-pulling.
   a. Hand pulling. The advantages of pulling include its small ecological impact, minimal damage to neighboring plants, and low (or no) cost for equipment or supplies. Pulling is extremely labor intensive, however, and is effective only for relatively small areas, even when abundant volunteer labor is available.
   b. Pulling using tools. Most weed-pulling tools are designed to grip the weed stem and provide the leverage necessary to pull its roots out. Tools vary in their size, weight, and the size of the weed they can extract.

2. Mowing, Brush-Cutting, Weed Eating. Mowing and cutting can reduce seed production and restrict weed growth, especially in annuals cut before they flower and set seed. Some species however, re-sprout vigorously when cut, replacing one or a few stems with many that can quickly flower and set seed. Mowing and cutting are often used as primary treatments to remove aboveground biomass, in combination with herbicide treatments or prescribed burning.

3. Stabbing. Some plants can be killed by severing or injuring (stabbing) the carbohydrate storage structure at the base of the plant. Depending on the species, this structure may be a root corm, storage rhizome (tuber), or taproot. These organs are generally at the base of

the stem and under the soil. Cutting off access to these storage structures can help "starve" or greatly weaken some species.

4. Girdling. Girdling is often used to control trees or shrubs that have a single trunk. It involves cutting away a strip of bark several centimeters wide all the way around the trunk. The removed strip must be cut deep enough into the trunk to remove the vascular cambium, or inner bark, the thin layer of living tissue that moves sugars and other carbohydrates between areas of production (leaves), storage (roots), and growing points. This inner cambium layer also produces all new wood and bark.

5. Mulching. Mulching can be used on relatively small areas, but will often stunt or stop growth of desirable native species. Mulching cannot control some perennial weeds because their extensive food reserves allow them to continue to grow up through the mulch.

6. Tilling. Tilling, or the turning-over of soil, is often used for weed control in agricultural crops. Its use in wildland management is largely limited, however, to restoration sites where soils are already badly disturbed. Tilling is effective against annuals and shallow-rooted perennials, but small fragments of some species, particularly those perennials with rhizomes, can often resprout following tillage. Tilling should be completed before seeds develop and are shed onto the soil.

7. Soil Solarization. Soil solarization is the technique of placing a cover (usually black or clear plastic) over the soil surface to trap solar radiation and cause an increase in soil temperatures to levels that kill plants, seeds, plant pathogens, and insects.

8. Flooding. In situations where the water level of a wetland or riverine system can be manipulated, flooding can be used to control some plant species. Some species, however, have vegetative buds or underground storage organs that can survive several months or more under flooded conditions.

9. Steaming or Foaming. Pouring boiling hot water onto weeds, or subjecting weeds to hot steam, is a method of weed control that has been practiced for some time. A New Zealand company named Waipuna™ provides a hot foam system for steam-killing vegetation. This system employs hot foam to deliver and trap superheated steam onto foliage to kill weeds.

10. Grazing. Grazing can either promote or reduce weed abundance at a particular site. By itself, grazing will rarely, if ever, completely eradicate invasive plants. However, when grazing treatments are combined with other control techniques, such as herbicides or biocontrol, severe infestations can be reduced and small infestations may be eliminated. Grazing animals may be particularly useful in areas where herbicides cannot be applied (*e.g.,* near water) or are prohibitively expensive (*e.g.,* large infestations). In general, the specific weed and desirable native plants will determine the number and species of animal grazers and the duration and frequency of grazing.

11. Biological. Biological control is the use of animals, fungi, or other microbes to feed upon, parasitize or otherwise interfere with a targeted pest species. Successful biocontrol programs usually significantly reduce the abundance of the pest, but in some cases, they simply prevent the damage caused by the pest (*e.g.* by preventing it from feeding on valued crops) without reducing pest abundance. Biocontrol is often viewed as a progressive and environmentally friendly way to control pest organisms because it leaves behind no chemical residues that might have harmful impacts on humans or other organisms, and when successful, it can provide essentially permanent, widespread control with a very favorable cost-benefit ratio. However, some biocontrol programs have resulted in significant, irreversible harm to untargeted (non-pest) organisms and to ecological processes.

12. Prescribed Fire. Agencies and organizations that manage land for biodiversity often use prescribed burns to promote desired vegetation and species. Fire is sometimes necessary to prompt the germination of some plants, including a number of rare and endangered species. On the other hand, fire can also sharply reduce the abundance of some species. The weather, topography, and available fuel will determine the temperature and intensity of the prescribed burn, and this along with the timing of the treatment, largely determine how the burn impacts the vegetation and the abundance of particular species.

13. Herbicides. Herbicide application methods are defined as follows:
    a. Foliar applications. These methods apply herbicide directly to the leaves and stems of a plant. An adjuvant or surfactant is often needed to enable the herbicide to penetrate the plant cuticle, a thick, waxy layer present on leaves and stems of most plants. There are several types of foliar application tools available.
    b. Spot applicators. Spray herbicide directly onto target plants only, and avoid spraying other desirable plants. These applicators range from motorized rigs with spray hoses to backpack sprayers, to hand-pumped spray or squirt bottles, which can target very small plants or parts of plants.
    c. Wick (wipe-on) applicators. Use a sponge or wick on a long handle to wipe herbicide onto foliage and stems. Use of a wick eliminates the possibility of spray drift or droplets falling on non-target plants. However, herbicide can drip or dribble from some wicks.
    d. Boom applicator. A boom, a long horizontal tube with multiple spray heads, is mounted or attached to a tractor, ATV (or other four-wheel drive vehicle), helicopter, or small plane. The boom is then carried above the weeds while spraying herbicide, allowing large areas to be treated rapidly with each sweep of the boom. Offsite movement due to vaporization or drift and possible treatment of non-target plants can be of concern when using this method.

14. Basal Bark. This method applies a 6 to 12 inch band of herbicide around the circumference of the trunk of the target plant, approximately one foot above ground. The width of the sprayed band depends on the size of the plant and the species' susceptibility to the herbicide. The herbicide can be applied with a backpack sprayer, hand-held bottle, or a wick.

15. Frill or Hack and Squirt. The frill method, also called the "hack and squirt" treatment, is often used to treat woody species with large, thick trunks. The tree is cut using a sharp knife, saw, or ax, or drilled with a power drill or other device. Herbicide is then immediately applied to the cut with a backpack sprayer, squirt bottle, syringe, or similar equipment. Because the herbicide is placed directly onto the thin layer of growing tissue in the trunk (the cambium), an ester formulation is not required.

16. Injection. Herbicide pellets can be injected into the trunk of a tree using a specialized tool. Herbicides can also be injected into herbaceous stems by using a needle and syringe.

17. Cut-Stump. This method is often used on woody species that normally re-sprout after being cut. Cut down the tree or shrub, and immediately spray or squirt herbicide on the exposed cambium (living inner bark) of the stump. The herbicide must be applied to the entire inner bark (cambium) within minutes after the trunk is cut. The outer bark and heartwood do not need to be treated since these tissues are not alive, although they support and protect the tree's living tissues. The cut stump treatment allows for a great deal of control over the site of herbicide application, and therefore, has a low probability of affecting non-target species or contaminating the environment. It also requires only a small amount of herbicide to be effective.

Proposed Conservation Measures

The proposed action includes a variety of conservation measures intended to reduce or eliminate adverse effects on ESA-listed species and their habitats. The NMFS regards these conservation measures as integral components of the proposed action and expects that all proposed project activities will be completed consistent with those measures. We have completed our effects analysis accordingly. Any project activity that deviates from these conservation measures will be beyond the scope of this consultation and will not be exempted from the prohibition against take as described in the attached incidental take statement. Further consultation will be required to determine what effect the modified action may have on listed species or critical habitats.

Action Area

'Action area' means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). For purposes of this consultation, the action area includes all national forest system lands within Region Six and those areas beyond national forest system lands that may experience effects from the proposed action.

The potential effects of the action beyond national forest system lands are determined by the mechanisms for herbicide movement (*e.g.,* water, wind, carried by animals, water table, vehicles), soil movement (*e.g.,* mass wasting, erosion), noise effects, and other water quality and stream habitat parameters (*e.g.,* shade, temperature, bank stability, width/depth ratio) that can be affected by the control of invasive plants.

For purposes of analyzing the potential aquatic effects of this action beyond national forest lands, the analysis area used was all 4th field hydrologic unit code (HUC) watersheds containing national forest system lands.

Subsequent site-specific consultations will include a more detailed description of the action area for specific projects or groups of projects.

This document addresses 19 national forests, one national grassland, one national scenic area, and one national resource area (Table 2).

Table 2. National Forest management areas included in the proposed action

Washington	Oregon	National Scenic and Natural Recreation Area
Colville	Deschutes	Columbia Gorge
Gifford Pinchot	Fremont	Hell's Canyon
Mt. Baker-Snoqualmie	Malheur	
Okanogan	Mt. Hood	
Olympic	Ochoco, Crooked River Grassland	
Wenatchee	Rogue River	
	Siskiyou	
	Siuslaw	
	Umatilla	
	Umpqua	
	Wallowa-Whitman	
	Willamette	
	Winema	

A total of 17 ESA-listed and proposed ESUs occur within the action area (Table 3).

Table 3. Federal Register notices for final rules that list species, designate critical habitat, or apply protective regulations to ESUs considered in this consultation. (Listing status: 'T' means listed as threatened under the ESA; 'E' means listed as endangered; 'P' means proposed for listing, proposed for designation as critical habitat, or proposed as protective regulations; and 'D' means that the final listing determination is deferred until December 28, 2005 (hatchery and resident only for *O. mykiss*). See also, proposed listing determinations for 27 ESUs of West Coast salmonids, at 69 FR 33102, 6/14/04; and proposed protective regulations at 69 FR 74572, 12/14/04.) The designation of critical habitat for LCR Chinook salmon, UWR spring-run Chinook salmon, UCR spring-run Chinook salmon, PS Chinook salmon, HC chum salmon, CR chum salmon, LCR coho salmon, LCR steelhead, UWR steelhead, MCR steelhead, UCR steelhead, and SRB steelhead is not effective until January 2, 2006.

Species ESU	Listing Status	Critical Habitat	Protective Regulations
Chinook salmon (*Oncorhynchus tshawytscha*)			
Lower Columbia River	T 3/24/99; 64 FR 14308; T 6/28/05; 70 FR 37160	09/02/05; 50 FR 52630	6/28/05; 70 FR 37160
Upper Willamette River spring-run	T 3/24/99; 64 FR 14308; T 6/28/05; 70 FR 37160	09/02/05; 50 FR 52630	6/28/05; 70 FR 37160
Upper Columbia River spring-run	E 3/27/99; 64 FR 14308; E 6/28/05; 70 FR 37160	09/02/05; 50 FR 52630	ESA Section 9 applies
Snake River spring/summer run	T 4/22/92; 57 FR 14653; T 6/28/05; 70 FR 37160	10/25/99; 64 FR 57399	6/28/05; 70 FR 37160
Snake River fall-run	T 6/3/92; 57 FR 23458; T 6/28/05; 70 FR 37160	12/28/93; 58 FR 68543	6/28/05; 70 FR 37160
Puget Sound	T 3/24/99; 64 FR 14308	09/02/05; 50 FR 52630	07/10/00; 65 FR 42481
Chum salmon (*O. keta*)			
Hood Canal summer-run	T 3/24/99 64 FR 14508	09/02/05; 50 FR 52630	07/10/00; 65 FR 42481
Columbia River	T 3/25/99; 64 FR 14508; T 6/28/05; 70 FR 37160	09/02/05; 50 FR 52630	6/28/05; 70 FR 37160
Coho salmon (*O. kisutch*)			
Lower Columbia River	P 6/14/04; 69 FR 33102; T 6/28/05; 70 FR 37160	Not applicable	6/28/05; 70 FR 37160
Oregon Coast	P 6/14/04; 69 FR 33102 D 6/28/05; 70 FR 37160	09/02/05; 50 FR 52630	P 6/14/04; 69 FR 33102
Southern Oregon / Northern California Coasts	T 5/6/97; 62 FR 24588; T 6/28/05; 70 FR 37160	5/5/99; 64 FR 24049	6/28/05; 70 FR 37160
Sockeye salmon (*O. nerka*)			
Snake River	E 11/20/91; 56 FR 58619; E 6/28/05; 70 FR 37160	12/28/93; 58 FR 68543	ESA Section 9 applies
Steelhead (*O. mykiss*)			
Lower Columbia River	T 3/19/98; 63 FR 13347 D 6/28/05; 70 FR 37160	09/02/05; 50 FR 52630	7/10/00; 65 FR 42422
Upper Willamette River	T 3/25/99; 64 FR 14517 D 6/28/05; 70 FR 37160	09/02/05; 50 FR 52630	7/10/00; 65 FR 42422
Middle Columbia River	T 3/25/99; 64 FR 14517 D 6/28/05; 70 FR 37160	09/02/05; 50 FR 52630	7/10/00; 65 FR 42422
Upper Columbia River	E 8/18/97; 62 FR 43937 D 6/28/05; 70 FR 37160	09/02/05; 50 FR 52630	ESA Section 9 applies
Snake River Basin	T 8/18/97; 62 FR 43937 D 6/28/05; 70 FR 37160	09/02/05; 50 FR 52630	7/10/00; 65 FR 42422

ENDANGERED SPECIES ACT

The ESA established a national program to conserve threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with the FWS, NMFS, or both, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their critical habitats. Section 7(b)(4) requires the provision of an incidental take statement that specifies the impact of any incidental taking and includes reasonable and prudent measures to minimize such impacts.

Biological and Conference Opinion

This Opinion presents NMFS' review of the status of each evolutionarily significant unit (ESU)[8] considered in this consultation, the condition of critical habitat, the environmental baseline for the action area, all the effects of the action as proposed, and cumulative effects (50 CFR 402.14(g)). For the jeopardy analysis, NMFS analyzes those combined factors to conclude whether the proposed action is likely to appreciably reduce the likelihood of both the survival and recovery of the affected ESA-listed species.

The critical habitat analysis determines whether the proposed action will destroy or adversely modify critical habitat for ESA-listed species by examining any change in the conservation value of the essential features of that critical habitat. This analysis relies on statutory provisions of the ESA, including those in Section 3 that define "critical habitat" and "conservation," in Section 4 that describe the designation process, and in Section 7 setting forth the substantive protections and procedural aspects of consultation. The regulatory definition of "destruction or adverse modification" at 50 CFR 402.02 is not used.

If the action under consultation is likely to jeopardize the continued existence of an ESA-listed species, or destroy or adversely modify a critical habitat, NMFS must identify any reasonable and prudent alternatives for the action that avoid jeopardy or destruction or adverse modification of critical habitat and meet other regulatory requirements (50 CFR 402.02).

Status of the Species and Critical Habitat

This section defines the biological requirements of each ESU, and reviews the status of each ESU and each affected critical habitat relative to those requirements. The present risk of extinction faced by each ESU informs NMFS' determination of whether additional risk will 'appreciably reduce' the likelihood that each ESU will survive or recover in the wild. The greater the present risk, the more likely it is that any additional risk resulting from the proposed action's effects on the population size, productivity (growth rate), distribution, or genetic diversity of the ESU (McElhany *et al.* 2000), or on the conservation value of critical habitat, will be an appreciable reduction.

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[8] 'ESU' means a population or group of populations that is considered distinct (and hence a 'species') for purposes of conservation under the ESA. To qualify as an ESU, a population must (1) be reproductively isolated from other conspecific populations, and (2) represent an important component in the evolutionary legacy of the biological species (Waples 1991).

<u>Status of the Species</u>. The NMFS reviews the condition of the species affected by the proposed action using criteria that describe a 'viable salmonid population' (VSP) (McElhany *et al*. 2000). Attributes associated with a viable salmonid population include abundance, productivity, spatial structure, and genetic diversity that maintain a capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment. These attributes are influenced by survival, behavior, and experiences throughout the entire life cycle, characteristics that are influenced in turn by habitat and other environmental conditions.

The ESA-listed steelhead ESUs include all natural-origin populations of anadromous *O. mykiss* and resident forms of *O. mykiss* within ESU boundaries. Steelhead from artificial propagation facilities that are genetically no more than moderately divergent from natural populations are proposed for listing (June 14, 2004, 69 FR 33102).

***Chinook salmon*.** Chinook salmon, also commonly referred to as king, spring, quinnat, Sacramento, California, or tyee salmon, is the largest of the Pacific salmon (Myers *et al.* 1998). The species historically ranged from the Ventura River in California to Point Hope, Alaska, in North America, and in northeastern Asia from Hokkaido, Japan to the Anadyr River in Russia (Healey 1991). Additionally, Chinook salmon have been reported in the Mackenzie River area of Northern Canada (McPhail and Lindsey 1970). Chinook salmon exhibit very diverse and complex life-history strategies. Healey (1986) described 16 age categories for Chinook salmon, seven total ages with three possible freshwater ages.

Two generalized freshwater life-history types were initially described by Gilbert (1912): "stream-type" Chinook salmon reside in freshwater for a year or more following emergence, whereas "ocean-type" Chinook salmon migrate to the ocean predominately within their first year. Healey (1983, 1991) has promoted the use of broader definitions for "ocean-type" and "stream-type" to describe two distinct races of Chinook salmon. This racial approach incorporates life-history traits, geographic distribution, and genetic differentiation and provides a valuable frame of reference for comparisons of Chinook salmon populations. For this reason, the BRT adopted the broader "racial" definitions of ocean- and stream-type for this review.

***Lower Columbia River (LCR) Chinook salmon*.** The status of LCR Chinook was initially reviewed by NMFS in 1998 (Myers *et al.* 1998) and updated in that same year (NMFS 1998a). In the 1998 update, the BRT noted several concerns for this ESU. The 1998 BRT was concerned that there were very few naturally self-sustaining populations of native Chinook salmon remaining in the LCR ESU. Naturally reproducing (but not necessarily self-sustaining) populations identified by the 1998 BRT were the Lewis and Sandy Rivers "bright" fall-runs and the "tule" fall-runs in the Clackamas, East Fork Lewis and Coweeman Rivers. These populations were identified as the only bright spots in the ESU. The few remaining populations of spring Chinook salmon in the ESU were not considered by the previous BRT to be naturally self-sustaining because of either small size, extensive hatchery influence, or both. The previous BRT felt that the dramatic declines and losses of spring-run Chinook salmon populations in the LCR ESU represented a serious reduction in life-history diversity in the region. The previous BRT felt that the presence of hatchery Chinook salmon in this ESU posed an important threat to the persistence of the ESU and also obscured trends in abundance of native fish. The previous BRT noted that habitat degradation and loss due to extensive hydropower development projects, urbanization, logging and agriculture threatened the Chinook salmon spawning and rearing habitat in the Lower Columbia River. A majority of the previous BRT concluded that the LCR ESU was likely to become endangered in the foreseeable future. A minority felt that Chinook salmon in this ESU were not presently in danger of extinction, nor were they likely to become so in the foreseeable future.

Data acquired for the BRT (2003) report included spawner abundance estimates through 2001, new estimates of the fraction of hatchery spawners and harvest estimates. In addition, estimates of historical abundance have been provided by the Washington Department of Fish and Wildlife (WDFW). Information on recent hatchery releases was also obtained. New analyses include the designation of relatively demographically independent populations, recalculation of previous BRT metrics with additional years data, estimates of median annual growth rate under different assumptions about the reproductive success of hatchery fish, and estimates of current and historically available kilometers of stream.

The ESU exhibits three major life history types: Fall-run ("tules"), late fall-run ("brights"), and spring-run. The ESU spans three ecological zones: Coastal (rain-driven hydrograph), Western Cascade (snow or glacial-driven hydrograph), and Gorge (transitioning to drier interior Columbia ecological zones). The fall Chinook populations are currently dominated by large scale hatchery production, relatively high harvest and extensive habitat degradation (discussed in previous status reviews). The Lewis River late fall Chinook population is the healthiest in the ESU and has a reasonable probability of being self-sustaining. The spring-run populations are largely extirpated as the result of dams which block access to their high elevation habitat. Abundances have largely declined since the last status review update (1998) and trend indicators for most populations are negative, especially if hatchery fish are assumed to have a reproductive success equivalent to that of natural-origin fish. However, 2001 abundance estimates increased for most LCR Chinook populations over the previous few years and preliminary indications are that 2002 abundance also increased (Rawding, personal communication, cited in BRT 2003). Many salmon populations in the Northwest have shown increases in abundance over the last few years and the relationship of these increases to potential changes in marine survival are discussed in the introduction to the BRT (2003) report.

A majority (71%) of the BRT votes for this ESU fell in the "likely to become endangered" category, with minorities falling in the "danger of extinction" and "not likely to become endangered" categories. Moderately high concerns for all Viable Salmonid Populations (VSP) elements are indicated by estimates of moderate to moderately high risk for abundance and diversity. All of the risk factors identified in previous reviews were still considered important by the BRT. The Willamette/Lower Columbia River Technical Review Team has estimated that 8-10 historic populations in this ESU have been extirpated, most of them spring-run populations. Near loss of that important life history type remains in important BRT concern. Although some natural production currently occurs in 20 or so populations, only one exceeds 1000 spawners. High hatchery production continues to pose genetic and ecological risks to natural populations and to mask their performance. Most populations in this ESU have not seen as pronounced increases in recent years as occurred in many other geographic areas.

Upper Willamette River (UWR) spring-run Chinook salmon. The status of UWR spring-run Chinook was initially reviewed by NMFS in 1998 (Myers *et al.* 1998) and updated in that same year (NMFS 1998a). In the 1998 update, the BRT noted several concerns for this ESU. The previous BRT was concerned about the few remaining populations of spring-run Chinook salmon in the Upper Willamette River ESU, and the high proportion of hatchery fish in the remaining runs. The BRT noted with concern that the Oregon Department of Fish and Wildlife (ODFW) was able to identify only one remaining naturally reproducing population in this ESU: the spring Chinook salmon in the McKenzie River. The previous BRT was concerned about severe declines in short-term abundance that occurred throughout the ESU, and the McKenzie River population had declined precipitously, indicating that it may not be self-sustaining. The 1998 BRT also noted the potential for interactions between native spring-run and introduced fall-run Chinook salmon had increased relative to historical times due to fall-run Chinook salmon hatchery programs and the laddering of Willamette Falls. The previous BRT partially attributed the declines in UWR spring-run Chinook salmon to the extensive habitat blockages caused by dam construction. The previous BRT was encouraged by efforts to reduce harvest pressure on naturally-produced spring Chinook salmon in upper Willamette River tributaries, and the increased focus on selective marking of hatchery fish should help managers targeting specific populations of wild or hatchery Chinook salmon. A majority of the previous (1998) BRT concluded that the LCR ESU was "likely to become endangered" in the foreseeable future. A minority concluded that Chinook salmon in this ESU were not presently in danger of extinction, nor were they likely to become so in the foreseeable future.

Data for this update included spawner abundance through 2002 in the Clackamas River, 2001 in the McKenzie River and 2001 at Willamette Falls. In addition, new data include updated redd surveys in the basin, new estimates of the fraction of hatchery-origin spawners in the McKenzie and North Santiam from an otolith marking study, the first estimate of hatchery fraction in the Clackamas (2002 data), and information on recent hatchery releases. New analyses for this update include: the designation of relatively demographically independent populations, recalculation of previous BRT metrics in the McKenzie with additional years of data, estimates of current and historically available kilometers of stream, and updates on current hatchery releases.

The updated information provided in the BRT (2003) report, the information contained in previous UWR spring-run Chinook status reviews, and preliminary analysis by the Willamette/Lower Columbia Technical Review Team, indicate that most natural spring Chinook populations are likely extirpated or nearly so. The only population considered potentially self-sustaining is the McKenzie. However, its abundance has been relatively low (low thousands) with a substantial number of these fish being of hatchery origin. The population has shown a substantial increase in the last couple of years, hypothesized to be a result of increase ocean survival. It is unknown what ocean survivals will be in the future and the long-term sustainability of this population in uncertain.

Although the number of adult UWR spring-run Chinook salmon crossing Willamette Falls is in the same range (about 20,000 to 70,000) it has been for the last 50 years, a large fraction of these are hatchery produced. The score for spatial structure reflects concern by the BRT that perhaps a third of the historic habitat used by fish in this ESU is currently inaccessible behind dams, and the BRT remained concerned that natural production in this ESU is restricted to a very few areas. Increases in the last three to four years in natural production in the largest remaining population (the McKenzie) were considered encouraging by the BRT. With the relatively large incidence of hatchery fish, it is difficult to determine trends in natural production.

A majority (70%) of the BRT votes for this ESU fell in the "likely to become endangered" category, with minorities falling in the "danger of extinction" and "not likely to become endangered" categories. The BRT found moderately high risks in all VSP elements, with risk estimates ranging from moderate for growth rate/productivity to moderately high for spatial structure.

Upper Columbia River (UCR) spring-run Chinook salmon. No estimates of historical abundance specific to this ESU are available before the 1930s. The drainages supporting this ESU are all above Rock Island Dam on the Upper Columbia River. Rock Island Dam is the oldest major hydroelectric project on the Columbia River; it began operations in 1933. Counts of returning Chinook salmon have been made since the 1930s. Annual estimates of the aggregate return of spring-run Chinook salmon to the Upper Columbia River are derived from the dam counts based on the nadir between spring and summer return peaks. Spring-run Chinook salmon currently spawn in three major drainages above Rock Island Dam: Wenatchee, Methow and Entiat Rivers. Historically, spring-run Chinook salmon may have also used portions of the Okanogan River.

Grand Coulee Dam, completed in 1938, formed an impassable block to the upstream migration of anadromous fish. Chief Joseph Dam was constructed on the mainstem Columbia River downstream from Grand Coulee Dam and is also an anadromous block. No specific estimates are available of historical production of spring-run Chinook salmon from mainstem tributaries above Grand Coulee Dam. Habitat typical of that used by spring-run Chinook salmon in accessible portions of the Columbia River basin is found in the middle/upper reaches of mainstem tributaries above Grand Coulee Dam. It is possible that the historical range of this ESU included these areas; alternatively, fish from the upper reaches of the Columbia River may have been in a separate ESU.

Artificial production efforts in the area occupied by the UCR spring-run Chinook salmon ESU extend back to the 1890s. Hatchery efforts were initiated in the Wenatchee and Methow systems to augment catches in response to declining natural production (*e.g.*, Craig and Soumela 1941). While there are no direct estimates of adult production from early efforts, it is likely contributions were small.

In the late 1930s, the Grand Coulee Fish Maintenance Program (GCFMP) was initiated to address the fact that the completion of the Grand Coulee dam cut off anadromous access above site of the dam. Returning salmonids, including spring-run Chinook salmon, were trapped at Rock Island Dam and either transplanted as adults or released as juveniles into selected production areas within the accessible drainages below Grand Coulee Dam. Nason Creek in the Wenatchee system was a primary adult transplantation area in this effort. The program was conducted annually from 1938 until the mid-1940s.

The UCR spring-run Chinook salmon ESU was reviewed by the BRT in late 1998 (NMFS 1998). The BRT was mostly concerned about risks falling under the abundance/distribution and trends/productivity risk categories for the ESU. Average recent escapement to the ESU has been less than 5,000 hatchery plus wild Chinook salmon, and individual populations all consist of less than 100 fish. The BRT was concerned that at these population sizes, negative effects of demographic and genetic stochastic processes are likely to occur. Furthermore, both long- and short-term trends in abundance are declining, many strongly so. The BRT noted that the implementation of emergency natural broodstocking and captive broodstocking efforts for the ESU indicates the severity of the population declines to critically small sizes. The BRT recognized that habitat degradation, blockages and hydrosystem passage mortality all have contributed to the significant declines in this ESU.

The WDFW, the Yakima Tribe and the FWS conduct annual redd count surveys in nine selected production areas within the geographical area encompassed by this ESU (Carie 2000; Hubble and Crampton 2000; Mosey and Murphy 2002). Before 1987, redd count estimates were single-survey peak counts. From 1987 on, annual redd counts are generated from a series of on-the-ground counts and represent the total number of redds constructed in any particular year. The agencies use annual dam counts from the mainstem mid-Columbia River dams as the basis for expanding redd counts to estimates of total spring-run Chinook salmon returns. In the Wenatchee basin, video counts at Tumwater Dam are available for recent years. Returns to hatchery facilities are subtracted from the dam counts before the expansion.

An initial set of population definitions for UCR spring-run Chinook salmon ESU along with basic criteria for evaluating the status of each population were developed using the VSP guidelines described in McElhany *et al.* (2000). The definitions and criteria are described in Ford *et al.* (2001) and have been used in the development and review of Mid-Columbia River Public Utility District plans and the Biological Opinion for those plans. The interim definitions and criteria are being reviewed as recommendations by the Interior Columbia Technical Recovery Team. The historical status of spring-run Chinook salmon production in the Okanogan River is uncertain. The committee deferred a decision on the Okanogan to the Technical Recovery Team. Abundance, productivity and spatial structure criteria for each of the populations in the ESU were developed and are described in Ford *et al.* (2001).

Many populations in this ESU have rebounded somewhat from the critically low levels that immediately preceded the last status review evaluation, and this was reflected in the substantial minority of BRT votes cast that were not cast in the "danger of extinction" category. Although this was considered an encouraging sign by the BRT, the last year or two of higher returns come on the heels of a decade or more of steep declines to all time record low escapements. In addition, this ESU continues to have a very large influence by hatchery production, both from production/mitigation and supplementation programs. The extreme management measures taken in an effort to maintain populations in this ESU during some years in the late 1990s (collecting all adults from major basins at downstream dams) are a strong indication of the ongoing risks to this ESU, although the associated hatchery programs may ultimately play a role in helping to restore self-sustaining natural populations.

Assessments by the BRT of the overall risks faced by this ESU were divided, with a slight majority (53%) of the votes being cast in the "danger of extinction" category and a substantial minority (45%) in the "likely to be endangered" category. The risk estimates reflect strong ongoing concerns regarding abundance and growth rate/productivity (high to very high risk) in this ESU and somewhat less (but still significant) concerns for spatial structure (moderate risk) and diversity (moderately high risk).

Snake River (SR) spring/summer run Chinook salmon. Spring/summer run Chinook salmon runs returning to the major tributaries of the Snake River were classified as an ESU by NMFS (Matthews and Waples 1991). This ESU includes production areas that are characterized by spring-timed returns, summer-timed returns, and combinations from the two adult timing patterns. Runs classified as spring-run Chinook salmon are counted at Bonneville Dam beginning in early March and ending the first week of June; runs classified as summer-run Chinook salmon return to the Columbia River from June through August. Returning fish hold in deep mainstem and tributary pools until late summer, when they outmigrate up into tributary areas and spawn. In general, spring-run type Chinook salmon tend to spawn in higher elevation reaches of major Snake River tributaries in mid- through late August, and summer-run SR Chinook salmon spawn approximately one month later than spring-run fish.

Many of the Snake River tributaries used by spring and summer Chinook salmon runs exhibit two major features: extensive meanders through high elevation meadowlands and relatively steep lower sections joining the drainages to the mainstem Salmon (Matthews and Waples 1991). The combination of relatively high summer temperatures and the upland meadow habitat creates the potential for high juvenile salmonid productivity. Historically, the Salmon River system may have supported more than 40% of the total return of spring-run and summer-run Chinook salmon to the Columbia River system (Fulton 1968).

The SR spring/summer run Chinook salmon ESU includes current runs to the Tucannon River, the Grand Ronde River system, the Imnaha River and the Salmon River (Matthews and Waples 1991). The Salmon River system contains a range of habitats used by spring/summer run Chinook salmon. The South Fork and Middle Fork tributaries to the Salmon currently support the bulk of natural production in the drainage. Two large tributaries entering above the confluence of the Middle Fork, the Lemhi and Pahsimeroi Rivers, drain broad alluvial valleys and are believed to have historically supported substantial, relatively productive anadromous fish runs. Returns into the Upper Salmon River tributaries have re-established following the opening of passage around Sunbeam Dam on the mainstem Salmon River downstream from Stanley, Idaho. Sunbeam Dam in the Upper Salmon River was a serious impediment to migration of anadromous fish and may have been a complete block in at least some years before its partial removal in 1934 (Waples *et al.* 1991).

Current runs returning to the Clearwater River drainages were not included in the SR spring/summer run Chinook salmon ESU. Lewiston Dam in the lower mainstem of the Clearwater River was constructed in 1927 and functioned as an anadromous block until the early 1940s (Matthews and Waples 1991). Spring and summer Chinook salmon runs into the Clearwater system were reintroduced via hatchery outplants beginning in the late 1940s. As a result, Matthews and Waples (1991) concluded that even if a few native salmon survived the hydropower dams, the massive outplantings of non-indigenous stocks presumably substantially altered, if not eliminated, the original gene pool.

Spring-run and summer-run Chinook salmon from the Snake River basin exhibit stream type life-history characteristics (Healey 1983). Eggs are deposited in late summer and early fall, incubate over the following winter and hatch in late winter/early spring of the following year. Juveniles rear through the summer, overwinter and migrate to sea in the spring of their second year of life. Depending on the tributary and the specific habitat conditions, juveniles may migrate extensively from natal reaches into alternative summer rearing and/or overwintering areas. SR spring/summer run Chinook salmon return from the ocean to spawn primarily as 4 and 5-year-old fish, after two to three years in the ocean. A small fraction of the fish return as 3-year-old "jacks," heavily predominated by males.

The 1991 ESA status review (Mathews and Waples 1991) of the SR spring/ summer run Chinook salmon ESU concluded that the ESU was at risk based on a set of key factors. Aggregate abundance of naturally-produced SR spring/summer run Chinook salmon runs had dropped to a small fraction of historical levels. Short-term projections (including jack counts, habitat/flow conditions in the brood years producing the next generation of returns) were for a continued downward trend in abundance. Risk modeling indicated that if the historical trend in abundance continued, the ESU as a whole was at risk of extinction within 100 years. The review identified related concerns at the population level within the ESU. Given the large number of potential production areas in the Snake basin and the low levels of annual abundance, risks to individual subpopulations may be greater than the extinction risk for the ESU as a whole. The 1998 Chinook salmon status review Myers *et al.* 1998) summarized and updated these concerns. Both short and long-term abundance trends had continued downward. The report identified continuing disruption due to the impact of mainstem hydroelectric development including altered flow regimes and impacts on estuarine habitats. The 1998 review also identified regional habitat degradation and risks associated with the use of outside hatchery stocks in particular areas—specifically including major sections of the Grande Ronde River basin.

Tributary habitat conditions vary widely among the various drainages of the Snake River basin. Habitat degradation in many areas of the basin is a result of forest, grazing and mining practices. Impacts relative to anadromous fish include lack of pools, increased water temperatures, low flows, poor overwintering conditions, and high sediment loads. Substantial portions of the Salmon River drainage, particularly in the Middle Fork, are protected in wilderness areas.

Direct estimates of annual runs of historical spring/summer run Chinook salmon to the Snake River are not available. Chapman (1986) estimated that the Columbia River produced 2.5 million to 3.0 million spring-run and summer-run Chinook salmon per year in the late 1800s. Total spring-run and summer-run Chinook salmon production from the Snake River basin contributed a substantial proportion of those returns; the total annual production of SR spring-run and summer-run Chinook salmon may have been in excess of 1.5 million adult returns per year (Matthews and Waples 1991). Returns to Snake River tributaries had dropped to roughly 100,000 adults per year by the late 1960s (Fulton 1968). Increasing hatchery production contributed to subsequent years' returns, masking a continued decline in natural production.

Although there are concerns about loss of an unquantified number of spawning aggregations that historically may have provided connectivity between headwater populations, natural spawning in this ESU still occurs in a wide range of locations and habitat types.

Like many others, this ESU saw a large increase in escapement in many (but not all) populations in 2001. The BRT considered this an encouraging sign, particularly given the record low returns seen in many of these populations in the mid 1990s. However, recent abundance in this ESU is still short of the levels that the proposed recovery plan for SR salmon indicated should be met over at least an eight-year period (NMFS 1995). The BRT considered it a positive sign that the non-native Rapid River broodstock has been phased out of the Grande Ronde system, but the relatively high level of both production/mitigation and supplementation hatcheries in this ESU leads to ongoing risks to natural populations and makes it difficult to assess trends in natural productivity and growth rate.

About two-thirds (68%) of the BRT votes for this ESU fell in the “likely to become endangered” category, with minorities falling in the “danger of extinction” and “not likely to become endangered” categories. The BRT rated abundance and growth rate/productivity factors as moderately high risk, and spatial structure and diversity as moderately low risk.

Snake River (SR) fall-run Chinook salmon. SR fall-run Chinook salmon enter the Columbia River in July and August. The Snake River component of the fall Chinook salmon run migrates past the Lower Snake River mainstem dams from August through November. Spawning occurs from October through early December. Juveniles emerge from the gravels in March and April of the following year. SR fall-run Chinook salmon are subyearling migrants, moving downstream from natal spawning and early rearing areas from June through early fall.

Fall-run Chinook salmon returns to the Snake River generally declined through the first half of the 20th century (Irving J.S. and Bjornn 1991). In spite of the declines, the Snake River basin remained the largest single natural production area for fall-run Chinook salmon in the Columbia River drainage into the early 1960s (Fulton 1968). Spawning and rearing habitat for SR fall-run Chinook salmon was significantly reduced by the construction of a series of Snake River mainstem dams. Historically, the primary spawning fall-run Chinook salmon spawning areas were on the upper mainstem Snake River. Currently, natural spawning is limited to the area from the upper end of Lower Granite Reservoir to Hells Canyon Dam, the lower reaches of the Imnaha, Grande Ronde, Clearwater and Tucannon Rivers, and small mainstem sections in the tail races of the Lower Snake hydroelectric dams.

Adult counts at Snake River dams are an index of the annual return of SR fall-run Chinook salmon to spawning grounds. Lower Granite Dam is the uppermost of the mainstem Snake River dams that allow for passage of anadromous salmonids. Adult traps at Lower Granite Dam have allowed for sampling of the adult run as well as for removal of a portion of non-local hatchery fish passing above the dam. The dam count at Lower Granite covers a majority of fall-run Chinook salmon returning to the Snake basin. However, SR fall-run Chinook salmon do return to locations downstream from Lower Granite Dam and are therefore not included in the ladder count. Lyons Ferry Hatchery is on the mainstem Snake River below both Little Goose and Lower Monumental Dams. Although a fairly large proportion of adult returns from the Lyons

Ferry Hatchery program do stray to Lower Granite Dam, a substantial proportion of the run returns directly to the facility. In addition, mainstem surveying efforts have identified relatively small numbers of fall-run Chinook salmon spawning in the tail races of Lower Snake River mainstem hydroelectric dams (Dauble *et al.* 1999).

Lyons Ferry Hatchery was established as one of the hatchery programs under the Lower Snake Compensation Plan administered through the USFWS. SR fall-run Chinook salmon production is a major program for Lyons Ferry Hatchery, which is operated by the WDFW and is along the SR mainstem between Little Goose Dam and Lower Monumental Dam. The WDFW began developing a SR fall-run Chinook salmon broodstock in the early 1970s through a trapping program at Ice Harbor Dam and Lower Granite Dam. The Lyons Ferry facility became operational in the mid-1980s and took over incubation and rearing for the SR fall Chinook mitigation/compensation program.

Previous Chinook salmon status reviews (Waples *et al.* 1991, Myers *et al.* 1998) identified several concerns regarding SR fall-run Chinook salmon; steady and severe decline in abundance since the early 1970s, loss of primary spawning and rearing areas upstream from the Hells Canyon Dam complex, increase in non-local hatchery contribution to adult escapement over Lower Granite Dam, and relatively high aggregate harvest impacts by ocean and in-river fisheries. Available habitat for SR fall-run Chinook salmon has not had any major changes since the previous status reviews.

On the positive side, the number of natural origin spawners in 2001 was well in excess of 1000 for the first time since counts at Lower Granite Dam began in 1975. Management actions have reduced (but not eliminated) the fraction of fish passing Lower Granite Dam that are strays from out-of-ESU hatchery programs. Returns in the last two years also reflect an increasing contribution from supplementation programs based on the native Lyons Ferry Broodstock. With the exception of the increase in 2001, the ESU has fluctuated between approximately 500 to1000 adults, suggesting a somewhat higher degree of stability in growth rate and trends than is seen in many other salmon populations.

In spite of the recent increases, however, the recent geometric mean number of naturally-produced spawners is still less than 1000, a very low number for an entire ESU. Because of the large fraction of naturally spawning hatchery fish, it is difficult to assess the productivity of the natural population. The moderately high risk estimate for spatial structure and diversity reflect the concerns of the BRT that a large fraction of historic habitat for this ESU is inaccessible, diversity associated with those populations has been lost, the single remaining population is vulnerable to variable environmental conditions or catastrophes, and continuing immigration from outside the ESU at levels that are higher than occurred historically. Some BRT members were concerned that the efforts to remove stray, out-of-ESU hatchery fish only occur at Lower Granite Dam, well upstream from the geographic boundary of this ESU. Specific concerns are that natural spawners in lower river areas will be heavily affected by strays from Columbia River hatchery programs, and that this approach effectively removes the natural buffer zone between the SR ESU and Columbia River ocean-type Chinook salmon. The effects of these factors on ESU viability are not known, as the extent of natural spawning in areas below Lower Granite Dam is not well understood, except in the Lower Tucannon River.

A majority (60%) of the BRT votes for this ESU fell in the "likely to become endangered" category, with minorities falling in the "danger of extinction" and "not likely to become endangered" categories. This represented a somewhat more optimistic assessment of the status of this ESU than was the case at the time of the original status review, when the BRT concluded that SR fall-run Chinook salmon face a substantial risk of extinction if present conditions continue (Waples *et al.* 1991). The BRT found moderately high risks in all VSP elements, with risk estimates ranging from moderate for growth rate/productivity to moderately high for spatial structure.

Puget Sound (PS) Chinook salmon. The Puget Sound ESU encompasses all naturally-spawned spring, summer, and fall runs of chinook salmon in the Puget Sound region, from the North Fork Nooksack River to the Elwha River on the Olympic Peninsula. The NMFS concluded that, on the basis of genetic separation, the Puget Sound ESU does not include Canadian populations of Chinook salmon.

The majority of Puget Sound fish emigrate to the ocean as subyearlings. Many of the rivers have well-developed estuaries that are important rearing areas for emigrating ocean-type smolts. In contrast, the Suiattle and South Fork Nooksack Rivers have been characterized as producing mostly yearling (stream type) smolts (Marshall *et al.* 1995). Glacially-influenced conditions on the Suiattle River may be responsible for limiting juvenile growth, delaying smolting, and producing a higher proportion of 4 and 5-year-old spawners compared to other Puget Sound Chinook stocks, which mature predominantly as 3 and 4-year-olds.

Adult spring-run Chinook salmon in the Puget Sound ESU typically return to freshwater in April and May and spawn in August and September. Adults migrate to the upper portions of their respective river systems and hold in pools until they mature. In contrast, summer-run fish begin their freshwater migration in June and July and spawn in September, while summer/fall-run fish begin to return in August and spawn from late September through January. In rivers with an overlap in spawning time, temporal runs on the same river system maintain a certain amount of reproductive isolation through geographic separation.

Meyers *et al.* (1998) noted that anthropogenic activities have limited the access to historical spawning grounds and altered downstream flow and thermal conditions. Water diversion and hydroelectric dams have prevented access to portions of several rivers. Watershed development and activities throughout the Puget Sound, Hood Canal, and Strait of Juan de Fuca regions have resulted in increased sedimentation, higher water temperatures, decreased large woody debris recruitment, decreased gravel recruitment, a reduction in river pools and spawning areas, and a loss of estuarine rearing areas (Bishop and Morgan 1996). These impacts on the spawning and rearing environment may also have altered the expression of many life-history traits, and masked or exaggerated the phenotypic distinctiveness of many stocks.

Habitat throughout the ESU has been blocked or degraded. In general, upper tributaries have been impacted by forest practices, and lower tributaries and mainstem rivers have been impacted by agriculture and/or urbanization. Diking for flood control, draining and filling of freshwater and estuarine wetlands, and sedimentation due to forest practices and urban development are cited as problems throughout the ESU (WDF-WDW-WWTIT 1993). Blockages by dams, water diversions, and shifts in flow regime due to hydroelectric development and flood control projects are major habitat problems in several basins.

In the 2003 status review update, NMFS modified previous approaches to ESU risk assessment to incorporate VSP criteria (McElhany *et al.* 2000): abundance, growth rate/productivity, spatial structure, and diversity. The most recent five-year geometric mean natural spawner numbers range from 42 to 7,000. Most population spawner numbers range in the hundreds (median = 481). Analysis of long-term data indicate approximately half of populations increasing, half decreasing. The number of populations with declining abundance over the short-term is also about half. The most extreme short-term declines were in the North Fork Nooksack, Green River, and Elwha populations.

The ESU is comprised of 31 historically quasi-independent populations of Chinook, 22 of which are believed to be extant currently. The 22 extant populations are distributed among 8 geographic areas throughout Puget Sound: the Nooksack River, Skagit River, Stillaguamish River, and Snohomish River basins, Lake Washington drainage, south Puget Sound, Hood Canal, and the Strait of Juan de Fuca. Populations that are presumed to be extinct are mostly of early-returning fish, and most of these are in the mid to southern parts of Puget Sound or in Hood Canal/Strait of Juan de Fuca.

Most populations believed to have a high fraction of hatchery spawners. Populations with the most positive short-term trends and population growth rates are the Upper Skagit, White River and Dosewallips populations. Populations with the highest estimated fractions of hatchery fish tend to be in Hood Canal, Strait of Juan de Fuca, and mid to southern parts of Puget Sound. The Technical Recovery Team identified 5 geographic regions of diversity and correlated population risk in Puget Sound that are intended to assist in evaluating ESU-wide recovery scenarios

The estimated total run size of Chinook salmon to Puget Sound in the early 1990s was 240,000 Chinook, down from an estimated 690,000 historic run size. Estimates of historical equilibrium abundance range from 1,700 to 51,000 potential Chinook spawners among populations. The historical estimates of spawner capacity are several orders of magnitude higher than spawner abundances currently observed throughout the ESU.

The five-year geometric mean of spawning escapement of natural chinook salmon runs in North Puget Sound during the period of 1992 through 1996 was approximately 13,000. Both long and short-term trends for these runs were negative, with few exceptions. In south Puget Sound, spawning escapement of the natural runs averaged 11,000 spawners at the time of the last status review update. In this area, both long and short-term trends were predominantly positive. In Hood Canal, spawning populations in six streams were considered a single stock by the co-managers because of extensive transfers of hatchery fish (WDF *et al.* 1993). Fisheries in the area were managed primarily for hatchery production and secondarily for natural escapement; high harvest rates directed at hatchery stocks resulted in failure to meet natural escapement goals in most years. The five-year geometric mean natural spawning escapement at the time of the last update was 1,100, with negative short- and long-term trends (except in the Dosewallips River). The ESU also included the Dungeness and Elwha Rivers, which had natural Chinook salmon runs as well as hatcheries. The Dungeness River had a run of spring/summer-run Chinook salmon with a five-year geometric mean natural escapement of 105 fish at the time of the last status review update. The Elwha River has a five-year geometric mean escapement of 1,800 fish during the mid-1990s, which included a large, but unknown fraction of naturally spawning hatchery fish. Both the Elwha and Dungeness populations exhibited downward trends in abundance in the 1990s.

Chum salmon. Chum salmon spend more of their life history in marine waters than other Pacific salmonids. Chum salmon, like pink salmon, usually spawn in coastal areas, and juveniles out migrate to seawater almost immediately after emerging from the gravel that covers their redds (Salo 1991). This ocean-type migratory behavior contrasts with the stream-type behavior of some other species in the genus *Oncorhynchus* (*e.g.*, coastal cutthroat trout, steelhead, coho salmon, most types of Chinook and sockeye salmon), which usually migrate to sea at a larger size, after months or years of freshwater rearing. This means survival and growth in juvenile chum salmon depends less on freshwater conditions than on favorable estuarine conditions. Another behavioral difference between chum salmon and species that rear extensively in freshwater is that chum salmon form schools, presumably to reduce predation (Pitcher 1986), especially if their movements are synchronized to swamp predators (Miller and Brannon 1982).

In December 1997, the first ESA status review of west coast chum salmon (Johnson *et al.* 1997) was published which identified four ESUs: (1) Puget Sound/Strait of Georgia ESU, which includes all chum salmon populations from Puget Sound, the Strait of Georgia, and the Strait of Juan de Fuca up to and including the Elwha River, with the exception of summer-run chum salmon from Hood Canal; (2) Hood Canal summer-run ESU, which includes summer-run populations from Hood Canal and Discovery and Sequim Bays on the Strait of Juan de Fuca; (3) Pacific coast ESU, which includes all natural populations from the Pacific coasts of California, Oregon, and Washington, west of the Elwha River on the Strait of Juan de Fuca; and (4) Columbia River ESU.

In March 1998, NMFS published a Federal Register notice describing the four ESUs and proposed a rule to list two as threatened (Hood Canal summer-run and Columbia River ESUs) under the ESA (NMFS 1998b). In March 1999, the two ESUs were listed as proposed, with the exception that the Hood Canal summer-run ESU was extended westward to include summer-run fish recently documented in the Dungeness River (NMFS 1999a).

The NMFS convened a BRT to update the status of ESA-listed chum salmon ESUs coast-wide. The chum salmon BRT1 met in January, March and April 2003 in Seattle, Washington, to review updated information on each of the ESUs under consideration.

Columbia River (CR) chum salmon. The NMFS last provided an updated status report on CR chum in 1999 (NMFS 1999). As documented in the 1999 report, the previous BRT was concerned about the dramatic declines in abundance and contraction in distribution from historical levels. The previous BRT was also concerned about the low productivity of the extant populations, as evidenced by flat trend lines at low population sizes. A majority of the previous BRT concluded that the CR chum salmon ESU was likely to become endangered in the foreseeable future and a minority concluded that the ESU was currently in danger of extinction.

New data includes spawner abundance through 2000, with a preliminary estimate of 2002, new information on the hatchery program, and new genetic data describing the current relationship of spawning groups. New analyses include designation of relatively demographically independent populations, recalculation of previous BRT metrics with additional years data, estimates of median annual growth rate, and estimates of current and historically available kilometers of stream.

Updated information provided in the BRT (2003), the information contained in previous Lower Columbia River status reviews, and preliminary analyses by the Willamette/Lower Columbia Technical Review Team suggest that 14 of the 16 historical populations (88%) are extinct or nearly so. The two extant populations have been at low abundance for the last 50 years in the range where stochastic processes could lead to extinction. Encouragingly, there has been a substantial increase in the abundance of these two populations. In addition there are the new (or newly discovered) Washougal River mainstem spawning groups. However, it is not known if the increase will continue and the abundance is still substantially below the historical levels.

Nearly all of the likelihood votes for this ESU fell in the "likely to become endangered" (63%) or "danger of extinction" (34%) categories. The BRT had substantial concerns about every VSP element, as indicated risk estimates scores that ranged from moderately high for growth rate/productivity to high to very high for spatial structure. Most or all of the risk factors identified previously by the BRT remain important concerns. The Willamette/Lower Columbia Technical Review Team has estimated that close to 90% of the historical populations in the ESU are extinct or nearly so, resulting in loss of much diversity and connectivity between populations. The populations that remain are small, and overall abundance for the ESU is low. This ESU has showed low productivity for many decades, even though the remaining populations are at low abundance and density dependent compensation might be expected. The BRT was encouraged that unofficial reports for 2002 suggest a large increase in abundance in some (perhaps many) locations. Whether this large increase is due to any recent management actions or simply reflects unusually good conditions in the marine environment is not known at this time, but the result is encouraging, particularly if it were to be sustained for a number of years.

Hood Canal (HC) summer-run chum salmon. Hood Canal summer-run chum are the southern most occurrence of the summer-run life history for the species. The ESU appears to be uniquely adapted to the local habitat conditions, allowing this life-history to persist in what otherwise would be deemed an inhospitable environment. The summer chum streams are characterized by low summer/fall flows and likely experience elevated stream temperatures during the summer chum spawning periods. Migration to spawning grounds occurs from late August through late October. Adults generally spawn in low gradient, lower mainstem reaches, typically in center channel areas due to the low flows encountered in the late summer and early fall. Eggs incubate for 5-6 months and fry emerge between January and May. Fry rapidly move downstream to sub-estuarine habitats.

The Hood Canal summer chum ESU is comprised of 16 historically quasi-independent populations, nine of which are presumed to be extant currently. Most of the extirpated populations occur on the eastern side of Hood Canal, and some of the seven putatively extinct stocks are the focus of extensive supplementation programs underway in the ESU.

The Hood Canal summer-run chum salmon are part of an extensive rebuilding program developed and implemented since 1992 by the state and tribal co-managers. The Summer Chum Salmon Conservation Initiative involves six supplementation and two reintroduction projects. The primary supplementation program occurs at the Big Quilcene River fish hatchery, and beginning with the 1997 brood year, all fry from the Quilcene facility have been adipose-fin-clipped. Other supplementation programs in Hood Canal have recently begun thermal mass-marking of otoliths to distinguish hatchery-origin from natural-origin spawners. Reintroduction programs have been started in Big Beef and Chimacum creeks. Small numbers of marked fish collected in streams (< 3 per stream) over the 1999-2000 season indicate that straying of summer chum from the Big Quilcene River supplementation program is occurring into other Hood Canal streams.

Very few of the streams in Hood Canal containing summer chum populations have data on returns of hatchery adults to the stream. The marking of hatchery-origin fish has begun recently (fin clips began in Quilcene in 1997, otolith marks: 1992 in Salmon Creek, 1997 in Lilliwaup, Hamma Hamma; 1998 in Big Beef Creek; 1999 in Chimacum and Jimmycomelately creeks; 2000 in Union River). Therefore, distinguishing hatchery-produced from naturally-produced summer chum was not expected to be possible in most Hood Canal streams until 2001 at the earliest.

In the 2003 status review update, NMFS modified previous approaches to ESU risk assessment to incorporate VSP criteria: abundance, growth rate/productivity, spatial structure, and diversity. Mean abundance ranged from one to nearly 4,500 spawners per population (16 populations total). Only two populations had long-term increases in abundance (Quilcene and Union River). Median long-term growth rate for all populations was $\lambda = 0.88$, indicating that most populations are declining at an average rate of 12% per year.

The number of populations with declining abundance over the short-term was fewer than those with declining long-term trends, indicating a possible recent increase in productivity. The hatchery program initiated in 1992 was at least partially responsible for returns to Quilcene River system. Greatly reduced incidental harvest rates have also probably contributed to overall increased abundance.

Strong returns to west-side streams were the result of a single, strong year class. Population increases in 1995 and 1996 were limited to west-side streams, especially the Quilcene River system, while streams on the south and east sides continued to have few or no returning spawners.

In 1994, petitioners identified 12 streams in Hood Canal as recently supporting spawning populations of summer chum salmon. At the time of the petition, summer chum salmon runs in five of these streams may already have been extinct, and those in six of the remaining seven showed strong downward trends. Similarly, summer chum salmon in Discovery and Sequim Bays were also at low levels of abundance. Spawner surveys in 1995 and 1996 revealed substantial increases in the number of summer chum salmon returning to some streams in Hood Canal and the Strait of Juan de Fuca.

Long-term trends in abundance and median population growth rates for naturally spawning populations of summer chum in Hood Canal both indicate that only two populations (combined Quilcene and Union River) are increasing in abundance over the length of available time series. Long-term population growth rates (λ) were calculated under two assumptions about the reproductive success of naturally spawning hatchery fish: the reproductive success was 0, or the reproductive success was equivalent to that of wild fish. Calculations of long-term λ for Hood Canal summer chum populations were not affected by the assumptions about the reproductive success of hatchery fish because of the dearth of information on the fraction of hatchery fish in time series.

The median long-term population growth rate for all populations is λ = 0.88 (regardless of assumptions about hatchery fish reproduction), indicating that most populations are declining at an average rate of 12% per year. Similarly, the probability that the long-term trend (median across populations = 1.0, mean = 0.85) or long-term λ (median across populations = 0.91-0.83, mean = 0.72-0.80) is less than one indicates that on average, populations have declining trends and growth rates. The most extreme long-term declines in natural spawning abundance have occurred in the Big Beef Creek, Dewatto, Tahuya, and Lilliwaup populations. Those populations with the greatest long-term population growth rates are the Union and Quilcene. The Quilcene population positive growth rate is almost surely due to the supplementation program on that stream.

The number of populations with declining abundance over the short-term is fewer than those with declining long-term trends—three of 12 (short-term trend) and four of 12 (short-term λ) populations in the ESU are declining. The median short-term λ over all populations is more positive than the long-term estimates of λ, likely a reflection of the supplementation program and possibly recent improvements in ocean conditions. The probability that the short-term trend or short-term λ is less than one indicates that on average, populations have stable to increasing trends and growth rates. The most extreme short-term declines in natural spawner abundance have occurred in the Jimmycomelately Creek and Lilliwaup populations. The populations with the most positive short-term trends and population growth rates are the Quilcene, Big Beef Creek, and Dosewallips populations.

Coho Salmon. Coho salmon is a widespread species of Pacific salmon, occurring in most major river basins around the Pacific Rim from Monterey Bay in California, north to Point Hope, Alaska, through the Aleutians and from Anadyr River south to Korea and northern Hokkaido, Japan (Laufle *et al.* 1986). From central British Columbia south, the vast majority of coho salmon adults are 3-year-olds, having spent approximately 18 months in freshwater and 18 months in saltwater (Gilbert 1912, Pritchard 1940, Sandercock 1991). The primary exceptions to this pattern are "jacks," sexually mature males that return to freshwater to spawn after only 5-7 months in the ocean. However, in southeast and central Alaska, the majority of coho salmon adults are 4-year-olds, having spent an additional year in freshwater before going to sea (Godfrey *et al.* 1975, Crone and Bond 1976). The transition zone between predominantly 3-year-old and 4-year-old adults occurs somewhere between central British Columbia and southeast Alaska.

With the exception of spawning habitat, which consists of small streams with stable gravels, summer and winter freshwater habitats most preferred by coho salmon consist of quiet areas with low flow, such as backwater pools, beaver ponds, dam pools, and side channels (Reeves *et al.* 1989). Habitats used during winter generally have greater water depth than those used in summer, and also have greater amounts of large woody debris. West Coast coho smolts typically leave freshwater in the spring (April to June) and re-enter freshwater when sexually mature from September to November and spawn from November to December and occasionally into January (Sandercock 1991). Stocks from British Columbia, Washington, and the Columbia River often have very early (entering rivers in July or August) or late (spawning into March) runs in addition to "normally" timed runs.

The status of coho salmon for purposes of ESA listings has been reviewed many times, beginning in 1990. The first two reviews occurred in response to petitions to list coho salmon in the Lower Columbia River and Scott and Waddell Creeks (central California) under the ESA. The conclusions of these reviews were that NMFS could not identify any populations that warranted protection under the ESA in the LCR (Johnson *et al.* 1991), and that Scott and Waddell Creeks' populations were part of a larger, undescribed ESU (Bryant 1994).

A review of West Coast (Washington, Oregon, and California) coho salmon populations began in 1993 in response to several petitions to list numerous coho salmon populations and NMFS' own initiative to conduct a coastwide status review of the species. This coastwide review identified six coho salmon ESUs, of which the three southern most were proposed for listing, two were candidates for listing, and one was deemed "not warranted" for listing (Weitkamp *et al.* 1995).

Lower Columbia River (LCR) coho salmon. The status of LCR coho salmon was initially reviewed by NMFS in 1996 (NMFS 1996) and the most recent review occurred in 2001 (NMFS 2001). In the 2001 review, the BRT was very concerned that the vast majority (over 90%) of the historical populations in the LCR coho salmon ESU appear to be either extirpated or nearly so. The two populations with any significant production (Sandy and Clackamas) were at appreciable risk because of low abundance, declining trends, and failure to respond after a dramatic reduction in harvest. The large number of hatchery coho salmon in the ESU was also considered an important risk factor. The majority of the 2001 BRT votes were for "at risk of extinction" with a substantial minority in "likely to become endangered."

Data include reviewed spawner abundance estimated through 2002 for Clackamas and Sandy populations (the previous status review had data just through 1999). In addition, the ODFW conducted surveys of Oregon LCR coho salmon using a stratified random sampling design in 2002, which provided the first abundance estimates for lower tributary populations (previously only limited index surveys were available. Estimates of the fraction of hatchery-origin spawners accompany the new abundance estimates. In Washington, no surveys of natural-origin adult coho salmon abundance are conducted. Updated information through 2002 on natural-origin smolt production from Cedar, Mill, Germany, and Abernathy Creeks and the Upper Cowlitz River were provided by the WDFW.

New analyses include the tentative designation of demographically independent populations, the recalculation of metrics reviewed by previous BRTs with additional years of data, estimates of median annual growth rate under different assumptions about the reproductive success of hatchery fish, a new stock assessment of Clackamas River coho by the ODFW (Zhou and Chilcote 2003), and estimates of current and historically available kilometers of stream.

As part of its effort to develop viability criteria for LCR salmon and steelhead, the Willamette/Lower Columbia Technical Recovery Team has identified historically demographically independent populations of ESA-listed salmon and steelhead in the Lower Columbia River (Myers *et al.* 2002). Population boundaries are based on an application of Viable Salmonid Populations definition (McElhany *et al.* 2000). Based on the Willamette/Lower Columbia Technical Review Team's framework for Chinook and steelhead, the BRT tentatively designated populations of LCR coho salmon. A working group at the Northwest Fisheries Science Center hypothesized that the LCR coho salmon ESU historically consisted of 23 populations. These population designations have not yet been reviewed by the Willamette/Lower Columbia Technical Review Team.

Previous BRT and ODFW analyses have treated the coho in the Clackamas River as a single population (see previous status review updates for more complete discussion and references). However, recent analysis by the ODFW (Zhou and Chilcote 2003) supports the hypothesis that coho salmon in the Clackamas River consist of two populations, an early-run and a late-run. The late-run population is believed to be descendant of the native Clackamas River population, and the early-run is believed to descend from hatchery fish introduced from Columbia River populations outside the Clackamas River basin. The population structure of Clackamas River coho is uncertain, therefore, in the BRT (2003) report, analyses on Clackamas River coho are conducted under both the single population and two population hypotheses for comparison.

For other salmonid species, the Willamette/Lower Columbia Technical Review Team partitioned LCR populations into a number of "strata" based on major life-history characteristics and ecological zones. These analyses suggest that a viable ESU would require a number of viable populations in each of these strata. Coho salmon do not have the major life-history variation seen in LCR steelhead or Chinook, and would thus be divided into strata based only on ecological zones.

On the positive side, adult returns in 2000 and 2001 were up noticeably in some areas, and evidence for limited natural production has been found in some areas outside the Sandy and Clackamas. The paucity of naturally-produced spawners in this ESU can be contrasted with the very large number of hatchery-produced adults. Although the scale of the hatchery programs, and the great disparity in relative numbers of hatchery and wild fish, produce many genetic and ecological threats to the natural populations, collectively these hatchery populations contain a great deal of genetic resources that might be tapped to help promote restoration of more widespread naturally spawning populations.

The status of the LCR coho salmon ESU was reviewed by the BRT in 2000, so relatively little new information was available. A majority (68%) of the likelihood votes for LCR coho salmon fell in the "danger of extinction" category, with the remainder falling in the "likely to become endangered" category. As indicated by the risk matrix totals, the BRT had major concerns for this ESU in all VSP risk categories (risk estimates ranged from high risk for spatial structure/connectivity and growth rate/productivity to very high for diversity). The most serious overall concern was the scarcity of naturally-produced spawners throughout the ESU, with attendant risks associated with small population, loss of diversity, and fragmentation and isolation of the remaining naturally-produced fish. In the only two populations with significant natural production (Sandy and Clackamas), short and long-term trends are negative and productivity (as gauged by pre-harvest recruits) is down sharply from recent (1980s) levels.

Oregon Coast (OC) coho salmon. The OC coho ESU has been assessed in three previous status reviews (Weitkamp *et al.* 1995, NMFS 1996, 1997a). In the 1995 status review (Weitkamp *et al.* 1995), the BRT considered evidence from many sources to identify ESU boundaries in coho populations from Washington to California. For the most part, evidence from physical environment, ocean conditions/upwelling patterns, marine and coded wire tag recovery patterns, coho salmon river entry and spawn timing as well as estuarine and freshwater fish and terrestrial vegetation distributions were the most informative to the ESU delineation process. Genetic information was used for an indication of reproductive isolation between populations and groups of populations. Based on this assessment, six ESUs were identified, including the OC coho ESU, which includes naturally spawning populations in Oregon coastal streams north of Cape Blanco, to south of the Columbia River.

In 1997, there were extensive survey data available for coho salmon in this region. Overall, spawning escapements had declined substantially during the century, and may have been at less than 5% of their abundance in the early 1900s. Average spawner abundance had been relatively constant since the late 1970s, but pre-harvest abundance had declined. Average recruits-per-spawner may also have declined. Coho salmon populations in most major rivers appeared to have had heavy hatchery influence, but some tributaries may have been sustaining native stocks.

For this ESU, information on trends and abundance were better than for the more southerly ESUs. Main uncertainties in the assessment included the extent of straying of hatchery fish, the influence of such straying on natural population trends and sustainability, the condition of freshwater habitat, and the influence of ocean conditions on population sustainability. Total average (5-year geometric mean) spawner abundance for this ESU in 1996 was estimated at about 52,000. Corresponding ocean-run size for the same year was estimated to be about 72,000; this corresponds to less than one-tenth of ocean-run sizes estimated in the late 1800s and early 1900s, and only about one-third of those in the 1950s (ODFW 1995). Total freshwater habitat production capacity for this ESU was estimated to correspond to ocean-run sizes between 141,000 under poor ocean conditions and 924,000 under good ocean conditions (Oregon Plan 1997). Abundance was unevenly distributed within the ESU at this time, with the largest total escapement in the relatively small Mid/South Coast Gene Conservation Group and lower numbers in the North/Mid-Coast and Umpqua Gene Conservation Groups.

Trend estimates using data through 1996 showed that for all three measures (escapement, run size, and recruits-per-spawner), long-term trend estimates were negative. More recent escapement trend estimates were positive for the Umpqua and Mid/South Coast Monitoring Areas, but negative in the North/Mid-Coast. Recent trend estimates for recruitment and recruits-per-spawner were negative in all three areas, and exceed 12% annual decline in the two northern areas. Six years of stratified random survey population estimates showed an increase in escapement and decrease in recruitment.

To put these data in a longer term perspective, ESU-wide averages in 1996 that were based on peak index and area under the curve escapement indices, showed an increase in spawners up to levels of the mid-to-late 1980s, but much more moderate increases in recruitment. Recruitment remained only a small fraction of average levels in the 1970s. An examination of return ratios showed that spawner-to-spawner ratios had remained above replacement since the 1990 brood year as a result of higher productivity of the 1990 broodyear and sharp reductions in harvest for the subsequent broods. As of 1996, recruit-to-spawner ratios for the 1991-1994 broods were the lowest on record, except for 1988 and, possibly, 1984. The 1997 BRT considered risk of extinction for this ESU under two scenarios: first, if present conditions and existing management continued into the foreseeable future and, second, if certain aspects of the Oregon Plan (1997) relating to harvest and hatchery production were implemented.

With respect to habitat, the BRT had two primary concerns: first, that the habitat capacity for coho salmon within this ESU has significantly decreased from historical levels; and second, that the Nickelson and Lawson (1998) model predicted that, during poor ocean survival, only high quality habitat is capable of sustaining coho populations, and subpopulations dependent on medium and low quality habitats would be likely to go extinct. Both of these concerns caused the BRT to consider risks from habitat loss and degradation to be relatively high for this ESU.

In 1997, the BRT concluded that, assuming that 1997 conditions continued into the future (and that proposed harvest and hatchery reforms were not implemented), this ESU was not at significant short-term risk of extinction, but that it was likely to become endangered in the foreseeable future. A minority felt that the ESU was not likely to become endangered. Of those members who concluded that this ESU was likely to become endangered, several expressed the opinion that it was near the border between this and a “not at risk” category.

The BRT generally agreed that implementation of the harvest and hatchery proposals of the Oregon Plan (1997) would have a positive effect on the status of the ESU, but the BRT was about evenly split as to whether the effects would be substantial enough to move the ESU out of the “likely to become endangered” category. Some members felt that, in addition to the extinction buffer provided by the estimated 80,000 naturally-produced spawners in 1996, the proposed reforms would promote higher escapements and alleviate genetic concerns so that the ESU would not be at significant risk of extinction or endangerment. Other members saw little reason to expect that the hatchery and harvest reforms by themselves would be effective in reducing what they viewed as the most serious threat to this ESU—declining recruits-per-spawner.

If the severe declines in recruits-per-spawner of natural populations in this ESU were partly a reflection of continuing habitat degradation, then risks to this ESU might remain high even with full implementation of the hatchery and harvest reforms. While harvest and hatchery reforms may substantially reduce short-term risk of extinction, habitat protection and restoration were viewed as key to ensuring long-term survival of the ESU, especially under variable and unpredictable future climate conditions. The BRT therefore concluded that these measures would not be sufficient to alter the previous conclusion that the ESU is likely to become endangered in the foreseeable future.

The ocean regime shift in 1976 was the beginning of an extended period of poor marine survival for coho salmon in Oregon. Conditions worsened in the 1990s, and hatchery survival reached a low of 0.006 adults per smolt in 1997 (1996 ocean entry). Coastal hatcheries appear to have fared even worse, although adult counts at these facilities are often incomplete, biasing these estimates low. Following an apparent shift to a more productive climate regime in 1998, marine survival started to improve, reaching 0.05 for adults returning in 2001. The Pacific Decadal Oscillation had been in a cold, productive phase for about 4 years and in August, 2001 reversed indicating a warm, unproductive period. This reversal may be short-lived; the Pacific Decadal Oscillation historically has shown a 20 to 60 year cycle. However, the use of past decadal patterns should be used cautiously as predictive models for the future due to the rising influence of global warming (Nathan J. Mantua, personal communication, cited in BRT 2003).

A long-term understanding of the prospects for OC coho can be constructed from a simple conceptual model incorporating a trend in habitat quality and cyclical ocean survival (Lawson 1993). Short-term increases in abundance driven by marine survival cycles can mask longer-term downward trends resulting from freshwater habitat degradation or longer-term trends in marine survival that may be a consequence of global climate change. Decreases in harvest rates can increase escapements and delay ultimate extinction. Harvest rates have been reduced to the point where no further meaningful reductions are possible. The current upswing in marine survival is a good thing for OC coho, but will only provide a temporary respite unless other downward trends are reversed.

This ESU continues to present challenges to those assessing extinction risk. The BRT found several positive features compared to the previous assessment in 1997. Adult spawners for the ESU in 2001 and 2002 exceeded the number observed for any year in the past several decades, and pre-harvest run size rivaled some of the high values seen in the 1970s. Some notable increases in spawners have occurred in many streams in the northern part of the ESU, which was the most depressed area at the time of the last status review evaluation. Hatchery reforms have continued, and the fraction of natural spawners that are first-generation hatchery fish has been reduced in many areas compared to highs in the early to mid 1990s.

On the other hand, the recent years of good returns were preceded by three years of low spawner escapements—the result of three consecutive years of recruitment failure, in which the natural spawners did not replace themselves the next generation, even in the absence of any directed harvest. These three years of recruitment failure, which immediately followed the last status review in 1997, are the only such instances that have been observed in the entire time series of data collected for Oregon Coast coho salmon. Whereas the recent increases in spawner escapement have resulted in long-term trends in spawners that are generally positive, the long-term trends in productivity in this ESU are still strongly negative.

As indicated in the risk matrix results, the BRT considered the decline in productivity to be the most serious concern for this ESU with a moderate risk estimate. With all directed harvest for these populations already eliminated, harvest management can no longer compensate for declining productivity by reducing harvest rates. The BRT was concerned that if the long-term decline in productivity reflects deteriorating conditions in freshwater habitat, this ESU could face very serious risks of local extinctions during the next cycle of poor ocean conditions. With the cushion provided by strong returns in the last 2-3 years before its report, the BRT had much less concern about short-term risks associated with abundance and assigned them a low risk estimate.

A minority of the BRT felt that the large number of spawners in the last few years demonstrate that this ESU is not currently at significant risk of extinction or likely to become endangered. Furthermore, these members felt that the recent years of high escapement, following closely on the heels of the years of recruitment failure, demonstrate that populations in this ESU have the resilience to bounce back from years of depressed runs.

The BRT votes reflected ongoing concerns for the long-term health of this ESU: a majority (56%) of the votes were cast in the "likely to become endangered" category, with a substantial minority (44%) falling in the "not likely to become endangered" category. Although the BRT considered the significantly higher returns in recent years to be encouraging, most members felt that the factors responsible for the increases were more likely to be unusually favorable marine productivity conditions than improvements in freshwater productivity. The majority of BRT members felt that to have a high degree of confidence that the ESU is healthy, high spawner escapements should be maintained for a number of years, and the freshwater habitat should demonstrate the capability of supporting high juvenile production from years of high spawner abundance.

Southern Oregon/Northern California Coasts (SONC) coho salmon. The SONC coho salmon ESU extends from Cape Blanco in southern Oregon to Punta Gorda in northern California (Weitkamp *et al.* 1995). The status of coho salmon coastwide, including the SONC coho ESU, was formally assessed in 1995 (Weitkamp *et al.* 1995). Two subsequent status review updates have been published by NMFS: one addressing all West Coast coho salmon ESUs (NMFS 1996) and a second specifically addressing the OC and SONC ESUs (NMFS 1997).

In the 1995 status review, the BRT was unanimous in concluding that coho salmon in the SONC coho ESU were not in danger of extinction but were likely to become so in the foreseeable future if present trends continued (Weitkamp *et al.* 1995). In the 1997 status update, estimates of natural population abundance in this ESU were based on very limited information. Favorable indicators included recent increases in abundance in the Rogue River and the presence of natural populations in both large and small basins, factors that may provide some buffer against extinction of the ESU. However, large hatchery programs in the two major basins (Rogue and Klamath/Trinity) raised serious concerns about effects on, and sustainability of, natural populations.

New data on presence/absence in northern California streams that historically supported coho salmon were even more disturbing than earlier results, indicating that a smaller percentage of streams in this ESU contained coho salmon compared to the percentage presence in an earlier study. However, it was unclear whether these new data represented actual trends in local extinctions, or were biased by sampling effort. This new information did not change the BRT's conclusion regarding the status of the SONC coho ESU. Although the Oregon Plan (1997) proposals were directed specifically at the Oregon portion of this ESU, the harvest proposal would affect ocean harvest of fish in the California portion as well. The proposed hatchery reforms can be expected to have a positive effect on the status of populations in the Rogue River basin. However, the BRT concluded that these measures would not be sufficient to alter the previous conclusion that the ESU is likely to become endangered in the foreseeable future.

One effect of the Oregon Plan for Salmon and Watersheds has been increased monitoring of salmon and habitats throughout the Oregon coastal region. Besides continuation of the abundance data series analyzed in the 1997 status update, Oregon has expanded its random survey monitoring to include areas south of Cape Blanco, including monitoring of spawner abundance, juvenile densities, and habitat condition.

New data for the SONC coho salmon ESU includes expansion of presence-absence analyses, a limited analysis of juvenile abundance in the Eel River basin, a few indices of spawner abundance in the Smith, Mad, and Eel River basins, and substantially expanded monitoring of adults, juveniles, and habitat in southern Oregon. None of these data contradict conclusions reached previously by the BRT. Nor do any of recent data (1995 to present) suggest any marked change, either positive or negative, in the abundance or distribution of coho salmon within the SONC coho ESU. Coho salmon populations continued to be depressed relative to historical numbers, and there are strong indications that breeding groups have been lost from a significant percentage of streams within their historical range. Although the 2001 broodyear appears to be the one of the strongest perhaps of the last decade, it follows a number of relatively weak years. The Rogue River stock is an exception; there has been an average increase in spawners over the last several years, despite two low years (1998, 1999).

Risk factors identified in previous status reviews, including severe declines from historical run sizes, the apparent frequency of local extinctions, long-term trends that are clearly downward, and degraded freshwater habitat and associated reduction in carrying capacity continue to be of concern to the BRT. Termination of hatchery production of coho salmon at the Mad River and Rowdy Creek facilities has eliminated potential adverse risk associated with hatchery releases from these facilities. Likewise, restrictions on recreational and commercial harvest of coho salmon since 1994 have undoubtedly had a substantial positive impact on coho salmon adult returns to SONC streams. An additional risk factor that has been identified within the SONC coho ESU is predation resulting from the illegal introduction of non-native Sacramento pikeminnow (*Ptychocheilus grandis*) to the Eel River basin (NMFS 1998c). Sacramento pikeminnow were introduced to the Eel River via Pillsbury Lake in the early 1980s and have subsequently spread to most areas within the basin. The rapid expansion of pikeminnow populations is believed to have been facilitated by alterations in habitat conditions (particularly increased water temperatures) that favor pikeminnow (Brown *et al.* 1994; NMFS 1998b).

The BRT remained concerned about low population abundance throughout the ESU relative to historical numbers and long-term downward trends in abundance; however, the paucity of data on escapement of naturally-produced spawners in most basins continued to hinder assessment of risk. A reliable time series of adult abundance is available only for the Rogue River. These data indicate that long-term (22-year) and short-term (10-year) trends in mean spawner abundance were upward in the Rogue; however, the positive trends reflect effects of reduced harvest (rather than improved freshwater conditions) since trends in pre-harvest recruits are flat. Less-reliable indices of spawner abundance in several California populations reveal no apparent trends in some populations and suggest possible continued declines in others.

Additionally, the BRT considered the relatively low occupancy rates of historical coho salmon streams (between 37 and 61% from broodyear 1986 to 2000) as an indication of continued low abundance in the California portion of this ESU. The relatively strong 2001 broodyear, likely the result of favorable conditions in both freshwater and marine environments, was viewed as a positive sign, but was a single strong year following more than a decade of generally poor years.

The moderate risk matrix scores for spatial structure reflected a balancing of several factors. On the negative side was the modest percentage of historical streams still occupied by coho salmon (suggestive of local extirpations or depressed populations). The BRT also remains concerned about the possibility that losses of local populations have been masked in basins with high hatchery output, including the Trinity, Klamath, and Rogue systems. The extent to which strays from hatcheries in these systems are contributing to natural production remains uncertain, however, it is generally believed that hatchery fish and progeny of hatchery fish constitute the majority of production in the Trinity River, and may be a significant concern in parts of the Klamath and Rogue systems a well. On the positive side, extant populations can still be found in all major river basins within the ESU. Additionally, the relatively high occupancy rate of historical streams observed in broodyear 2001 suggests that much habitat remains accessible to coho salmon. The BRT's concern for the large number of hatchery fish in the Rogue, Klamath, and Trinity systems was also evident in the moderate risk rating for diversity.

A majority (67%) of BRT votes fell into the "likely to become endangered" category, while votes in the "endangered" category outnumbered those in the "not warranted" categories by 2-to-1. The BRT found moderately high risks for abundance and growth rate/production, with mean matrix scores of 3.5 to 3.8, respectively, for these two categories. Risks to spatial structure and diversity were judged by the BRT to be moderate.

Sockeye Salmon. Sockeye salmon spawn in North America from the Columbia River in Oregon north to the Noatak River in Alaska, and in Asia from Hokkaido, Japan, north to the Anadyr River in Russia (Atkinson *et al.* 1967; Burgner 1991). The vast majority of sockeye salmon spawn in inlet or outlet streams of lakes or in lakes themselves. The juveniles of these "lake-type" sockeye salmon rear in lake environments for 1 to 3 years, migrate to sea, and return to natal lake systems to spawn after 1 to 4 years in the ocean. However, some sockeye salmon populations spawn in rivers without juvenile lake rearing habitat. Their juveniles rear in slow velocity sections of rivers for 1 or 2 years ("river-type") or migrate to sea as underyearlings and thus rear primarily in saltwater ("sea-type") (Wood 1995). As with lake-type sockeye salmon, river/sea-type sockeye salmon return to natal spawning habitat after 1 to 4 years in the ocean.

Certain self-perpetuating, nonanadromous populations of sockeye salmon that become resident in lake environments over long periods of time are called kokanee in North America. Genetic differentiation among sockeye salmon and kokanee populations indicates that kokanee are polyphyletic, having arisen from sockeye salmon on multiple independent occasions, and that kokanee may occur sympatrically or allopatrically with sockeye salmon. Numerous studies (reviewed in Gustafson *et al.* 1997) indicate that sockeye salmon and kokanee exhibit a suite of heritable differences in morphology, early development rate, seawater adaptability, growth and maturation that appear to be divergent adaptations that have arisen from different selective regimes associated with anadromous vs. nonanadromous life histories. These studies also provide evidence that sympatric populations of sockeye salmon and kokanee can be both genetically distinct and reproductively isolated (see citations in Gustafson *et al.* 1997). Occasionally, a proportion of juveniles in an anadromous sockeye population will remain in the rearing lake environment throughout life and will be observed on the spawning grounds together with their anadromous siblings. Ricker (1938) first used the terms "residual sockeye" and "residuals" to refer to these resident, non-migratory progeny of anadromous sockeye salmon.

In April 1990, NMFS initiated a status review of sockeye salmon in the Salmon River basin and received a petition from the Shoshone-Bannock Tribes of the Fort Hall Indian Reservation to list SR sockeye salmon as endangered under the ESA (NMFS 1990, 1991). NMFS BRT conducted a status review and unanimously agreed that there was insufficient information available to determine with reasonable degree of certainty the origin of the current sockeye salmon gene pool in Redfish Lake (Waples *et al.* 1991). After some discussion, the BRT reached a strong consensus that, in this instance, obligations as resource stewards required them to proceed under the assumption that recent sockeye salmon in Redfish Lake were descended from the original sockeye salmon gene pool. Therefore, as stipulated in Waples (1991), the anadromous component of sockeye salmon was considered separately from the non-anadromous (kokanee) component in determining whether an ESA listing was warranted. The decision to treat Redfish Lake sockeye salmon as distinct from kokanee led the BRT to conclude that the Redfish Lake sockeye salmon were in danger of extinction (Waples *et al*. 1991). Subsequently, a proposed rule to list SR sockeye salmon as endangered was published (NMFS 1991). After consideration of 183 written comments and testimony from public hearings, NMFS published its final listing determination (NMFS 1991a) that designated SR sockeye salmon as an endangered species.

In September 1994, in response to a petition seeking protection for Baker Lake, Washington, sockeye salmon under the ESA and more general concerns about the status of West Coast salmon and steelhead, NMFS initiated a coastwide status review of sockeye salmon in Washington, Oregon, and California, and formed a BRT to conduct the review. After considering available information on genetics, phylogeny and life history, freshwater ichthyo-geography, and environmental features that may affect sockeye salmon, the BRT identified six ESUs (Ozette Lake, Okanogan River, Lake Wenatchee, Quinault Lake, Baker River, and Lake Pleasant) and one provisional ESU (Big Bear Creek). The BRT reviewed population abundance data and other risk factors for these ESUs and concluded that one (Ozette Lake) was likely to become endangered in the foreseeable future, and that the remaining ESUs were not in significant danger of becoming extinct or endangered, although there were substantial conservation concerns for some of these (Gustafson *et al*. 1997). In March 1998, NMFS published a proposed rule to list the Ozette Lake ESU as threatened under the ESA, and to place the Baker River ESU on the candidate list. Due to the lack of natural spawning habitat and the vulnerability of the entire population to problems in artificial habitats, NMFS proposed to add the Baker River ESU to the list of candidate species (NMFS 1998c). Subsequently, based on the updated NMFS status review (Waples *et al.* 1991) and other information received, NMFS published its final listing determination (NMFS 1999b) that designated the Ozette Lake sockeye salmon ESU as threatened and removed the Baker River ESU from the candidate list.

In considering the ESU status of resident forms of sockeye salmon, the key issue is evaluating the strength and duration of reproductive isolation between resident and anadromous forms. Many kokanee populations appear to have been strongly isolated from sympatric sockeye populations for long periods of time. Since the two forms experience very different selective regimes over their life cycle, reproductive isolation provides an opportunity for adaptive divergence in sympatry. Kokanee populations that fall in this category will generally not be considered part of sockeye ESUs. On the other hand, resident fish appear to be much more closely integrated into some sockeye populations. For example, in some situations, anadromous fish may give rise to progeny that mature in freshwater (as is the case with residual sockeye), and some resident fish may have anadromous offspring. In these cases, where there is presumably some regular, or at least episodic, genetic exchange between resident and anadromous forms, they should be considered part of the same ESU. The sockeye salmon BRT met in January, March, and April 2003, to discuss new data received and to determine if the new information warranted any modification of the conclusions of the original BRTs.

Snake River (SR) sockeye salmon. The first formal ESA status review for salmon in the Pacific Northwest was conducted in response to a 1990 petition to list sockeye salmon from Redfish Lake in Idaho as an endangered species. The distinctiveness of this population became apparent early in the process: it spawns at a higher elevation (2,000 m), and has a longer freshwater migration (1,500 km) than any other sockeye salmon population in the world (Waples *et al.* 1991). Nor was the precarious nature of the anadromous run in doubt; in the fall of 1990, during the course of the status review, no adults were observed at Lower Granite Dam or entering the lake, and only one fish was observed in each of the two previous years. However, a population of kokanee also existed in Redfish Lake, and the relationship between the sockeye and kokanee was not well understood. This issue was complicated by uncertainty regarding the effects of Sunbeam Dam, which stood for over two decades about 20 miles downstream from Redfish Lake. By all accounts, the dam was a serious impediment to anadromous fish, but opinions differed as to whether it was an absolute barrier. Some argued that the original sockeye population in Redfish Lake was extirpated as a result of Sunbeam Dam, and that adult returns in recent decades were simply the result of sporadic seaward drift of kokanee (Chapman *et al.* 1990). According to this hypothesis, the original sockeye gene pool was extinct and the remaining kokanee population was not at risk because of its reasonably large size (ca. 5,000-10,000 spawners per year). An alternative hypothesis held that the original sockeye salmon population managed to persist in spite of Sunbeam Dam, either by intermittent passage of adults or recolonization from holding areas downstream from the dam. The fact that the kokanee population spawns in the inlet stream (Fishhook Creek) in August-September and all the recent observations of sockeye spawning have been on the lake shore in October-November was cited as evidence that the sockeye and kokanee represent separate populations. According to this hypothesis, the sockeye population was critically endangered, and perhaps, on the brink of extinction.

At the time of the status review, the BRT unanimously agreed that there was not enough information to determine which of the above hypotheses were true (Waples *et al.* 1991). Although the kokanee population had been genetically characterized and determined to be quite distinctive compared to other sockeye salmon populations in the Pacific Northwest, no adult sockeye were available for sampling, so the BRT could not evaluate whether the two forms shared a common gene pool. When pressed to make a decision regarding the ESU status of Redfish Lake sockeye salmon, the BRT concluded that, because they could not determine with any certainty that the original sockeye gene pool was extinct, they should assume that it did persist and was separate from the kokanee gene pool. This conclusion was strongly influenced by consideration of the irreversible consequences of making an error in the other direction (*i.e.*, if the species was not listed based on the assumption that kokanee and sockeye populations were a single gene pool and this later proved not to be the case, the species could easily go extinct before the error was detected).

The status review of Redfish Lake sockeye salmon is the only instance in which the BRT has been asked to apply the precautionary principle in its deliberations. In subsequent evaluations, when the "best available scientific information" was insufficient to distinguish with any certainty among competing hypotheses regarding key ESA questions, the BRT has simply reported this result and tried to characterize the degree of uncertainty in the team's conclusions. Decisions about how best to apply the precautionary principle in the face of uncertainty in making listing determinations have been left to the NMFS management/policy arm. Based on results of the status review, NMFS proposed a listing of Redfish Lake sockeye as endangered in April 1991. When finalized in late 1991, this represented the first ESA listing of a Pacific salmon population in the Pacific Northwest. At the time of the listing, the only population that the BRT and NMFS were confident belonged in this ESU was the beach spawning population of sockeye from Redfish Lake. Historical records indicated that sockeye once occurred in several other lakes in the Stanley basin, but no adults had been observed in these lakes for many decades and their relationship to the Redfish Lake ESU was uncertain.

Four adult sockeye returned to Redfish Lake in 1991; these were captured and taken into captivity to join several hundred smolts collected in spring 1991 as they outmigrated from Redfish Lake. The adults were spawned, and their progeny reared to adulthood along with the emigrants as part of a captive broodstock program, whose major goal was to perpetuate the gene pool for a short period of time (one or two generations) to give managers a chance to identify and address the most pressing threats to the population. As a result of this program and related research, a great deal of new information has been gained about the biology of Redfish Lake sockeye salmon and limnology of the lakes in the Stanley basin. Genetic data collected from the returning adults and the emigrants showed that they were genetically similar but distinct from the Fishhook Creek kokanee. However, otolith microchemistry data (Rieman *et al.* 1994) indicated that many of the emigrants had a resident female parent. These results inspired a search of the lake for another population of resident fish that was genetically similar to the sockeye. These efforts led to discovery of a relatively small number (perhaps a few hundred) kokanee-sized fish that spawn at approximately the same time and place as the sockeye. These fish, termed "residual" sockeye salmon, are considered to be part of the listed ESU.

Subsequent genetic analysis (Winans *et al*. 1996, Waples *et al*. 1997) has established the following relationships between extant populations of sockeye salmon from the Stanley basin and other populations in the Pacific Northwest: (1) Native populations of sockeye salmon from the Stanley basin (including Redfish Lake sockeye and kokanee and Alturas Lake kokanee) are genetically quite divergent from all other North American sockeye salmon populations that have been examined; (2) within this group, Redfish Lake sockeye and kokanee are genetically distinct, and Alturas Lake kokanee are most similar to Redfish Lake kokanee; (3) two gene pools of sockeye salmon have been identified in Stanley Lake, one may be the remnant of a native gene pool that survived rotenone treatments in the lake, while the other can be traced to introductions from Wizard Falls Hatchery in Oregon; and (4) no trace of the original gene pool of sockeye salmon has been found in Pettit Lake. The population that has spawned in Pettit Lake in recent decades can be traced to introductions of kokanee from northern Idaho, and those populations in turn can be traced to stock transfers of Lake Whatcom (Washington) kokanee early in the last century.

Between 1991 and 1998, 16 naturally-produced adult sockeye returned to the weir at Redfish Lake and were incorporated into the captive broodstock program. This program, overseen by the Stanley Basin Sockeye Technical Oversight Committee, has produced groundbreaking research in captive broodstock technology (Hebdon *et al*. 1999, Kline and Willard 2001, Frost *et al*. 2002) and limnology (Kohler *et al.* 2002). The program used three different rearing sites to minimize chances of catastrophic failure and has produced several hundred thousand eggs and juveniles, as well as several hundred adults, for release into the wild. A milestone was reached in 2000, when > 200 adults from the program returned to Redfish Lake. Currently, the captive broodstock program is being maintained as a short-term safety net, pending decisions about longer-term approaches to recovery of the ESU.

The Snake River Salmon Recovery Team (Bevan *et al.* 1994; NMFS 1995) suggested that to be considered recovered under the ESA, this ESU should have viable populations in three different lakes, with at least 1,000 naturally-produced spawners per year in Redfish Lake and at least 500 in each of two other Stanley basin lakes. As a step toward addressing this recommendation, releases of progeny from the Redfish Lake captive broodstock program have been made in Pettit Lake and Alturas Lake as well. In 1991, about 100 emigrants from Alturas Lake were collected at the same time as the Redfish Lake emigrants and reared to maturity as a separate population in captivity. However, because of funding and space limitations and uncertainties about priorities for propagating this population, the resulting adults were released into the lake rather than being kept for spawning and another generation of captive rearing. Because the Alturas Lake kokanee spawn earlier than Redfish lake sockeye and in the inlet stream, it is hoped that the introduction of Redfish Lake sockeye into Alturas Lake will not adversely affect this native gene pool.

Steelhead. Steelhead is the name commonly applied to the anadromous form of the biological species *Oncorhynchus mykiss*. The present distribution of steelhead extends from Kamchatka in Asia, east to Alaska, and down to southern California (NMFS 1999d), although the historical range of steelhead extended at least to the Mexico border (Busby *et al.* 1996). Steelhead exhibit perhaps the most complex suite of life-history traits of any species of Pacific salmonid. They can be anadromous or freshwater resident (and under some circumstances, apparently yield offspring of the opposite form). Those that are anadromous can spend up to seven years in fresh water before smoltification, and then spend up to three years in salt water before first spawning. The half-pounder life-history type in Southern Oregon and Northern California spends only 2 to 4 months in salt water after smoltification, then returns to fresh water and outmigrates to sea again the following spring without spawning. This species can also spawn more than once (iteroparous), whereas all other species of *Oncorhynchus* except *O. clarki* spawn once and then die (semelparous).

Although no subspecies are currently recognized within any of the species of Pacific salmon, Behnke (1992) has proposed that two subspecies of steelhead with anadromous life history occur in North America: *O. mykiss irideus* (the "coastal" subspecies), which includes coastal populations from Alaska to California (including the Sacramento River), and *O. mykiss gairdneri* (the "inland" subspecies), which includes populations from the interior Columbia, Snake and Fraser Rivers. In the Columbia River, the boundary between the two subspecies occurs at approximately the Cascade Crest. A third subspecies of anadromous steelhead (*O. mykiss mykiss*) occurs in Kamchatka, and several other subspecies of steelhead are also recognized which only have resident forms (Behnke 1992).

Within the range of West Coast steelhead, spawning migrations occur throughout the year, with seasonal peaks of activity. In a given river basin there may be one or more peaks in migration activity; since these runs are usually named for the season in which the peak occurs, some rivers may have runs known as winter, spring, summer, or fall steelhead. For example, large rivers, such as the Columbia, Rogue, and Klamath Rivers, have migrating adult steelhead at all times of the year. Names used to identify the seasonal runs of steelhead vary locally; in Northern California, some biologists have retained the use of the terms spring and fall steelhead to describe what others would call summer steelhead.

Steelhead can be divided into two basic reproductive ecotypes, based on the state of sexual maturity at the time of river entry, and duration of spawning migration (Burgner *et al.* 1992). The stream-maturing type (summer steelhead in the Pacific Northwest and Northern California) enters fresh water in a sexually immature condition between May and October and requires several months to mature and spawn. The ocean-maturing type (winter steelhead in the Pacific Northwest and Northern California) enters fresh water between November and April with well-developed gonads and spawns shortly thereafter.

In basins with both summer and winter steelhead runs, it appears that the summer-run occurs where habitat is not fully used by the winter-run or a seasonal hydrologic barrier, such as a waterfall, separates them. Summer steelhead usually spawn farther upstream than winter steelhead (Withler 1988, Roelofs 1983, Behnke 1992). Coastal streams are dominated by winter steelhead, whereas inland steelhead of the Columbia River basin are almost exclusively summer steelhead. Winter steelhead may have been excluded from inland areas of the Columbia River basin by Celilo Falls or by the considerable migration distance from the ocean. The Sacramento/San Joaquin River basin may have historically had multiple runs of steelhead that probably included both ocean-maturing and stream-maturing stocks (CDFG 1995; McEwan and Jackson 1996). These steelhead are referred to as winter steelhead by the CDFG; however, some biologists call them fall steelhead (Cramer 1995). It is thought that hatchery practices and modifications in the hydrology of the basin caused by large-scale water diversions may have altered the migration timing of steelhead in this basin (D. McEwan, personal communication, cited in BRT 2003).

Inland steelhead of the Columbia River basin, especially the Snake River subbasin, are commonly referred to as either A-run or B-run. These designations are based on a bimodal migration of adult steelhead at Bonneville Dam (235 km from the mouth of the Columbia River) and differences in age (1- versus 2-ocean) and adult size observed among SRB steelhead. It is unclear, however, if the life-history and body size differences observed upstream are correlated back to the groups forming the bimodal migration observed at Bonneville Dam. Furthermore, the relationship between patterns observed at the dams and the distribution of adults in spawning areas throughout the Snake River basin is not well understood. A-run steelhead are believed to occur throughout the steelhead-bearing streams of the Snake River basin and the inland Columbia River; B-run steelhead are thought to be produced only in the Clearwater, Middle Fork Salmon, and South Fork Salmon Rivers (IDFG 1994).

The half-pounder is an immature steelhead that returns to fresh water after only 2 to 4 months in the ocean, generally overwinters in fresh water, and then outmigrates again the following spring. Half-pounders are generally less than 400 mm and are reported only from the Rogue, Klamath, Mad, and Eel Rivers of Southern Oregon and Northern California (Barnhart 1986; Everest 1973; Kesner and Barnhart 1972; Snyder 1925), however, it has been suggested that as mature steelhead, these fish may only spawn in the Rogue and Klamath River basins (Cramer 1995). Various explanations for this unusual life history have been proposed, but there is still no consensus as to what, if any, advantage it affords to the steelhead of these rivers.

In May 1992, NMFS was petitioned by the Oregon Natural Resources Council (ONRC) and 10 co-petitioners to list Oregon's Illinois River winter steelhead (ONRC 1992). NMFS concluded that Illinois River winter steelhead by themselves did not constitute an ESA "species" (Busby *et al.* 1993; NMFS 1993). In February 1994, NMFS received a petition seeking protection under the ESA for 178 populations of steelhead (anadromous steelhead) in Washington, Idaho, Oregon, and California. At the time, NMFS was conducting a status review of coastal steelhead populations (*O. m. irideus*) in Washington, Oregon, and California. In response to the broader petition, NMFS expanded the ongoing status review to include inland steelhead (*O. m. gairdneri*) occurring east of the Cascade Mountains in Washington, Idaho, and Oregon.

In 1995, the steelhead BRT met to review the biology and ecology of West Coast steelhead. After considering available information on steelhead genetics, phylogeny, and life history, freshwater ichthyogeography, and environmental features that may affect steelhead, the BRT identified 15 ESUs—12 coastal forms and three inland forms. After considering available information on population abundance and other risk factors, the BRT concluded that five steelhead ESUs (Central California Coast, South-Central California Coast, Southern California, Central Valley, and Upper Columbia River) were presently in danger of extinction, five steelhead ESUs (Lower Columbia River, Oregon Coast, Klamath Mountains Province, Northern California, and Snake River basin) were likely to become endangered in the foreseeable future, four steelhead ESUs (Puget Sound, Olympic Peninsula, Southwest Washington, and Upper Willamette River) were not presently in significant danger of becoming extinct or endangered, although individual stocks within these ESUs may be at risk, and one steelhead ESU (Middle Columbia River) was not presently in danger of extinction but the BRT was unable to reach a conclusion as to its risk of becoming endangered in the foreseeable future.

Of the 10 steelhead ESUs identified by NMFS and listed as threatened or endangered under the ESA, five occur in the overall action area. The West Coast steelhead BRT met in January, March, and April 2003 to discuss new data received and to determine if the new information warranted any modification of the conclusions of the original BRT (BRT 2003).

Lower Columbia River (LCR) steelhead. The status of LCR steelhead was initially reviewed by NMFS in 1996 (Busby *et al.* 1996), and the most recent review occurred in 1998 (NMFS 1998d). In the 1998 review, the BRT noted several concerns for this ESU, including the low abundance relative to historical levels, the universal and often drastic declines observed since the mid-1980s, and the widespread occurrence of hatchery fish in naturally spawning steelhead populations. Analysis also suggested that introduced summer steelhead may negatively affect winter native winter steelhead in some populations. A majority of the 1998 BRT concluded that steelhead in the LCR ESU were at risk of becoming endangered in the foreseeable future.

New data available for this update included: recent spawner data, additional data on the fraction of hatchery-origin spawners, recent harvest rates, updated hatchery release information, and a compilation of data on resident steelhead. For many of the Washington Chinook salmon populations, the WDFW has conducted analyses using the Ecosystem Diagnosis and Treatment (EDT) model (Busack and Rawding 2003). The EDT model attempts to predict fish population performance based on input information about reach-specific habitat attributes (http://www.olympus.net/community/dungenesswc/EDTprimer.pdf). New analyses for this update include the designation of demographically independent populations, recalculation of previous BRT metrics with additional years' data, estimates of median annual growth rate under different assumptions about the reproductive success of hatchery fish, and estimates of current and historically available kilometers of stream.

Based on the provisional framework discussed in the general Introduction to the BRT (2003) report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of this ESU, while those above long-standing natural barriers (*e.g.*, in Upper Clackamas, Sandy, and some of the small tributaries of the Columbia River Gorge) are not. Case 3 resident fish above dams on the Cowlitz, Lewis, and Sandy Rivers are of uncertain ESU status.

A large majority (over 79%) of the BRT votes for this ESU fell in the "likely to become endangered" category, with small minorities falling in the "danger of extinction" and "not likely to become endangered" categories. The BRT found moderate risks in all the VSP categories, with mean risk matrix scores ranging from moderately low for spatial structure to moderately high for both abundance and growth rate/productivity. All of the major risk factors identified by previous BRTs still remain. Most populations are at relatively low abundance, and those with adequate data for modeling are estimated to have a relatively high extinction probability. Some populations, particularly summer-run, have shown higher returns in the 2 – 3 years before the BRT report. The Willamette/Lower Columbia River Technical Review Team (Myers *et al.* 2002) has estimated that at least four historical populations are now extinct. The hatchery contribution to natural spawning remains high in many populations.

Upper Willamette River (UWR) steelhead. The status of UWR steelhead was initially reviewed by NMFS in 1996 (Busby *et al*. 1996) and the most recent review occur in 1999 (NMFS 1999d). In the 1999 review, the BRT noted several concerns for this ESU, including the relatively low abundance and steep declines since 1988. The previous BRT was also concerned about the potential negative interaction between non-native summer steelhead and wild winter steelhead. The previous BRT considered the loss of access to historical spawning grounds because of dams a major risk factor. The 1999 BRT reached a unanimous decision that the UWR steelhead ESU was at risk is of becoming endangered in the foreseeable future.

New data for UWR steelhead include redd counts and dam/weir counts through 2000, 2001, or 2002 and estimates of hatchery fraction and harvest rates through 2000. New analyses for this update include the designation of demographically independent populations, and estimates of current and historically available kilometers of stream.

As part of its effort to develop viability criteria for UWR steelhead, the Willamette/Lower Columbia Technical Recovery Team has identified historically demographically independent populations (Myers *et al*. 2002). Population boundaries are based on an application of Viable Salmonid Populations definition (McElhany *et al*. 2000). Myers *et al*. (2002) hypothesized that the ESU historically consisted of at least four populations (Mollala, North Santiam, South Santiam and Calapooia) and possibly a fifth (Coast Range). The historical existence of a population in the coast range is uncertain. The populations identified in Myers *et al*. are used as the units for the new analyses in the BRT (2003) report.

Based on the updated information provided in the BRT (2003) report, the information contained in previous UWR steelhead ESU status reviews, and preliminary analyses by the Willamette/Lower Columbia Technical Review Team, the BRT could not conclusively identify a single population that is naturally self-sustaining. All populations are relatively small, with the recent mean abundance of the entire ESU at less than 6,000. Over the period of the available time series, most of the populations are in decline. The recent elimination of the winter-run hatchery production will allow estimation of the natural productivity of the populations in the future, but the available time series are confounded by the presence of hatchery-origin spawners. On a positive note, the counts all indicate an increase in abundance in 2001, likely at least partly as a result of improved marine conditions. The issue of changing marine conditions is discussed in the introduction to this update report, as it is an issue for many ESUs.

Because coastal cutthroat trout is a dominant species in the basin, resident steelhead are not as widespread here as in areas east of the Cascades. Resident fish below barriers are found in the Pudding/Molalla, Lower Santiam, Calapooia, and Tualatin drainages, and these would be considered part of the steelhead ESU based on the provisional framework discussed in the general Introduction. Resident fish above Big Cliff and Detroit Dams on the North Fork Santiam and above Green Peter Dam on the South Fork Santiam are of uncertain ESU affinity. Although no obvious physical barrier separates populations upstream from the Calapooia from those lower in the basin, resident steelhead in these upper reaches of the Willamette basin are quite distinctive both phenotypically and genetically and are not considered part of the steelhead ESU.

The majority (over 76%) of the BRT votes for this ESU fell in the “likely to become endangered” category, with small minorities falling in the “danger of extinction” and “not likely to become endangered” categories. The BRT did not identify any extreme risks for this ESU but found moderate risks in all the VSP categories, ranging from moderately low for diversity to moderate spatial structure and growth rate/productivity. On a positive note, after a decade in which overall abundance (Willamette Falls count) hovered around the lowest levels on record, adult returns for 2001 and 2002 were up significantly, on par with levels seen in the 1980s. Still, the total abundance is small for an entire ESU, resulting in a number of populations that are each at relatively low abundance. The recent increases are encouraging but it is uncertain whether they can be sustained. The BRT considered it a positive sign that releases of the "early" winter-run hatchery population have been discontinued, but remained concerned that releases of non-native summer-run steelhead continue.

Middle Columbia River (MCR) steelhead. The MCR steelhead ESU includes steelhead populations in Oregon and Washington drainages upstream from the Hood and Wind River systems to and including the Yakima River. The Snake River is not included in this ESU. Major drainages in this ESU are the Deschutes, John Day, Umatilla, Walla-Walla, Yakima, and Klickitat River systems. Almost all steelhead populations within this ESU are summer-run fish, the exceptions being winter-run components returning to the Klickitat, and Fifteen Mile Creek watersheds. Most of the populations within this ESU are characterized by a balance between 1- and 2-year-old smolt emigrants. Adults return after 1 or 2 years at sea.

Hatchery facilities are in a number of drainages within the geographic area of this ESU, although there are also subbasins with little or no direct hatchery influence. The John Day River system, for example, has not been outplanted with hatchery steelhead. Similarly, hatchery production of steelhead in the Yakima River system was relatively limited historically and has been phased out since the early 1990s. However, the Umatilla and the Deschutes River systems each have ongoing hatchery production programs based on locally derived broodstocks. Moreover, straying from out-of-basin production programs into the Deschutes River has been identified as a chronic occurrence. The Walla Walla River (three locations in Washington sections) historically received production releases of Lyons Ferry stock summer steelhead from the Lower Snake River Compensation Program (LSRCP). Mill Creek releases were halted after 1998 due to concerns associated with the then pending listing of MCR steelhead under the ESA. A new endemic broodstock is under development for the Touchet River release site (beginning with the 1999/2000 return year). Production levels at the Touchet and Walla Walla River release site have been reduced in recent years (WDFW, cited in BRT 2003).

Blockages have prevented access to sizable steelhead production areas in the Deschutes River and the White Salmon River. In the Deschutes River, Pelton Dam blocks access to upstream habitat historically used by steelhead. Conduit Dam, constructed in 1913, blocked access to all but 2-3 miles of habitat suitable for steelhead production in the Big White Salmon River. Substantial populations of resident trout exist in both areas.

Previous reviews identified several concerns including relatively low spawning levels in those streams for which information was available, a preponderance of negative trends (10 out of 14), and the widespread presence of hatchery fish throughout the ESU. The 1999 BRT review specifically identified the serious declines in abundance in the John Day River basin as a point of concern given that the John Day system had supported large populations of naturally spawning steelhead in the recent past. Concerns were also expressed about the low abundance of returns to the Yakima River system relative to historical levels with the majority of production coming from a single stream (Satus Creek). The sharp decline in returns to the Deschutes River system was also identified as a concern.

The 1999 BRT review identified increases of stray steelhead into the Deschutes River as a "major source of concern." The review acknowledged that initial results from radio tagging studies indicated that a substantial proportion of steelhead entering the Deschutes migrated out of the system before spawning. The previous BRT review identified a set of habitat problems affecting basins within this ESU. High summer and low winter temperatures are characteristic of production or migration reaches associated with populations within this ESU. Water withdrawals have seriously reduced flow levels in several Mid-Columbia drainages, including sections of the Yakima, Walla-Walla, Umatilla, and Deschutes Rivers. Riparian vegetation and instream structure has been degraded in many areas—the previous BRT report states that of the stream segments inventoried within this ESU, riparian restoration is needed for between 37 and 84% of the riverbank in various basins.

The John Day is the only basin of substantial size in which production is clearly driven by natural spawners. For the other major basin in the ESU, the Klickitat, no quantitative abundance information is available. The other difficult issue centered on how to evaluate contribution of resident fish, which according to Kostow (2003) and other sources are very common in this ESU and may greatly outnumber anadromous fish. The BRT concluded that the relatively abundant and widely distributed resident fish somewhat mitigated extinction risk in this ESU. However, due to significant threats to the anadromous component the majority of BRT members concluded the ESU was likely to become endangered.

Historically, resident fish are believed to have occurred in all areas in the ESU used by steelhead, although current distribution is more restricted. Based on the provisional framework discussed in the general Introduction to the BRT (2003), the BRT assumed as a working hypothesis that resident fish below historical barriers are part of this ESU, while those above long-standing natural barriers (*e.g.*, in Deschutes and John Day basins) are not. Case 3 resident fish above Condit Dam in the Little White Salmon; above Pelton and Round Butte Dams (but below natural barriers) in the Deschutes; and above irrigation dams in the Umatilla Rivers are of uncertain ESU status.

A slight majority (51%) of the BRT votes for this ESU fell in the "likely to become endangered" category, with a substantial minority (49%) falling in the "not likely to become endangered" category. The BRT did not identify any extreme risks for this ESU but found moderately risks in all the VSP categories. This ESU proved difficult to evaluate for two reasons. First, the status of different populations within the ESU varies greatly. On one hand, abundance in two major basins, the Deschutes and John Day, is relatively high and over the five years before the BRT report is close to or slightly over the interim recovery targets (NMFS 2002). On the other hand, steelhead in the Yakima basin, once a large producer of steelhead, remain severely depressed (10% of the interim recovery target) in spite of increases in the two years before the BRT report. Furthermore, in recent years escapement to spawning grounds in the Deschutes River has been dominated by stray, out-of-basin (and largely out-of-ESU) fish – which raises substantial questions about genetic integrity and productivity of the Deschutes population.

Upper Columbia River (UCR)sSteelhead. The life-history patterns of UCR steelhead are complex. Adults return to the Columbia River in the late summer and early fall; most migrate relatively quickly up the mainstem to their natal tributaries. A portion of the returning run overwinters in the mainstem reservoirs, passing over the upper mid-Columbia dams in April and May of the following year. Spawning occurs in the late spring of the calendar year following entry into the river. Juvenile steelhead spend one to seven years rearing in freshwater before migrating to the ocean. Smolt outmigrations are predominately age 2 and age 3 juveniles. Most adult steelhead return after one or two years at sea, starting the cycle again.

Estimates of the annual returns of UCR steelhead populations are based on dam counts. Cycle counts are used to accommodate the prevalent return pattern in up-river summer steelhead (runs enter the Columbia River in late summer and fall, some fish overwinter in mainstem reservoirs—migrating past the upper dams before spawning the following spring). Counts over Wells Dam are assumed to be returns originating from natural production and hatchery outplants into the Methow and Okanogan River systems. The total returns to Wells Dam are calculated by adding annual broodstock removals at Wells to the dam counts. The annual estimated return levels above Wells Dam are broken down into hatchery and wild components by applying the ratios observed in the Wells sampling program for run years since 1982.

Harvest rates on upper river steelhead have been cut back substantially from historical levels. Direct commercial harvest of steelhead in non-Indian fisheries was eliminated by legislation in the early 1970s. Incidental impacts in fisheries directed at other species continued in the lower river, but at substantially reduced levels. In the 1970s and early 1980s, recreational fishery impacts in the Upper Columbia escalated to very high levels in response to increasing returns augmented by substantial increases in hatchery production. In 1985, steelhead recreational fisheries in this region (and in other Washington tributaries) were changed to mandate release of wild fish. Treaty harvest of summer-run steelhead (including returns to the Upper Columbia) occurs mainly in mainstem fisheries directed at up-river bright fall Chinook.

Hatchery returns predominate the estimated escapement in the Wenatchee, Methow and Okanogan River drainages. The effectiveness of hatchery spawners relative to their natural counterparts is a major uncertainty for both populations. Hatchery effectiveness can be influenced by at least three sets of factors: (1) Relative distribution of spawning adults; (2) relative timing of spawning adults; and (3) relative effectiveness of progeny. No direct information is available for the Upper Columbia River stocks. Outplanting strategies have varied over the time period the return/spawner data were collected (1976-1994 broodyears). While the return timing into the Columbia River is similar for both wild and hatchery steelhead returning to the Upper Columbia, the spawning timing in the hatchery is accelerated. The long-term effects of such acceleration on the spawning timing of returning hatchery-produced adults in nature is not known. We have no direct information on relative fitness of UCR steelhead progeny with at least one parent of hatchery origin.

The 1998 steelhead status review identified a number of concerns for the UCR steelhead ESU. While the total abundance of populations within this ESU has been relatively stable or increasing, it appears to be occurring only because of major hatchery supplementation programs. Estimates of the proportion of hatchery fish in spawning escapement are 65% (Wenatchee River) and 81% (Methow and Okanogan Rivers). The major concern for this ESU is the clear failure of natural stocks to replace themselves. The BRT members are also strongly concerned about the problems of genetic homogenization due to hatchery supplementation, apparent high harvest rates on steelhead smolts in rainbow trout fisheries and the degradation of freshwater habitats within the region, especially the effects of grazing, irrigation diversions and hydroelectric Dams. The BRT also identified two major areas of uncertainty; relationship between anadromous and resident forms, and the genetic heritage of naturally spawning fish within this ESU.

Based on the provisional framework discussed in the general introduction to the BRT (2003) report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of this ESU, while those above long-standing natural barriers (*e.g.*, in the Entiat, Methow, and perhaps Okanogan basins) are not. Resident fish potentially occur in all areas in the ESU used by steelhead. Case 3 resident fish above Conconully Dam are of uncertain ESU affinity. The BRT did not attempt to resolve the ESU status of resident fish residing above Grand Coulee Dam, as little new information is available relevant to this issue. Possible ESU scenarios for these fish include: (1) They were historically part of the ESU and many of the remnant resident populations still are part of this ESU; (2) they were historically part of the ESU but no longer are, due to either introductions of hatchery rainbow trout or rapid evolution in a novel environment; or (3) they were historically part of a separate ESU. For many BRT members, the presence of relatively numerous resident fish mitigated the assessment of extinction risk for the ESU as a whole.

A slight majority (54%) of the BRT votes for this ESU fell in the “danger of extinction” category, with most of the rest falling in the “likely to become endangered” category. The most serious risk identified for this ESU was growth rate/productivity, estimated to be high to very high; other VSP factors were also relatively high, ranging from moderate for spatial structure to moderately high for diversity. The last 2 to 3 years have seen an encouraging increase in the number of naturally-produced fish in this ESU. However, the recent mean abundance in the major basins is still only a fraction of interim recovery targets (NMFS 2002). Furthermore, overall adult returns are still dominated by hatchery fish, and detailed information is lacking regarding productivity of natural populations. The ratio of naturally-produced adults to the number of parental spawners (including hatchery fish) remains low for UCR steelhead. The BRT did not find data to suggest that the extremely low replacement rate of naturally spawning fish (estimated adult:adult ratio was only 0.25-0.3 at the time of the last status review update) has improved substantially.

Snake River Basin (SRB) steelhead. The SRB steelhead ESU is distributed throughout the Snake River drainage system, including tributaries in southwest Washington, eastern Oregon and north/central Idaho (NMFS 1997b). SRB steelhead migrate a substantial distance from the ocean (up to 1,500 km) and use high elevation tributaries (typically 1,000-2,000 m above sea level) for spawning and juvenile rearing. SRB steelhead occupy habitat that is considerably warmer and drier (on an annual basis) than other steelhead ESUs. SRB steelhead are generally classified as summer-run, based on their adult run timing patterns. Summer steelhead enter the Columbia River from late June to October. After holding over the winter, summer steelhead spawn during the following spring (March to May). Managers classify up-river summer steelhead runs into to groups based primarily on ocean age and adult size upon return to the Columbia River. A-run steelhead are predominately age-1 ocean fish while B-run steelhead are larger, predominated by age-2 ocean fish.

With the exception of the Tucannon River and some small tributaries to the mainstem Snake River, the tributary habitat used by SRB steelhead ESU is above Lower Granite Dam. Major groupings of populations and/or subpopulations can be found in: (1) The Grande Ronde River system; (2) the Imnaha River drainage; (3) the Clearwater River drainages; (4) the South Fork Salmon River; (5) the smaller mainstem tributaries before the confluence of the mainstem; (6) the Middle Fork salmon production areas, (7) the Lemhi and Pahsimeroi valley production areas; and (8) Upper Salmon River tributaries.

Resident steelhead are believed to be present in many of the drainages used by SRB steelhead. Very little is known about interactions between co-occurring resident and anadromous forms within this ESU. The following review of abundance and trend information focuses on information directly related to the anadromous form.

Although direct historical estimates of production from the Snake basin are not available, the basin is believed to have supported more than half of the total steelhead production from the Columbia basin (Mallet 1974). Some historical estimates of returns are available for portions of the drainage. Lewiston Dam, constructed on the Lower Clearwater, began operation in 1927. Counts of steelhead passing through the adult fish ladder at the dam reached 40 to 60,000 in the early 1960s (Cichosz *et al.* 2001). Based on relative drainage areas, the Salmon River basin likely supported substantial production as well. In the early 1960s, returns to the Grande Ronde River and the Imnaha River may have exceeded 15,000 and 4,000 steelhead per year, respectively (ODFW 1991). Extrapolations from tag/recapture data indicate that the natural steelhead return to the Tucannon River may have exceeded 3,000 adults in the mid-1950s. The previous status review noted that the aggregate trend in abundance as measured by ladder counts at the uppermost Snake River dam (Lower Granite Dam since 1972) has been upward since the mid-1970s while the aggregate return of naturally-produced steelhead was downward for the same period. The decline in natural production was especially pronounced in the later years in the series.

The primary concern regarding SRB steelhead identified in the 1998 status review was a sharp decline in natural stock returns beginning in the mid-1980s. Of 13 trend indicators at that time, nine were in decline and four were increasing. In addition, Idaho Department of Fish and Game parr survey data indicated declines for both A- and B-run steelhead in wild and natural stock areas. The high proportion of hatchery fish in the run was also identified as a concern, particularly because of the lack of information on the actual contribution of hatchery fish to natural spawning. The review recognized that some wild spawning areas have relatively little hatchery spawning influence (Selway River, Lower Clearwater River, the Middle and South Forks of the Salmon River and the Lower Salmon River). In other areas, such as the Upper Salmon River, there is likely little or no natural production of locally-native steelhead. The review identified threats to genetic integrity from past and present hatchery practices as a concern. Concern for the North Fork Clearwater stock was also identified. That stock is currently maintained through the Dworshak Hatchery program but cut off from access to its native tributary by Dworshak Dam. The 1998 review also highlighted concerns for widespread habitat degradation and flow impairment throughout the Snake basin as well as for the substantial modification of the seaward migration corridor by hydroelectric power development on the Snake and Columbia mainstems.

Estimates of annual returns to specific production areas are not available for most of the SR ESU. Estimates are available for two tributaries below Lower Granite Dam (Tucannon and Asotin Creek). Annual ladder counts at Lower Granite Dam and associated sampling information allows for an estimate of the aggregate returns to the Snake River basin. In addition, area specific estimates are available for the Imnaha River and two major sections of the Grande Ronde River system. Returns to Lower Granite Dam remained at relatively low levels through the 1990s; the 2001 run size at Lower Granite Dam was substantially higher relative to the 1990s. The recent geometric mean abundance was down for the Tucannon River relative to the last BRT status review. Returns to the Imnaha River and to the Grande Ronde River survey areas were generally higher relative to the early 1990s.

Overall, long-term trends remained negative for four of the nine available series (including aggregate measures and specific production area estimates). Short-term trends improved relative to the period analyzed for the previous status review. The median short-term trend was +2.0% for the 1990 to 2001 period. Five out of the nine data sets showed a positive trend.

Based on the provisional framework discussed in the general introduction to the BRT (2003) report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of this ESU, while those above long-standing natural barriers (*e.g.*, in the Palouse and Malad Rivers) are not. Recent genetic data suggest that native resident steelhead above Dworshak Dam on the North Fork Clearwater River should be considered part of this ESU, but hatchery rainbow trout that have been introduced to that and other areas would not. The BRT did not attempt to resolve the ESU status of resident fish residing above the Hell's Canyon Dam complex, as little new information is available relevant to this issue. However, Kostow (2003) suggested that, based on substantial ecological differences in habitat, the anadromous steelhead that historically occupied basins upstream from Hells Canyon (*e.g.*, Powder, Burnt, Malheur, Owhyee Rivers) may have been in a separate ESU. For many BRT members, the presence of relatively numerous resident fish mitigated the assessment of extinction risk for the ESU as a whole.

On a more positive note, sharp upturns in 2000 and 2001 in adult returns in some populations and evidence for high smolt-adult survival indicate that populations in this ESU are still capable of responding to favorable environmental conditions. In spite of the recent increases, however, abundance in most populations for which there are adequate data were well below interim recovery targets (NMFS 2002).

A majority (over 70%) of the BRT votes for this ESU fell in the "likely to become endangered" category, with small minorities falling in the "danger of extinction" and "not likely to become endangered" categories. The BRT did not identify any extreme risks for this ESU but found moderate risks in all the VSP categories, ranging from moderately low risk for spatial structure to moderate risk for growth rate/productivity. The continuing depressed status of B-run populations was a particular concern. Paucity of information on adult spawning escapements to specific tributary production areas makes a quantitative assessment of viability for this ESU difficult. As indicated in previous status reviews, the BRT remained concerned about the replacement of naturally-produced fish by hatchery fish in this ESU; naturally produced fish now make up only a small fraction of the total adult run. Again, lack of key information considerably complicates the risk analysis. Although several large production hatcheries for steelhead occur throughout this ESU, relatively few data exist regarding the numbers and relative distribution of hatchery fish that spawn naturally, or the consequences of such spawnings when they do occur.

Status of Critical Habitat. The NMFS reviews the status of critical habitat affected by the proposed action by examining the condition and trends of primary constituent elements (PCEs) throughout the designated area. As summarized in Table 4, PCEs consist of the physical and biological features identified as essential to the conservation of the species in the documents identifying critical habitat. The ESUs using each PCE site and associated features likely to be affected by the proposed action are also listed in Table 4. The condition and trend of PCE sites and associated features within the action area vary by ESU, but national forest lands contribute important features key to the survival of all ESUs covered by this Opinion.

Table 4. Types of sites and essential physical and biological features designated as PCEs, life stages each PCE supports, and ESUs likely to be affected by the proposed action.

Site	Essential Physical and Biological Features	ESU Life Stage	ESUs
Freshwater spawning	Water quality, water quantity, and substrate	Spawning, incubation, and larval development	UCR Spring Chinook, Puget Sound Chinook, LCR Chinook, UWR Chinook, OC coho, Hood Canal Summer-run Chum, Columbia River Chum, UCR Steelhead, MCR Steelhead, LCR Steelhead, UWR Steelhead, SONC coho
Freshwater rearing	Water quantity and floodplain connectivity	Juvenile growth and mobility	UCR Spring Chinook, Puget Sound Chinook, LCR Chinook, UWR Chinook, OC coho, Hood Canal Summer-run Chum, Columbia River Chum, UCR Steelhead, MCR Steelhead, LCR Steelhead, UWR Steelhead, SONC coho
	Water quality and forage	Juvenile development	
	Natural cover[a]	Juvenile mobility and survival	
Freshwater migration	Free of artificial obstructions, water quality and quantity, and natural cover [a]	Juvenile and adult mobility and survival	SR Spring/Summer Chinook, SR Fall Chinook, SR Sockeye, SR Steelhead, UCR Spring Chinook, Puget Sound Chinook, LCR Chinook, UWR Chinook, OC coho, Hood Canal Summer-run Chum, Columbia River Chum, UCR Steelhead, MCR Steelhead, LCR Steelhead, UWR Steelhead, SONC coho
Estuarine areas	Free of obstruction, water quality and quantity, and salinity	Juvenile and adult physiological transitions between salt and freshwater	Puget Sound Chinook, OC coho
	Natural cover,[a] forage,[b] and water quantity	Growth and maturation	

[a] Natural cover includes shade, large wood, log jams, beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
[b] Forage includes aquatic invertebrate and fish species that support growth and maturation.

The highest quality, most productive habitat in most coho, chum, and Chinook ESUs was originally present in lower elevation stream reaches outside of national forest boundaries. In many ESUs, the physical, chemical, and biological features that supported the high productivity of these stream reaches have been lost to agricultural and urban development, and other long-term impacts (NRC 1996). In many coho and Chinook ESUs, stream reaches on national forest lands often now contain the highest quality habitat remaining. In addition, many steelhead ESUs extensively use national forest lands for spawning, rearing, and migration.

Environmental Baseline

The 'environmental baseline' includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

The NMFS describes the environmental baseline in terms of the biological requirements for habitat features and processes necessary to support all life stages of the subject ESUs within the action area. When the environmental baseline departs from those biological requirements, the adverse effects of a proposed action on the ESU or its habitat are more likely to jeopardize the listed species or result in destruction or adverse modification of a critical habitat.

The biological requirements of salmon and steelhead in the action area vary depending on the life history stage present, and the natural range of variation present within that system (Groot and Margolis 1991; NRC 1996; Spence *et al.* 1996). Generally, during spawning migrations, adult salmon require clean water with cool temperatures and access to thermal refugia, dissolved oxygen near 100% saturation, low turbidity, adequate flows and depths to allow passage over barriers to reach spawning sites, and sufficient holding and resting sites. Anadromous fish select spawning areas based on species-specific requirements of flow, water quality, substrate size, and groundwater upwelling. Embryo survival and fry emergence depend on substrate conditions (*e.g.,* gravel size, porosity, permeability, oxygen concentrations), substrate stability during high flows, and, for most species, water temperatures of 13°C or less. Habitat requirements for juvenile rearing include seasonally suitable microhabitats for holding, feeding, and resting. Migration of juveniles to rearing areas, whether the ocean, lakes, or other stream reaches, requires access to these habitats. Physical, chemical, and thermal conditions all may impede movements of adult or juvenile fish.

Each ESU considered in this Opinion resides in or migrates through the action area. Thus, for this action area, the biological requirements for salmon and steelhead are the habitat characteristics that support: (1) Successful freshwater spawning; (2) freshwater rearing; (3) estuarine rearing; and (4) successful juvenile and adult migrations. Water quality, natural cover, substrate, and forage are the habitat features most likely to be affected by the proposed action, and are the focus of the effects analysis.

The quality and quantity of fresh water habitat in much of Oregon and Washington has declined dramatically in the last 150 years. Forestry, farming, grazing, road construction, hydropower system development, mining, and housing/urban development have radically changed the historical habitat conditions within the Pacific Northwest.

Land management activities that have degraded habitat of anadromous salmonids include water withdrawals, unscreened water diversions, hydropower development, road construction, timber harvest, stream cleaning of large wood, splash dams, mining, farming, livestock grazing, outdoor recreation, and urbanization (FEMAT 1993; Lee *et al.* 1997; NRC 1996; Spence *et al.* 1996). In many river basins within the range of listed salmon and steelhead, land management activities have: (1) Reduced connectivity (*i.e.,* the flow of energy, organisms, and materials) between streams, riparian areas, floodplains, and uplands; (2) elevated fine sediment yields, filling pools and reducing spawning and rearing habitat; (3) reduced instream and riparian large woody debris that traps sediment, stabilizes streambanks, and helps form pools; (4) reduced or eliminated vegetative canopy that minimizes temperature fluctuations; (5) caused streams to become straighter, wider, and shallower, which has the tendency to reduce spawning and rearing habitat and increase temperature fluctuations; (6) altered peak flow volume and timing, leading to channel changes and potentially altering fish migration behavior; (7) altered floodplain function, water tables and base flows, resulting in riparian wetland and stream dewatering; and (8) degraded water quality by adding heat, nutrients and toxicants (FEMAT 1993; Henjum 1994; Lee *et al.* 1997; McIntosh *et al.* 1994; NRC 1996; Rhodes *et al.* 1994; Spence *et al.* 1996).

As a result of these land development patterns, national forest lands now contain much of the highest quality salmon and steelhead habitat remaining in Oregon and Washington. National forest lands are generally forested and situated in upstream portions of watersheds. While there has been substantial habitat degradation across all land ownerships, including national forest, habitat in many headwater stream segments is generally in better condition than in the largely non-Federal lower portions of tributaries (Doppelt *et al.* 1993; Frissell 1993; Henjum 1994; Lee *et al.* 1997). However, the environmental baseline on national forests varies widely throughout the analysis area. National forest management activities such as timber harvest, road construction, livestock grazing, mining, and public recreation have degraded riparian areas.

Extensive data was collected on invasive plants in the Pacific Northwest by the Forest Inventory and Analysis (FIA) Program of the Pacific Northwest Research Station (USDA-FS 2005). A pilot study found that nonnative plant species have become a significant component of forests across Oregon. The presence of invasive plants was confirmed in 70% of forested plots across Oregon. With results varying by forest ecotype, occurence of nonnative plants were highest in the Willamette Valley, and the Blue Mountains. Comparable data for Washington is scheduled for release late 2005.

Water Quality. Water quality problems are caused by a variety of activities such as urban development, forestry, farming, livestock grazing, riparian/channel alteration, road systems, and dams and other types of water management. More than 2,500 streams, river segments, and lakes in the Northwest do not meet Federally-approved, state, and/or tribal water quality standards and are now listed as water-quality-limited under Section 303(d) of the Clean Water Act. Most of the waterbodies in Oregon and Washington that are on the 303(d) list do not meet water quality standards for temperature.

Invasive plants can create or exacerbate conditions that reduce water quality. Directly or indirectly, invasive plants can affect streambank stability, sediment, turbidity, shade and stream temperature, dissolved oxygen, and pH. Once water quality is degraded, invasive plants can complicate or prevent water quality restoration. Invasive plants can also reduce water quantity. For instance, tamarisk (*Tamarix spp.*) and giant reed (*Arundo donax*) can alter stream form and use more water than native streamside plants, which can reduce, or even eliminate, the availability of surface water.

Every national forest within the Region Six has waterbodies that are water quality limited, though not all limiting parameters are related to invasive plants. On national forests in Oregon and Washington, the most common water quality limiting parameter is elevated summer stream temperatures. Invasive plants affect fish habitat parameters, such as; sedimentation, turbidity, dissolved oxygen, and biological criteria (quantities and diversity of aquatic invertebrate species).

Natural Cover and Substrate. Instream habitat in national forests has been simplified by riparian timber harvest, the removal of large woody debris, road construction, cattle grazing, and dredge mining. The type and degree of habitat alteration varies by location. For example, old coniferous forests now comprise approximately 20% of the riparian forests in the Cascades, but only 3% in the Coast Range. On national forest lands in both the Cascade and Coastal mountain ranges, timber harvest and road construction typically caused the greatest changes to instream habitat. Some mining and grazing impacts also occurred, but are generally minor by comparison. As a result, Cascade and coastal range stream systems frequently have fewer and lower quality pools, reduced hiding cover spawning gravels, gravel quality, and retention of organic materials.

On national forest lands in eastern Oregon and Washington, the climate, geology, topography, vegetation, and other local factors differ considerably from the Cascade and coastal ranges. National forest lands in eastern Oregon and Washington contain a more diverse mix of headwater mountain streams and channels flowing across wide valley bottoms. While large woody debris played a key role in habitat forming processes in mountain streams, meandering channel hydraulics formed gravel bars and pools in the wider valley bottoms. Thus, not only do the management activities on east-side national forests that affect instream habitat differ from the west side, the mix of habitat and habitat forming processes also differs. Effects of timber harvest and road construction are concentrated in mountainous headwater areas, with some effects extending downstream to lower elevation areas. Effects of dredge mining occur primarily in mid-elevation channel mainstems, often with devastating effects to habitat. The effects of cattle grazing were more wide spread, affecting habitat at nearly all elevations, but the most severe impacts were often in valley bottom channels. Grazing in stream channels wider and shallower, with fewer undercut banks, increased fine sediments, and altered trophic structure. This translates to east-side national forest habitat with fewer and lower quality pools, reduced hiding cover, reduced spawning gravels and gravel quality, and a more autochthonous based trophic structure.

In Region Six, inventoried weed-infested acres range from 0 to 47.5% within any single subbasin (Robbins 2003). Approximately 36,000 inventoried acres containing invasive plants are within 300 feet of water, representing 1.2% of land in the Region within 300 feet of water. However, inventories are incomplete in many subbasins and the inventories may have missed many small streams, so these numbers are approximate.

Invasive plants are adapted to riparian habitat and once established can quickly dominate the landscape. Invasive plants such as purple loosestrife can replace or suppress native vegetation in wetlands (Duncan 1997; Mullin *et al.* 2000). Purple loosestrife crowds out native plants such as cattails and bulrush, provides neither food nor shelter for most wetland wildlife, and occludes channels, increasing sediment deposition and decreasing channel capacity (Donaldson 1997). The rapid growth of many invasive plants allows them to out-compete native vegetation. This competitive advantage reduces rooting strength and protection against erosion, decreases slope stability, increases sediment loading to streams, and degrades water quality (Donaldson 1997).

Forage. Riparian timber harvest in coastal, Cascade, and east-side national forests resulted in a shift to food chains based more on photosynthesis and less on detritus (autochthonus). In east-side national forests, grazing also played a dominant role in the shift to more autochthonous based systems. Although these changes in food supply are not necessarily detrimental to salmonid fishes, they do represent fundamental changes to ecosystem function.

Effects of the Action

'Effects of the action' means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). If the proposed action includes off-site measures to reduce net adverse effects by improving habitat conditions and survival, NMFS will evaluate the net combined effects of the proposed action and the off-site measures as interrelated actions.

'Interrelated actions' are those that are part of a larger action and depend on the larger action for their justification; 'interdependent actions' are those that have no independent utility apart from the action under consideration (50 CFR 402.02). Future Federal actions that are not a direct effect of the action under consideration, and not included in the environmental baseline or treated as indirect effects, are not considered in this Opinion.

'Indirect effects' are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 CFR 402.02). Indirect effects may occur outside the area directly affected by the action, and may include other Federal actions that have not undergone Section 7 consultation but will result from the action under consideration.

The analysis contained in this Opinion is based on the assumption that the PACFISH and NWFP aquatic conservation strategies remain in place with at least the same level of aquatic ecosystem protections.

Potential Effects of Proposed Action Components. Implementation of the proposed action is likely to result in invasive plant prevention and treatment projects interrelated to the proposed action that may have beneficial or adverse affects on listed fish. Ultimately, the proposed action is likely to benefit aquatic species by restoring native vegetation and thereby restoring ecosystem and riparian function, and may have other beneficial effects as well. Consequently, most potential adverse effects are likely to be short-term and offset by long-term benefits to riparian function, surface erosion, and possibly other habitat features.

Table 5 displays specific elements of the five components of the proposed action described in the Introduction section of this Opinion, and the general potential effects of these elements. Some components of the proposed action allow the use of invasive plant prevention and control methods, and other components are designed to mitigate effects to and/or protect human health, ecosystems, and listed fish. The paragraphs below detail how the goals, objectives, and standards in Table 5 are linked to effects pathways that are expressed through treatment methods and other future projects. Effects of treatment methods are described in the "General Effects of the Proposed Action" section.

Benefits to ESA-listed fish from invasive plant control are also likely to occur. For example, invasive plants that exclude trees decrease shade, increase bank erosion, and reduce large woody debris sources. In riparian areas infested by Japanese knotweed, knotweed infestations tend to become monocultures and exclude native vegetation, organic matter input from native vegetation is reduced, and surface erosion is increased. If Japanese knotweed excludes trees, important riparian functions are affected locally and effects may persist for decades, until trees and other native vegetation can be reestablished. Thus, efforts to control invasive plants are expected to provide long-term benefits to listed fish in at least some circumstances.

Table 5. Components of the proposed action that may affect ESA-listed fish

	Sub-component	Effect
Desired Future Condition	- - -	None
Goals	Goal 1 Protect ecosystems from the impacts of invasive plants through an integrated approach that emphasizes prevention, early detection, and early treatment. All employees and users of the national forest recognize that they play an important role in preventing and detecting invasive plants.	Likely adverse effects from the use of invasive plant control tools.
	Goal 2 Minimize the creation of conditions that favor invasive plant introduction, establishment and spread during land management actions and land use activities. Continually review and adjust land management practices to help reduce the creation of conditions that favor invasive plant communities.	Likely beneficial effects from future reductions in disturbed ground.
	Goal 5 Expand collaborative efforts between the Forest Service, our partners, and the public to share learning experiences regarding the prevention and control of invasive plants, and the protection and restoration of native plant communities.	Potential for beneficial or adverse effects, depending on how projects are re-designed. Low potential for effects.
Objectives	Objective 1.1 Implement appropriate invasive plant prevention practices to help reduce the introduction, establishment and spread of invasive plants associated with management actions and land use activities.	Likely adverse effects from use of control tools and beneficial effects from reduced disturbed ground.
	Objective 1.4 Use an integrated approach to treating areas infested with invasive plants. Use a combination of available tools including manual, cultural, mechanical, herbicides, biological control.	Likely adverse effects from use of control tools
	Objective 1.5 Control new invasive plant infestations promptly, suppress or contain expansion of infestations where control is not practical, conduct follow up inspection of treated sites to prevent reestablishment.	Likely adverse effects from use of control tools
	Objective 2.1 Reduce soil disturbance while achieving project objectives through timber harvest, fuel treatments, and other activities that potentially produce large amounts of bare ground.	Likely beneficial effect from reduced erosion
	Objective 2.3 Reduce the introduction, establishment and spread of invasive plants during fire suppression and fire rehabilitation activities by minimizing the conditions that promote invasive plant germination and establishment.	Likely beneficial effect from reduced erosion
	Objective 2.4 Incorporate invasive plant prevention as an important consideration in all recreational land use and access decisions.	Likely beneficial effect from reduced erosion
	Objective 2.5 Place greater emphasis on managing previously "unmanaged recreation" (OHVs, dispersed recreation, etc.) to help reduce creation of soil conditions that favor invasive plants, and reduce transport of invasive plant seeds and propagules.	Likely beneficial effect from reduced erosion
	Objective 5.1 Use an adaptive management approach to invasive plant management that	Potential adverse or beneficial

	Sub-component	Effect
	emphasizes monitoring, learning, and adjusting management techniques. Evaluate treatment effectiveness and adjust future treatment actions based on the results of these evaluations.	effect
Standards	Standard 1 Prevention of invasive plant introduction, establishment and spread will be addressed in watershed analysis; roads analysis; fire and fuels management plans, Burned Area Emergency Recovery Plans; emergency wildfire situation analysis; wildland fire implementation plans; grazing allotment management plans, recreation management plans, vegetation management plans, and other land management assessments.	Potential adverse or beneficial effect
	Standard 6 Through annual operating instructions, and the revision of grazing allotment management plans, incorporate invasive plant prevention practices that reduce the spread of invasive plants. Plan and implement practices in cooperation with the grazing permit holder.	Likely beneficial effect from reduced erosion
	Standard 7 Inspect active gravel, fill, sand stockpiles, quarry sites, and borrow material for invasive plants before use and transport. Treat or require treatment of infested sources before any use of pit material. Use only gravel, fill, sand, and rock that is judged to be weed free by district or forest weed specialists.	Potential adverse effects from herbicides or fine sediment
	Standard 16 Select from herbicide formulations containing one or more of the following 10 active ingredients: chlorsulfuron, clopyralid, glyphosate, imazapic, imazapyr, metsulfuron methyl, picloram, sethoxydim, sulfometuron methyl, and triclopyr. Mixtures of herbicide formulations containing 3 or less of these active ingredients may be applied where the sum of all individual Hazard Quotients for the relevant application scenarios is less than 1.0. Chlorsulfuron, metsulfuron methyl, and sulfometuron methyl will not be applied aerially. The use of triclopyr is limited to selective application techniques only (e.g., spot spraying, wiping, basal bark, cut stump, injection).	Likely adverse effects from herbicides
	Standard 18 Use only adjuvants (e.g. surfactants, dyes) and inert ingredients reviewed in USFS hazard and risk assessment documents such as SERA, 1997a, 1997b; Bakke, 2002).	Potential adverse effects from additives (surfactants, etc.) to herbicides
Inventory and Monitoring Framework	- - -	None

Goal 1 and supporting objectives 1.1, 1.4, and 1.5 provide direction regarding the use of invasive plant treatment tools described in the proposed action to achieve the desired future condition. The potential effects of invasive plant control tools to listed fish are summarized in Table 7, and discussed in the associated section. As described in the following “General Effects of the Proposed Action” section, invasive plant treatment tools are likely to result in a variety of adverse effects to listed fish.

Goal 2 and supporting objectives 2.1, 2.3, 2.4, and 2.5 provide direction on how to minimize the conditions that favor invasive plant introduction, establishment, and spread. This direction is likely to provide benefits to listed fish by reducing sediment input associated with future management projects (timber harvest, road construction, vehicle access management, and fire suppression). Goal 5 and supporting objective 5.1 provide direction regarding USFS collaboration with their partners and the public on using an adaptive management approach to evaluate the effectiveness of treatment methods, and adjust future treatment methods based on those evaluations. Adjustments to the techniques used in employing the invasive plant treatment tools described in the proposed action may result in beneficial, adverse, or no effects to listed fish, depending on what adjustments are made.

Standard 1 provides direction to address invasive plant introduction, establishment, and spread in a variety of future land management projects. Depending on how these factors are addressed in future projects, the habitat of listed fish may be beneficially or adversely affected.

The direction provided in Standard 6 is intended to reduce the spread of invasive plants by adjusting livestock grazing practices in USFS allotments. One of the ways of adjusting grazing allotment practices to reduce invasive plant spread is reducing the amount of grazing-induced ground disturbance. Reducing grazing disturbance as a means of implementing Standard 6 may benefit the habitat of listed fish by reducing sediment input to streams and increasing bank stability.

Standards 7 and 18 provide direction that may adversely affect the habitat of listed fish when implemented. Standard 7 provides direction requiring the inspection and treatment of gravel pits before gravel use. Treatment of gravel pits in riparian areas or locations hydrologically connected to streams used by listed fish may deliver fine sediment or chemicals associated with herbicide application to streams. Standard 18 provides direction on the use of adjuvants and inert ingredients, and requires that they be reviewed in a USFS hazard and risk assessment before use. Standard 18 does not provide direction regarding acceptable levels of environmental risk, but, Standards 19 and 20 provide mitigation that will minimize this risk.

Standard 16 provides direction regarding the use of 10 herbicides to treat invasive plants. The BA concluded that some of the application scenarios analyzed are likely to result in adverse effects to listed fish, and that the likelihood of adverse effects will vary with project location and design. The use of 10 herbicides is allowed, including mixtures of formulations containing up to three active ingredients (providing the cumulative hazard quotient calculated is <1.0). Some restrictions on application methods apply to four of the herbicides. Triclopyr application is limited to selective application techniques only (no boom or aerial spraying). Chlorsulfuron, metsulfuron methyl, and sulfometuron methyl will not be applied aerially.

As documented in the BA analysis file, the proposed herbicide active ingredients are generally either slightly toxic or practically non-toxic to listed fish, with triclopyr and picloram being exceptions (triclopyr is moderately toxic and picloram is moderate to highly toxic). The toxicity of formulated products may be higher, depending on additives used. The risks and direct and indirect effects of herbicide delivery to streams on listed fish from a hypothetical application scenario were extensively analyzed in the BA. However, actual risks to listed fish will depend on the physical characteristics of the application site, proximity to conduits to streams used by listed fish, local weather patterns, application timing, application intensity, number of acres treated, and other factors. However, the BA analysis did clearly identify which herbicides were of higher risk to listed fish, and the nature of that risk. A summary of herbicide effect pathways is displayed in Table 6, as modified from the BA by analysis for this Opinion.

Table 6. Pathways of effects to ESA-listed fish from treatment methods

	Pathways of Effects							
Treatment Methods	**Disturbance***	**Chemical toxicity**	**Dissolved oxygen and nutrients**	**Water temperature**	**Fine sediment and turbidity**	**Instream habitat structure**	**Forage**	**Riparian and emergent vegetation**
Manual	X						X	X
Mechanical	X		X	X	X	X	X	X
Biological					X			
Cultural – fertilization & soil amendment, planting, grazing	X	X	X	X	X		X	X
Herbicides		X	X	X	X	X	X	X
Prescribed Fire			X	X	X		X	X

*stepping on redds, displacing, interrupting feeding, disturbing banks

The following objectives and standards are designed to mitigate adverse effects to aquatic species, including ESA-listed fish. Objective 4.1 directs that water quality be maintained while implementing invasive plant treatments. Objective 4.2 directs that herbicide application within riparian zones be consistent with PACFISH, INFISH, and the NWFP Aquatic Conservation Strategy. The BA and FEIS state in several places that the direction in the proposed action is not intended to supercede or take precedence over the riparian and aquatic protective measures contained in PACFISH, INFISH, and the NWFP Aquatic Conservation Strategy. Objective 4.3 specifically directs that treatment projects be designed to protect threatened and endangered species, and to maintain species viability. Objective 2.1 directs that projects such as timber sales, fuel treatments, and others be designed to reduce soil disturbance. Objective 3.2 directs that a reduction in reliance on herbicides as an invasive plant control tool occur over time.

Standards 19 and 20 direct that effects to water quality and aquatic biota, and species and critical habitats for proposed and/or listed fish, respectively, be minimized or eliminated. Standards 19 and 20 provide direction on mitigating effects to non-target species and listed species and critical habitats.

General Effects of the Proposed Action – Pathways of Effects. The proposed action does not authorize site-specific invasive plant treatment projects. Therefore, the magnitude, extent, and duration of the effects described in this section will vary depending on the specific invasive plant control strategy the USFS adopts. The timing of invasive plant control projects can also influence which life stages of listed fish are affected, and significantly alter risk to the species. For example, exposure to effects occurring during fry emergence may have a far greater impact on survival of listed species than the same effects occurring during juvenile rearing. Consultation will be required on future site-specific invasive plant treatment projects that may affect listed salmon and steelhead, allowing NMFS to assess how individual future invasive plant treatment projects affect listed species.

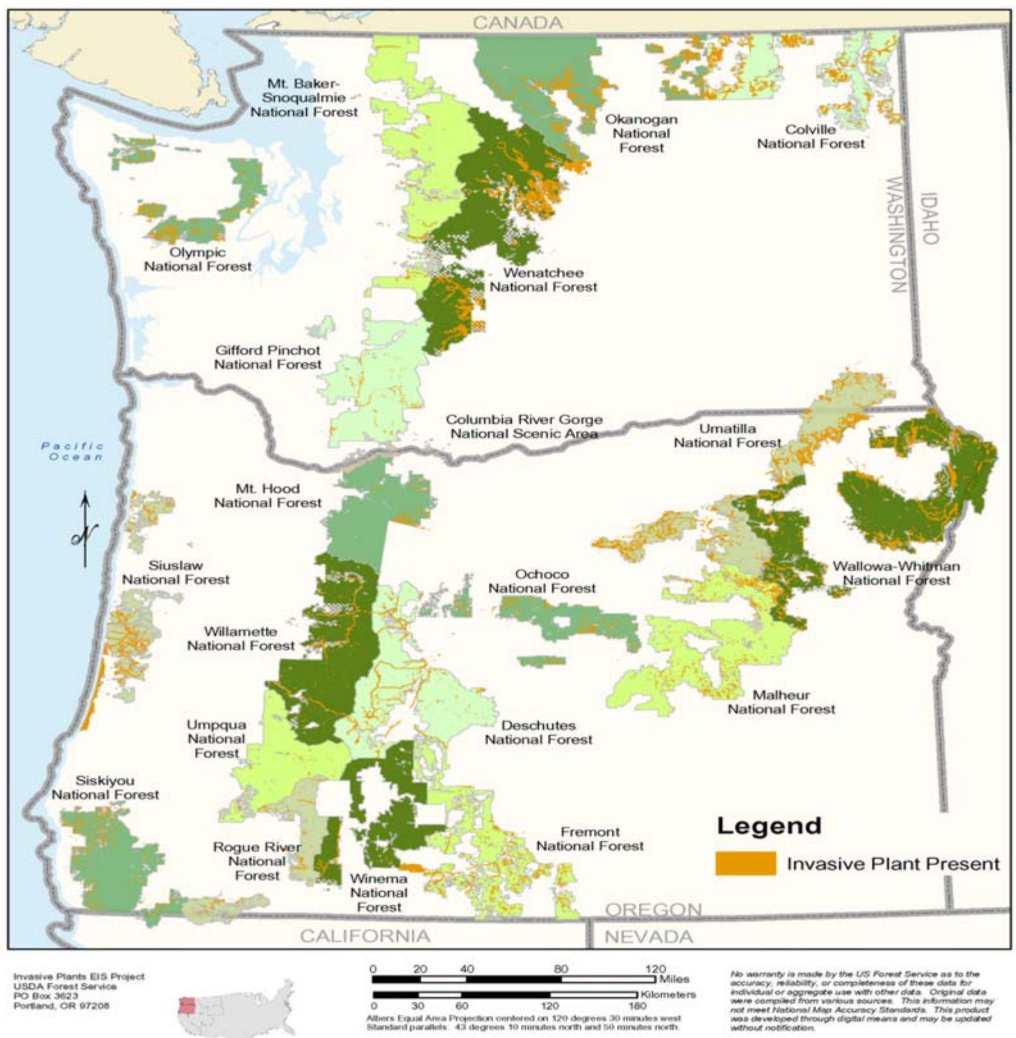
Figure 1 shows the USFS invasive plant inventory as of April, 2003. Due to an incomplete inventory in 2003 and subsequent spread of invasive plants, this inventory does not show the full extent of currently infested national forest lands, but accurately displays the areas with the highest levels of infestation. As stated in the FEIS, approximately 420,000 acres (approximately 1.7%) of national forest lands in Region Six were believed to be infested at the time the FEIS was published.

The effects to listed fish depend on spatial and temporal patterns of treatments. If specific, heavily-infested areas, such as the Wenatchee National Forest, Siuslaw National Forest, or Blue Mountains area of Oregon become a focus for invasive plant control, the risk to listed fish from adverse effects will be quite different than if treatments are spread more evenly across infested areas. The anticipated treatment level of approximately 30,000 acres per year across Region Six would have a higher potential for significant concerns if treatments were concentrated in high infestation areas that coincided with key or higher risk populations within a given ESU. The concentration of projects could be of particular concern if treatment areas were concentrated along stream corridors and roadside ditches (which are invasive plant dispersal corridors, and appear to represent much of the 2003 inventory). The risks to individuals and populations of listed species may be increased in areas with large, intensive projects. The response of both individuals and populations of listed fish to simultaneous effects on different essential habitat features may result in synergistic or currently unanticipated effects.

Most of the prevention and treatment methods supported by the proposed action are not new to national forests in Region Six. These include manual, mechanical, biological, cultural, prescribed fire, and herbicide treatments of invasive plant species, as well as preventive actions, such as vehicle washing. The proposed action updates the definition of these tools, and also updates the list of herbicides approved for use and associated mitigation. The use of five herbicides – glyphosate, triclopyr, dicamba, picloram and 2,4-D (a tool of last resort) – is allowed under current Regional direction. The use of 2,4-D and dicamba is not allowed under the proposed action because analysis indicated a higher level of concern for human health and wildlife relative to the new herbicides being proposed for use. The use of seven additional herbicides (chlorsulfuron, clopyralid, metsulfuron methyl, sulfometuron methyl, imazapic, imazapyr, and sethoxydim) is allowed under the proposed action. Chlorsulfuron, metsulfuron methyl, and sulfometuron methyl will not be applied aerially due to concerns over toxicity to non-target plants. Due to human health and wildlife concerns, triclopyr use will be limited to selective application techniques. Clopyralid, glyphosate, imazapyr, imazapic, picloram, and sethoxydim can be applied using all methods, including aerial. In summary, the proposed action is a refinement of the existing direction (the No Action alternative) regarding the treatment of invasive plants, and combined with mitigation and limitations in the proposed action, provides an improvement over baseline treatment methods. However, as concluded in the BA, even though the treatment tools and associated mitigation methods are improved, due to the location, size, and design of treatment projects needed to control some invasive plant infestations, adverse effects to listed fish are likely.

Figure 1.

Figure 1 Invasive Plants Inventory, April 2003



ESA-listed and proposed fish and their critical habitat are likely to be affected by different invasive plant treatment methods through the pathways displayed in Table 6, and discussed in the subsequent narrative:

Disturbance. In some circumstances, manual, mechanical, and cultural (*e.g.* planting) treatments are likely to be conducted by workers standing in the water. This is likely to result in direct adverse effects to listed fish through disturbance of individuals to the point of harassment, stepping on redds or stepping on individuals. The extent and intensity of these effects depend on the species present and life stage, the number of humans or animals in the water, the magnitude of the in-stream disturbance, and the amount of time spent in the water.

Chemical Toxicity. ESA-listed fish and their habitat are likely to be adversely affected during some riparian and roadside herbicide applications, or if an accidental direct application of an herbicide to surface water through overspray or drift occurs. In addition to active ingredients in formulations, inert ingredients, adjuvants, metabolites, and impurities could also affect listed fish. The mere presence of an herbicide may not result in effects to aquatic species; the risk of effects is a function of concentration, duration of exposure, species presence and life stage, and toxicity of the herbicide and associated compounds.

Herbicides and fertilizers (along with inert ingredients, adjuvants, metabolites, and impurities) indirectly enter surface water through a variety of routes. Plants treated with herbicides may release chemicals into the soil via roots or from rinsing during rainfall. Treated plant biomass containing slowly-decaying herbicides can become incorporated with soil organic matter, or overspray onto soil can contaminate soil. Fertilizers, herbicides, and formulation additives move from soil into surface water through leaching or soil erosion from wind or water.

The sub-lethal effects of chemicals can include changes in behaviors or body functions that are not directly lethal to listed species, but could affect reproduction, juvenile to adult survival, or other life history events. Indirect sub-lethal effects to listed fish may be mediated by effects to habitat or food supply. Herbicides are designed to kill plants, and have the potential to disrupt aquatic food webs by affecting instream primary productivity and cover provided by aquatic macrophytes.

Cultural (fertilization or soil amendments) and herbicide treatment methods indirectly introduce chemicals to surface water. Chemical concentrations, duration of exposure, and sensitivity of the species to the chemical (which can vary with life stage) affect the level of toxicity to listed fish. Chemical characteristics such as decay rate and strength of sorption to soil particles affect the concentration of the chemical in water. Environmental factors such as soil particle size, amount of organic matter in the soil, moisture level, and temperature affect decay rate, which in turn affects chemical concentrations in water.

Dissolved Oxygen (DO) and Nutrients. Mechanical, cultural, herbicide, and prescribed fire are treatment methods most likely to increase nutrient delivery and affect concentrations of DO. Fertilizer application, particularly in riparian areas, can have as large or a greater potential for nutrient delivery than prescribed fire. Manual and biological treatments are generally not confined to riparian areas, and typically do not destroy portions of the total riparian vegetation or cause a sudden influx of nutrients to surface water. The use of grazing animals (goats and sheep) may result in localized, short-term increases in nutrient input, but these increases are likely to be smaller than those resulting from fertilizer or prescribed fire.

The BA predicted that some herbicides are likely to be delivered to surface water in concentrations that harm phytoplankton, algae, rooted aquatic macrophytes, and other aquatic plants. A significant reduction of primary productivity or aquatic plants and algae could decrease DO concentrations.

An influx of nutrients can cause algal blooms, which in turn can decrease the amount of oxygen dissolved in water. Runoff from areas treated by prescribed fire, grazing animals, or treated with fertilizer could increase nutrient delivery to surface water. Algal blooms can result in photosynthesis-driven high diurnal DO levels (including supersaturation), and low nocturnal DO levels due to high algal respiration (Anderson and Carpenter 1998). In addition, algal decay following significant die-offs can also reduce DO levels.

Riparian and Emergent Vegetation. Riparian vegetation is likely to be affected by invasive plant treatments using manual, mechanical, cultural, herbicide, or prescribed fire techniques. Because of their proximity and connections to streams, ecological conditions and processes in riparian areas strongly influence aquatic habitats. Riparian areas provide: Shade that mediates water temperature; cover for fish hiding, resting, and feeding; structural elements of stream channels; and substrate materials. Riparian vegetation supplies and processes nutrients; supports food webs; stabilizes streambanks; dissipates stream energy; filters and traps upland and flood-transported sediments; captures marine-derived nutrients from salmonid carcasses; and hydrologically links side channels, floodplains, and groundwater (FEMAT 1993, Spence *et al.* 1996).

Invasive plant treatment in riparian areas is intended to improve the function of riparian areas by restoring native ecosystem components. Loss or reduction in the coverage and density of target and non-target riparian vegetation due to treatment of invasive plants is likely, and the length of time before suitable vegetation returns to perform riparian functions will vary considerably across Region Six. In general, improved riparian function due to invasive plant treatment will benefit listed fish by restoring inputs of native detritus to stream systems and reducing erosion, though there are likely to be localized, short-term adverse effects to habitat.

Emergent aquatic vegetation is likely to be adversely affected or killed by some herbicide applications, reducing hiding cover for listed fish. Mechanical treatment has the potential to disturb banks and introduce sediment to streams, primarily affecting spawning gravels. Manual, biological, and cultural treatment methods do not affect large trees that provide large woody debris for instream habitat structure.

Water Temperature. Mechanical and herbicidal treatments of some invasive plant species (such as knotweed) in riparian areas are likely to decrease shading of streams by vegetation and, in certain areas, increase the amount of incident solar radiation reaching the stream, increasing water temperatures. The loss of shade will persist until native vegetation reaches and surpasses the height of the invasive plants that were removed. This loss of shade will persist for one to several years, depending on the success of invasive plant treatment, stream size and location, topography, growing conditions for the replacement plants, and the density and height of the invasive plants when treated.

Cultural and prescribed fire treatments may affect water temperatures through effects to riparian vegetation, but the likelihood is lower than for mechanical and herbicide treatments due to much more limited use of cultural and fire as treatment tools.

Fine Sediment and Turbidity. Mechanical, cultural, and prescribed fire are treatment methods that disturb ground in riparian areas, increasing the delivery of fine sediment to surface waters. The significance of an increase in fine sediment depends on the amount of fine sediment introduced and local stream characteristics. Increased turbidity reduces feeding ability or gill function in some fish species. Persistence of increased turbidity depends on the size of the suspended particle and velocity of the water. Fine sediment fills the interstitial spaces of redds, reducing survival of eggs and fry and reducing space available for rearing juvenile fish. The intensity of adverse effects to listed fish will vary with the proximity of the species and their habitat to the treatment area, sensitivity of the listed species to turbidity and fine sediment, and extent and magnitude of the treatment.

Biological and herbicide treatments do not kill invasive species immediately. As treated vegetation dies and loses root strength, soil can be moved into surface water through water movement or wind. However, a substantial amount of vegetation die-off beside a stream would be necessary to significantly increase sediment delivery and turbidity.

Biological controls typically work slowly over a period of years, and only on specific target species, so biological controls are not likely to increase fine sediment and turbidity. Some applications of non-selective herbicides (for example, the broadcast glyphosate application modeled in the BA) in riparian areas or areas hydrologically connected to streams are likely to result in increased fine sediment delivery and increased turbidity. Many herbicides are selective, acting only on specific groups of plants and leaving non-target species on the treatment site. Selective herbicides are less likely to influence sediment delivery or turbidity.

Instream Habitat. Instream habitat is likely to be affected by mechanical and herbicide treatments. Mechanical treatments will affect instream habitat if mowers or brush cutting machinery operate in riparian areas and cause erosion or damage streambanks. Bank damage can result in loss of undercut banks (hiding cover), increased width/depth ratio, and sediment delivery. The effects of sediment delivery are discussed above. As previously discussed, herbicide treatments can potentially kill or damage aquatic macrophytes that provide cover for juvenile listed fish.

Forage. Manual, mechanical, cultural, herbicides, and prescribed fire methods in riparian areas are likely to affect food sources for listed fish. The significance of this effect is related to the intensity, frequency, and extent of invasive plant treatment in riparian areas.

Inputs of plant matter and insects from streamside vegetation are important sources of nutrients and energy in some aquatic systems, particularly small, heavily vegetated headwater streams.

Changes in the composition of riparian vegetation due to invasive plant treatment could potentially cause short-term changes in the availability and composition of these food sources. However, these changes are likely to favor native food sources and ultimately benefit listed fish.

Effects to allochthonous energy/food inputs from riparian areas occur through three pathways. Any invasive plant treatment in riparian areas could reduce primary production that provides allochthonous energy to the stream in the form of leaf or other vegetative material. The duration of this effect will be limited by restoration of appropriate vegetation, which would provide a new source of vegetative matter. Insects using treated riparian vegetation may be lost because of removal of forage vegetation. The duration of this effect would also be limited by the restoration of appropriate vegetation. Herbicide treatment can be toxic to terrestrial and aquatic insects that are a source of food for listed fish. The magnitude and duration of the effect to riparian insects is a function of the sensitivity of the invertebrate to the herbicide, the herbicide breakdown rate, the extent of the area treated, the toxicity of the herbicide, and the life stages of the invertebrates affected by the herbicide.

As discussed above (under "dissolved oxygen and nutrients"), mechanical and cultural treatment methods can indirectly affect primary production or DO levels in streams. Changes in either or both of these water quality parameters could positively or negatively affect the quantity and diversity of invertebrates within a waterbody. For example, cultural (fertilization or soil amendments) or fire treatment temporarily increase nutrients in surface water, to which the aquatic plant and invertebrate community can respond. The significance of an influx of nutrients varies with the extent of the area treated, size of the waterbody affected, existing nutrient concentrations, and the functional characteristics of the affected aquatic system. Significant inputs of fertilizer or nutrients change the aquatic food supply and can affect listed fish indirectly. However, the input of small quantities of fertilizer or nutrients is most likely to cause a short-term increase in productivity of a system, but not adversely affect listed species.

Herbicides can damage periphyton and other aquatic plants, the sources of autochthonous primary production in surface water. The importance of autochthonous primary production to instream food webs varies significantly among stream systems. The extent of effects to aquatic plants from herbicide exposure is a function of numerous factors, including the extent of the treatment area, proximity of the treatment area to the streams, herbicide half-life and soil affinity, sensitivity of aquatic plants to a specific herbicide, surface water characteristics such as pH, and suspended sediment load of the stream.

Effects on ESA-Listed Species

The applicability of effects pathways of invasive plant control methods, as discussed above, to the life stages of ESA-listed fish are displayed in Table 7. Standard 20 is designed to mitigate effects to ESA-listed species, but, as discussed on page 69, the wording of the standard does not provide a clear description of the intended level of mitigation.

Disturbance occurring during project implementation is likely to affect steelhead, spring/summer Chinook, and coho salmon. These species are the most likely to be present in the smaller streams beside manual, mechanical, cultural, or projects requiring instream activity. Spawning of chum salmon in streams on national forest lands in the action area is likely to be minimal. Human disturbance is likely to damage redds, injure or kill eggs and fry, and displace juveniles or adults. Injury of eggs or fry is likely to result in delayed mortality. The effect of displacing juveniles or adults will vary, depending on degree of disturbance, timing, species, presence of predators, and availability of refuge habitat.

Table 7. Likely effects pathways of invasive plant control tools to species by life stages

	Life stage of ESA-listed Fish				
Species	Spawning	Eggs/Fry	Juvenile Rearing	Juvenile Migration	Adult Migration
Spring/Summer Chinook	1 – 5 , 8	1 – 8	1 – 8	1 – 8	1 – 5, 8
Fall Chinook	1 – 5 , 8	1 – 8	1 – 8	1 – 8	1 – 5, 8
Chum	1, 2, 5	1, 2, 5, 6, 7	1, 2, 5, 6, 7	1, 2, 5, 7	1, 2, 5
Coho	1 – 5 , 8	1 – 8	1 – 8	1 – 8	1 – 5, 8
Sockeye	None	None	None	2, 5, 6, 7	2
Steelhead	1 – 5 , 8	1 – 8	1 – 8	1 – 8	1 – 5, 8

* Effect pathways. 1=Disturbance 2=Chemical toxicity, 3=Dissolved oxygen and nutrients, 4=Water temperature, 5=Turbidity and fine sediment, 6=Instream habitat structure, 7=Forage, 8=Riparian structure.

Water quality changes likely to affect individual fish are increased turbidity, increased water temperature, increased nutrient levels, altered pH and dissolved oxygen level, and the presence of herbicides and associated compounds. Increased turbidity may interfere with spawning, juvenile and adult migrations, fry, and juvenile feeding (Meehan 1991; Redding *et al.* 1987).

Increased water temperatures are likely to occur only when riparian areas heavily infested with knotweed are treated, and most vegetative shade is removed. In these circumstances, temperature increases are unlikely to be extensive due to the difficulty of large-scale treatment and patchy nature of knotweed infestations. Juvenile steelhead, spring/summer Chinook, and coho salmon are the species most likely to be present in areas affected by increased temperatures. Potential effects of increased water temperature include decreased growth, increased disease susceptibility, reduced survival, delayed migration, and increased competition from introduced warm-water fishes (EPA 2001).

Increased nutrient loading can change stream productivity as well as alter pH and DO levels. Overall stream productivity can increase following increased nutrient loads, which can benefit rearing salmonids. However, if the increase in nutrients is sufficiently high, pH and dissolved oxygen levels are affected (Anderson and Carpenter 1998), and result in adverse, though generally non-lethal, effects to salmonids. Adverse effects would most likely consist of temporary behavioral changes and migration out of the area. The species most likely to be affected by water temperature increases and increased nutrient inputs are those associated with smaller streams – steelhead, spring Chinook, and coho salmon.

Herbicides and associated compounds are likely to affect listed fish through several pathways. Lethal or sub-lethal toxicity to listed fish result if concentrations are high. Analysis conducted in the BA indicates that exposures to acute lethal or chronic sub-lethal concentrations as a result of the proposed action are very unlikely, and are generally not plausible. An exception may occur when heavily infested riparian areas, particularly in remote areas with difficult access, require intensive aerial treatment, trading short-term adverse effects to listed fish, which could include mortality, for the long-term ecosystem benefits of invasive plant control. Depending on the aerial application scenario, any of the listed fish and life stages covered in this consultation could be affected. Bioaccumulation rates are low to very low for all herbicides in the proposed action, and bioaccumulation of herbicides is not an issue.

The risk of acute indirect exposure to sub-lethal concentrations of herbicides from ground based application (boom spray) was also analyzed in the BA. Table 8 (page 182) of the BA summarizes the results of the acute sub-lethal exposure analysis. The toxicity benchmark for concern for acute sub-lethal exposure, or "level of concern" (LOC), in the BA was either the estimated or measured "no observable effect concentration" (NOEC), depending on the availability of toxicity data. Sub-lethal effects can include disruption of behavior such as migration, feeding, and predator avoidance (Meehan 1991; Sandahl *et al.* 2004; Scholz *et al.* 2000). Behavioral changes are driven by molecular-level physiological events, such as changes in enzymatic function, ligand-receptor interaction, or oxygen metabolism (Weis *et al.* 2001). Such small or subtle changes in physiological function can have biologically relevant consequences (McEwen and Wingfield 2003), even though they are difficult or impossible to measure.

Since the herbicide application scenarios analyzed in the BA do not incorporate protective measures in aquatic conservation plans applicable to listed salmonids, such as PACFISH and the NWFP Aquatic Conservation Strategy, which the BA and FEIS state are not superceded by the proposed action, indirect exposure risk from the scenario analyzed in the BA is probably overstated. However, Appendix 3 of the BA documents that local environmental factors will significantly influence indirect herbicide delivery, and may result in stream concentrations higher or lower than anticipated from modeling supporting the BA. Consideration of the existing aquatic conservation plans and mitigation direction in the proposed action during project design should result in local protective measures that are adequate to minimize sub-lethal effects to listed species for most projects.

Exposure of listed fish to concentrations of some herbicides above the NOEC level, most notably glyphosate and picloram, is likely to occur due to geographical variation in herbicide delivery to streams, uncertainty in the efficacy of mitigation measures, and the implementation of projects that would trade short-term adverse effects to listed fish for long-term ecosystem benefits. All life stages of steelhead, spring/summer and fall Chinook, coho, and chum salmon could be indirectly exposed to sub-lethal concentrations of herbicides or associated compounds as a result of projects following the proposed direction. The potential also exists for sub-lethal exposure of migrating sockeye salmon juveniles or adults from aerial or other large applications beside the Snake or Columbia Rivers.

The effects of fine sediment and turbidity generated by use of some treatment methods are expected to be localized, but likely to affect spawning gravels, egg incubation, and fry emergence, particularly in smaller streams inhabited by steelhead, spring Chinook, and coho salmon. Compliance with existing aquatic conservation plans and mitigation in the proposed action would minimize effects. Sediment delivery of a magnitude sufficient to cause pool filling and other effects to stream channel morphology is not likely.

Effects to forage of fry and juvenile fish are likely to occur through indirect exposure to herbicides. The BA indicates that following herbicide treatments, primary producers (algae and aquatic macrophytes) rather than invertebrate to prey of fish are the most likely to be adversely affected. Indirect herbicide inputs to streams are likely to occur in pulses associated with rainfall, and recovery of primary producers from the low exposure levels predicted in the BA is likely to occur quickly. If effects to primary producers results in a shortage of food supply, the growth of fry and juvenile listed fish could be affected, or they may migrate out of the area. The species most likely to be affected are those associated with smaller stream systems (steelhead, spring Chinook, and coho salmon) where the probability of herbicide concentrations toxic to primary producers is highest.

Effects on Critical Habitat

Critical habitat within the action area consists of freshwater rearing sites, freshwater spawning sites, freshwater migration corridors, and estuarine areas, along with their essential physical and biological features as listed below. The effects to critical habitat PCEs from the proposed action are a subset of the habitat-related effects already discussed in the Effects of the Action section. The intensity, duration, and extent of effects on critical habitat depends on project-specific considerations, conservation measures, and treatment methodologies as discussed in the previous section.

<u>Freshwater spawning sites</u> (UCR Spring Chinook, Puget Sound Chinook, LCR Chinook, UWR Chinook, OC coho, Hood Canal Summer-run Chum, Columbia River Chum, UCR Steelhead, MCR Steelhead, LCR Steelhead, UWR Steelhead, SONC coho)

Water quantity – No effect.
Water quality – Herbicides are likely to enter surface water through a variety of routes. Concentrations of herbicides in the stream depend on the rate of application, methodology, and the stream's surface to volume ratio. Effects are likely to be short-term, accounting for attenuation and eventual dilution. The reduction of streamside vegetation through chemical, mechanical, and herbicidal treatments is likely to increase the amount of solar radiation reaching the water's surface, increasing temperature. In addition to increased temperature, algal production may be simulated, potentially increasing the food base for invertebrates and fish. Changes in the aquatic vegetative community structure can result in changes in photosynthetic oxygen production and cellular respiration. This is likely to lead to exaggerated diel shifts in oxygen concentration and pH. These effects are likely to be short-term effects until streamside vegetation regrows.
Substrate – Manual, cultural, mechanical, and herbicide treatments are likely to cause alterations in the vegetative structure of riparian areas and are reasonably likely to influence aquatic ecosystems. The loss of rooting systems and vegetative cover is likely to cause streambanks and hillslopes to lose stability and increase erosion and sedimentation rates. Sedimentation is

reasonably likely to reduce fry and egg survival and the quality of rearing habitat in both short and long-term.

Freshwater rearing sites (UCR Spring Chinook, Puget Sound Chinook, LCR Chinook, UWR Chinook, OC coho, Hood Canal Summer-run Chum, Columbia River Chum, UCR Steelhead, MCR Steelhead, LCR Steelhead, UWR Steelhead, SONC coho)

Water quantity – No effect.
Floodplain connectivity – No effect.
Water quality – See above.
Forage – Herbicides leaching into the water are likely to adversely affect primary producers such as phytoplankton, algae, and rooted aquatic macrophytes by interfering with photosynthesis, respiration, growth, and reproduction. Reduced primary productivity is reasonably likely to cause negative changes in the species composition and abundance of terrestrial and aquatic communities that support terrestrial or aquatic insects, the food supply for juvenile salmonids. Sedimentation from increased erosion is also likely to contribute to the reduced diversity and abundance of aquatic insects and other invertebrate prey. These effects can be of long-term duration, as effects to multiple trophic levels can take substantial recovery times.
Natural cover – Use of herbicides in riparian areas are likely to reduce cover and shade from streamside vegetation.

Freshwater migration corridors (SR Spring/Summer Chinook, SR Fall Chinook, SR Sockeye, UCR Spring Chinook, UCR Spring Chinook, Puget Sound Chinook, LCR Chinook, UWR Chinook, OC coho, Hood Canal Summer-run Chum, Columbia River Chum, UCR Steelhead, MCR Steelhead, LCR Steelhead, UWR Steelhead, SONC coho)

Free passage – No effect.
Water quantity – No effect.
Water quality – Salmonids respond to temperature in their upstream migrations. Delays in upstream migration are likely to occur if temperature is too high as a result from reasons stated above. In addition, migrating salmon avoid waters with high silt loads and turbidity.
Natural cover – Use of herbicides in riparian areas are likely to reduce cover and shade from streamside vegetation. The reduction in natural cover correlates with a reduction in predator refugia.

Estuarine areas (Puget Sound Chinook, OC coho)

Free passage – No effect.
Water quality – Same as above.
Water quantity – No effect.
Salinity – No effect.
Natural cover – Same as above.
Juvenile forage – Same as above.
Adult forage – Same as above.

Information presented in the status and baseline sections have shown that infestation by invasive weeds has contributed to a decline of conservation value of critical habitat PCEs for the affected ESUs. With the exception of chemical contamination, most effects on critical habitat result from changes in soil and vegetation characteristics which in turn affect the rate of delivery of water, sediments, nutrients, and other physical parameters such as temperature, dissolved oxygen, and turbidity.

In the short term, the chemical, mechanical, and cultural treatment tools included in the proposed action are likely to adversely affect critical habitat elements for listed fish species through several effects pathways (see above), primarily through herbicide exposure and sediment introduction. In addition to aquatic protections provided in PACFISH and the NWFP, application mitigations developed at the project and sub-Regional level are expected to reduce these impacts. Adverse effects would be of short duration, and the expected beneficial effects of habitat restoration are likely to last longer.

Cumulative Effects

'Cumulative effects' are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Cumulative effects that reduce the capacity of listed ESUs to meet their biological requirements in the action area increase the risk that the effects of the proposed action on the ESU or its habitat can jeopardize listed species (NMFS 1999c).

Land uses and development on lands beside or outside national forest boundaries will likely continue to decrease effectiveness of USFS invasive plant management. For example, the use of invasive plants by landowners for landscaping, while localized, can collectively result in significant impacts, especially along riparian corridors.

Positive cumulative effects could occur as USFS invasive plant control efforts are combined with other efforts of Federal, state, county and private landowners, reducing the rate of spread regionally. The proposed action would complement the efforts of state control programs and community volunteer efforts. For example, the inclusion of English ivy on the state of Oregon noxious weed list has helped to reduce sale of this species in nurseries and prioritized funding for control of this species by the state. Local volunteer efforts to remove the species has not only decreased the extent of the species, but also educated the public on the problems associated with it, which in turn elicits control on the individual level in private backyards.

Between 2000 and 2003, the population of both Oregon and Washington increased by 4.0%. In areas of growing human population, adverse changes to watershed function from land uses such as residential development and water withdrawal are likely to increase. Land management activities on state and private lands, such as agriculture timber harvest or road construction, also may degrade stream habitats. In some areas, aquatic habitat quality may improve from watershed and stream restoration projects, improved management of riparian areas, and other land management improvements.

Conclusion

After reviewing the best available information on the status of the ESUs, both listed and proposed for listing, and the status of critical habitats, both designated and proposed for designation, [9] considered in this consultation, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, NMFS concludes that the action, as proposed, to amend forest plans in Region 6 to include new guidance for management of invasive plants, is not likely to jeopardize the continued existence of any of the listed or proposed ESUs, or likely to destroy or adversely modify designated or proposed critical habitats. These conclusions are based on the following considerations.

At the regional level, the status or risk of extinction for each ESU considered in this consultation ranges from threatened to endangered. The trend of each ESU toward recovery, as reflected in the distribution, abundance, productivity and diversity of its component sub-populations, varies at the watershed level. Also at the regional level, much of the highest quality freshwater habitats occupied by these ESUs occurs on national forest lands, although the baseline condition of individual national forest watersheds varies widely from poor to excellent. Expansion of invasive species must be controlled and eventually reversed in those watersheds or water quality and other aquatic habitat characteristics are likely to become degraded, or further degraded, within years or decades. The cumulative effects of future state or private activities that are reasonably certain to occur within Region 6 are likely to be relatively slight, given the landscape position of national forest lands in relation to regional patterns of land ownership and management control, but are also watershed dependent.

The forest plan-level amendments considered in this consultation do not authorize or prescribe the specific timing, location, or method of expected land management activities. Instead, among other things, the proposed amendments establish a process to that requires a separate consultation for every individual action or project that the USFS will conduct to control invasive species in Region 6 that may affect listed species or critical habitats. Although most invasive plant treatments completed under the new forest-plan level amendments are not expected to have adverse effects, site-specific consultations will ensure those projects that may have adverse effects will be conducted in a time, place, and manner that are consistent with Regional guidance, avoid jeopardy and adverse modification or destruction of critical habitats, and are further modified as necessary to minimize take. Thus, these amendments will ensure that the lethal and sub-lethal effects of every individual project are likely to be short-term (hours to weeks) and minor (affecting few individual fish in less sensitive life stages), while stimulating the growth of natural vegetation and other habitat forming processes essential to the long-term survival and recovery of listed species at the population or ESU scale.

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[9] **Listed ESUs** – LCR Chinook salmon, UWR spring-run Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer run Chinook salmon, SR fall-run Chinook salmon, PS Chinook salmon, HC chum salmon, CR chum salmon, LCR coho salmon , SONC coho salmon, SR sockeye salmon, LCR steelhead, UWR steelhead, MCR steelhead, UCR steelhead, SRB steelhead. **Designated critical habitat** - SR spring/ summer run Chinook, SR fall-run Chinook, SONC coho salmon, or SR sockeye salmon. **ESUs proposed for listing** – OC coho salmon or the resident and hatchery portion of the LCR steelhead, UWR steelhead, MCR steelhead, UCR steelhead, SRB steelhead. **Critical habitat proposed for designation** - LCR Chinook salmon, UWR spring-run Chinook salmon, UCR spring-run Chinook salmon, PS Chinook salmon, HC chum salmon, CR chum salmon, LCR coho salmon, LCR steelhead, UWR steelhead, MCR steelhead, UCR steelhead, or SRB steelhead.

The USFS may ask NMFS to confirm the conference opinion as a biological opinion issued through formal consultation if OC coho or hatchery and resident *O. mykiss* are listed, critical habitat is designated, or both. The request must be in writing. If NMFS reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during the conference, NMFS will confirm the conference opinion as the biological opinion on the project and no further Section 7 consultation will be necessary.

Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species.

In an effort to streamline future ESA consultations, NMFS offers the following list of conservation recommendations relating to herbicide application that may be necessary for ESA compliance at the project level, depending on site specific considerations. These recommendations are consistent with conservation measures and terms and conditions from previous ESA consultations. They are designed to provide guidance in selecting appropriate conservation measures and practices in future ESA consultations on actions implementing the proposed direction.

1. Where practicable, ground application adjacent to waters should only be done by hand wicking, wiping, dripping, painting or injecting.
2. Riparian buffer zones should be flagged before beginning herbicide applications.
3. Broadcast application should only occur when winds are not expected to cause drift into streams.
4. During broadcast application, consider monitoring weather conditions periodically by trained personnel at spray sites.
5. Consider not applying if precipitation has been forecasted to occur within 24 hours of spraying.
6. When practicable, use water to mix (dilute) herbicide products for application.
7. The applicator should only use surfactants or adjuvants in riparian areas that do not contain any ingredients on EPA's List 1 or 2, where listing indicates a chemical is of toxicological concern, or is potentially toxic with a high priority for testing (USEPA 2000). If a surfactant or adjuvant that contains any List 1 or 2 ingredients is considered, the risk to ESA-listed species and their habitat with that chemical should be evaluated before a use decision is made.
8. Maintenance and calibration of spray equipment should occur at least annually to ensure proper application rates.
9. If consistent with project site objectives, use herbicide formulations containing clopyralid, glyphosate, imazapic, imazapyr, metsulfuron methyl, or sulfometuron methyl in riparian areas beside habitat used by ESA-listed salmonids.
10. Aerial applications should be designed to deliver a median droplet diameter size appropriate to reduce drift.
11. Aerial spray should be released at the lowest height consistent with invasive plant control and flight safety.

Reinitiation of Consultation

Reinitiation of formal consultation is required and shall be requested by the Federal agency or by NMFS where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (a) if new information reveals effects of the action that may affect ESA-listed species or critical habitat in a manner or to an extent not previously considered; (b) if the proposed action is subsequently modified in a manner that has an effect to the ESA-listed species or critical habitat that was not considered in this Opinion; (c) if a new species is listed or critical habitat is designated that may be affected by the proposed action (50 CFR 402.16).

The NMFS may consider any of the below circumstances to be a modification of the action that causes an effect on listed species not previously considered, potentially resulting in the need to reinitiate consultation.

1. If the PACFISH or NWFP aquatic conservation strategies are eliminated, replaced, or modified in a manner that result in a lower level of protection for listed fish.
2. If two or more site-specific projects tiered to the proposed action are determined by NMFS to jeopardize listed fish or result in adverse modification to critical habitat.
3. If the monitoring described in the "inventory and monitoring plan framework" section of the proposed action is not carried out.

Reinitiation of consultation will also be required before this Opinion can be used to amend land and resource management plans after five (5) years from the date of signature of the Opinion. To reinitiate consultation, contact the Oregon State Habitat Office of NMFS and refer to the NMFS Number assigned to this consultation.

Incidental Take Statement

Section 9(a)(1) of the ESA prohibits the taking of listed species without a specific permit or exemption. Protective regulations adopted pursuant to Section 4(d) extend the prohibition to threatened species. Among other things, an action that harasses, wounds, or kills an individual of an ESA-listed species or harms a species by altering habitat in a way that significantly impairs its essential behavioral patterns is a taking (50 CFR 222.102). Incidental take refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(o)(2) exempts any taking that meets the terms and conditions of a written incidental take statement from the taking prohibition.

OC coho and resident and hatchery portions of MCR steelhead, LCR steelhead, UWR steelhead, and UCR steelhead are not protected by take prohibitions of the ESA until listed and, if listed as threatened, protective regulations are in effect. Therefore, an incidental take statement will not become effective for OC coho and resident and hatchery portions of MCR steelhead, LCR steelhead, UWR steelhead, and UCR steelhead until they are listed, protective regulations are in place, and this conference opinion is confirmed by NMFS as a biological opinion issued through formal consultation.

Amount or Extent of Take

Invasive plant control projects tiered (interrelated) to the proposed action are likely to occur in occupied habitat, and some level of incidental take is likely to result. As displayed in Table 5 of the "Effects of the Action" section, implementation of several components of the proposed action can potentially result in incidental take of ESA-listed salmonids. Since the proposed action does not describe, approve, or compel any site-specific projects, all take from invasive plant control will occur at the site-specific level and not at the plan level, NMFS does not authorize any take in this Opinion. All take authorization will occur in site-specific consultations.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The consultation requirements of Section 305(b) of the MSA direct Federal agencies to consult with NMFS on all actions, or proposed actions, that may adversely affect EFH. Adverse effects include the direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside EFH, and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that may be taken by the action agency to conserve EFH.

The Pacific Fishery Management Council (PFMC) designated EFH for groundfish (PFMC 1998a), coastal pelagic species (PFMC 1998b), and Pacific Salmon (PFMC 1999). The proposed action and action area for this consultation are described in the Introduction to this document.

The proposed project location includes freshwater habitat which has been designated as EFH for Chinook salmon, coho salmon, and Puget Sound pink salmon. Estuarine and ocean habitat are not expected to be affected by the proposed action, therefore there would be no effect to groundfish or coastal pelagic species EFH.

Based on information provided in the BA and the analysis of effects presented in the ESA portion of this document, NMFS concludes that proposed action will have adverse effects on EFH designated for Puget Sound pink, coho, and Chinook salmon. Pacific salmon EFH will be impacted in the same manner as critical habitat (refer to page 76), "Effects on Critical Habitat").

EFH Conservation Recommendations

The conservation recommendations presented above on page 80 of this Opinion are applicable to designated Pacific salmon EFH. Therefore, NMFS recommends that they be adopted as EFH conservation measures. Should the USFS adopt and implement these recommendations, potential adverse impacts to EFH would be minimized.

Statutory Response Requirement

Federal agencies are required to provide a detailed written response to NMFS' EFH conservation recommendations within 30 days of receipt of these recommendations [50 CFR 600.920(j)(1)]. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse affects of the activity on EFH. If the response is inconsistent with the EFH conservation recommendations, the response must explain the reasons for not following the recommendations, including the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the EFH portion of this consultation, we ask that you clearly identify the number of conservation recommendations accepted.

Supplemental Consultation

The USFS must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations [50 CFR 600.920(k)].

DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-554) (Data Quality Act) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Biological Opinion addresses these Data Quality Act (DQA) components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

Utility: Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users.

This ESA consultation concludes that the proposed action will not jeopardize the affected ESUs. Therefore, the USFS can authorize this action in accordance with its authority under the Forest and Rangeland Renewable Resources Planning Act (1974), as amended by the National Forest Management Act (1976) and its implementing regulations. The intended users are the USFS and its cooperators.

Individual copies were provided to the above-listed entities. This consultation will be posted on the NMFS Northwest Region website (http://www.nwr.noaa.gov). The format and naming adheres to conventional standards for style.

Integrity: This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

Objectivity:

Information Product Category: Natural Resource Plan.

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA Regulations, 50 CFR 402.01, *et seq.,* and the MSA implementing regulations regarding EFH, 50 CFR 600.920(j).

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the Literature Cited section. The analyses in this Opinion/EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with Northwest Region ESA quality control and assurance processes.

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