LAKE OZETTE SOCKEYE RECOVERY PLAN SUMMARY

keys to understanding

habitat

definition

recovery

INTRODUCTION

This is a Recovery Plan for the protection and restoration of Lake Ozette sockeye salmon. Lake Ozette sockeye were listed as a threatened species under the Endangered Species Act (ESA) in 1999. The ESA requires the National Marine Fisheries Service (NMFS) to develop recovery plans for all listed salmon species; therefore, this recovery plan was developed to comply with the law.

The plan includes a proposal for actions that may voluntarily be taken to stop the downward trend of the species and return it to a healthy, naturally self-sustaining condition.

Lake Ozette, its perimeter shore, and most of the Ozette River, which forms the outlet of the lake, are included in the 922,651-acre Olympic National Park (ONP). This plan complements, recognizes, and works within the authorities of the ONP, as well as Clallam County, the Forest Practices Habitat Conservation Plan (FPHCP), the Washington Department of Natural Resources (DNR) Habitat Conservation Plan (HCP), and tribal trust and treaty rights. The plan does not augment or supersede these or other authorities.

Why Lake Ozette sockeye?

- Lake Ozette sockeye salmon are a species listed under the Endangered Species Act because they are in danger of becoming extinct, and they are found nowhere else.
- Their numbers have dramatically declined from historical levels.

What about other species of fish in the lake?

Other fish species will also benefit from improvements to the freshwater habitat for sockeye.

NMFS, a branch of the National Oceanic and Atmospheric Administration (NOAA) has directed preparation of this recovery plan. NMFS, also called NOAA Fisheries, is the Federal agency charged with stewardship of the nation's marine resources, and NMFS has the responsibility for listing and delisting salmon species under the ESA. For purposes of this summary, the acronym NMFS will be used for the agency that directed this recovery plan.

NMFS prepared this recovery plan with the active participation of the Lake Ozette Steering Committee, a group made up of local citizens, landowners, biologists, and representatives of several county, state, tribal, and Federal entities (listed in Appendix A). The Steering Committee met 18 times over the last three and a half years to discuss and comment on all aspects of successive drafts of this recovery plan. Additionally, NMFS met with various groups and agencies with interests in this planning effort, including the Lake Ozette basin property owners (see Appendix C), timber companies, tribal representatives, Clallam County Commissioners and staff, and Olympic National Park. Input and comments from all of these meetings were considered, evaluated, and, where appropriate, incorporated into the Recovery Plan. Additionally, NMFS solicited public comments on the plan and incorporated these comments as appropriate. The plan's content, however, remains the responsibility of NMFS.

Although the ESA requires NMFS to develop recovery plans, NMFS will rely, to a great extent, on local citizens and jurisdictions to voluntarily implement actions the plan recommends or proposes. In many cases, the plan simply acknowledges and recommends coordinating the pre-existing, ongoing recovery efforts and pre-existing laws or regulations that are expected to benefit the species and its environment, such as the ongoing resource management and habitat restoration activities of Olympic National Park, Washington Department of Fish and Wildlife, and the Makah and Quileute Tribes. Some of the ongoing actions that are integrated into the plan are required under other, separate resource management regulatory processes, such as implementation of forest practices habitat conservation plans, Clallam County road maintenance, operation of the sockeye hatcheries, and regulation of fisheries that may affect sockeye. In addition, Olympic National Park might implement recommended actions on properties for which it is responsible. Other regulatory authorities might enact regulations based on the recommendations in this plan, such as Clallam County for land use issues, or Washington Department of Fish and Wildlife and the Tribes for harvest issues and water quality standards. This recovery plan is not an end in itself. After it is adopted, further work will be needed on such important questions as who will do what, the specific costs, the funding sources that may be available, the time frame for various actions, and what opportunities will be provided for public and agency input and involvement. Work will start on an implementation plan for Lake Ozette sockeye recovery later in 2009.

Why a recovery plan?

Because the ESA requires NMFS to develop recovery plans for all listed species as a means by which to organize and coordinate recovery of the species.

Is this plan voluntary or required?

NMFS is required to make a plan. Implementing the recovery actions is voluntary. The plan is not a law and it is not a regulation; it's just a roadmap, guidance, and resource for people and organizations willing to take action to help the fish.

What does "recovered" mean?

Biological recovery for a salmon species means that it is naturally self-sustaining – enough fish spawn in the wild and return year after year so they are likely to persist in the long run, defined as the next 100 years. The species also has to be resilient enough to survive catastrophic changes in the environment, including natural events such as floods, earthquakes, storms, and decreases in ocean productivity.

- In terms of protection, recovery means the threats that caused the species to decline have been abated.
- In terms of the ESA, recovery means the sockeye no longer needs the protection of the Act and can be taken off the list.
- In terms of social and cultural values, recovery means sufficient abundance for the fish to be self-sustaining and also to allow sustainable harvest.

GOALS

In general, the goal of this plan is for the Lake Ozette sockeye population to reach the point that it no longer needs the protection of the Act and can be delisted. The delisting decision must be based on the best available science. Biological recovery for a salmon species (the basis for delisting) means that it is naturally self-sustaining – enough fish spawn in the wild and return year after year so they are likely to persist in the long run, defined as the next 100 years. The species also has to be resilient enough to survive catastrophic changes in the environment, including natural events, such as floods, earthquakes, storms, and changes in ocean productivity.

A recovery plan can have "broad-sense" goals that may go beyond the requirements for delisting to acknowledge social, cultural, or economic values regarding the listed species. NMFS and the Lake Ozette Steering Committee crafted the following vision statement describing desirable future conditions for the Lake Ozette sockeye and its human and biological setting:

The naturally spawning Lake Ozette sockeye population is sufficiently abundant, productive, and diverse (in terms of life histories and geographic distribution) to provide significant ecological, cultural, social, and economic benefits. Protection and restoration of ecosystems have sustained processes necessary to maintain sockeye as well as other salmon, steelhead, cutthroat trout, and other native fish and wildlife species. Community livability, economic well-being, and treaty-reserved fishing rights have benefited by balancing salmon recovery with management of local forest and fishery economies.

This plan has undergone public comment processes and has been adopted by NMFS. The groups involved in voluntarily implementing the plan's recommendations may consider this vision statement and accept, reject or modify it as they wish.

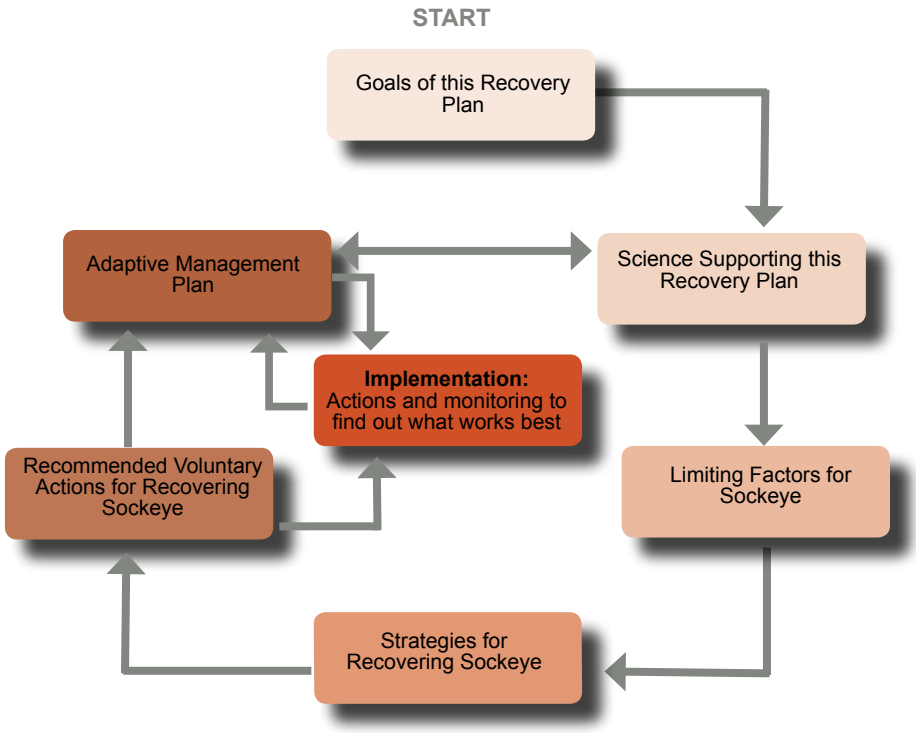
What's the goal of this recovery plan?

The primary goal is to be able to "delist" the sockeye – improve its status so that it is naturally self sustaining and no longer threatened with extinction.

What's delisting? Who makes the decision?

Under the Endangered Species Act (ESA) of 1973, listing and delisting of marine species, including salmon, are the responsibility of the National Marine Fisheries Service (NMFS). If a fish or other species is listed as threatened or endangered, legal requirements to protect it come into play. When NMFS decides through scientific review that the species is doing well enough to survive without ESA protection, NMFS will "delist" it. This decision must be based primarily on the best available science concerning the current status of the species and its prospects for long-term survival.

Figure S-1: Recovery Plan Process Schematic



TECHNICAL BASIS

NMFS-Appointed Technical Recovery Team

NMFS appointed teams of scientists with expertise in salmon species to provide scientific support for recovery planning in the Northwest. These technical recovery teams (TRTs) include biologists from NMFS, state, tribal, and local agencies, academic institutions, and private consulting groups. For Lake Ozette sockeye salmon, the scientific team was called the Puget Sound TRT, and it provided two reports: a description of the Lake Ozette sockeye population; and biological recovery criteria for the sockeye. The team also reviewed the draft recovery plan in detail, as well as a scientific document that identified the factors affecting sockeye salmon survival.

TRTs work from a common scientific foundation to ensure that recovery plans are scientifically sound and based on consistent biological principles. All the TRTs use biological principles established by NMFS for salmon recovery planning as a basis of the work they do.

The Lake Ozette sockeye ESU is made up of only one population. Many other salmon ESUs have several component populations spread out over a wide area, and therefore they have more diversity and potential resilience in the face of environmental change. There are five known subpopulations or aggregations of Lake Ozette sockeye, defined in terms of where they spawn—on beaches around the lake or in the tributaries (beach spawning subpopulations include Olsen's Beach and Allen's Beach, while tributary spawning subpopulations include Umbrella Creek, Big River, and Crooked Creek). The non-anadromous, resident sockeye are called kokanee, and they are genetically different enough from anadromous Lake Ozette sockeye to be considered a separate ESU.

What is an "evolutionarily significant unit" (ESU)?

ESUs are defined on the basis of geographic range as well as genetic, behavioral, and other traits.

Formally, an ESU is defined as a group of Pacific salmon or steelhead trout that is (1) substantially reproductively isolated from other groups of the same species and (2) represents an important component of the evolutionary legacy of the species.

All Pacific salmon belong to the family Salmonidae and the genus Oncorhynchus, while sockeye belong to the species *Oncorhynchus nerka*. Lake Ozette sockeye are an evolutionarily significant unit of *O. nerka*.

Most of the time, salmon return to spawn in the streams or lakes where they were born. However, they occasionally "stray" and choose to mate where conditions are right, perhaps in an adjacent stream or lake. The result is that salmon populations that are geographically widespread may have some amount of genetic similarity. They are linked because of straying, and differentiated because of long-term adaptation to different environments. In the Pacific Northwest, NMFS has identified seven sockeye ESUs.

Picture S-1: Lake Ozette (Courtesy of Olympic National Park)

What's a limiting factor?

A limiting factor is any aspect of the environment that affects a species' ability to reproduce, such as predation, water temperature, stream channel structure, or the amount of water in the stream.

What's a hypothesis?

A hypothesis is a statement that can be proved or disproved by further inquiry. It is an invitation to look for more information. A scientific hypothesis is based on some kind of evidence or observation, and it describes either a possible causal relationship or just a relationship of some sort.

It does not matter whether a hypothesis is precise or wildly speculative; the important thing is whether it can be proven or disproven, and how you go about getting the evidence. For example, "I think the moon is made of green cheese" is a hypothesis about the substance of the moon. The question is not where the hypothesis came from but what can be done with it. What's the evidence? How can it be proved or disproved?

An example of a hypothesis for Lake Ozette sockeye recovery planning:
High stream temperatures weaken juvenile and adult sockeye salmon migrating to or from the lake and result in higher mortality.

Limiting Factors Analysis

Technical information about Lake Ozette sockeye recovery is incorporated in a biological research paper, the Lake Ozette Sockeye Limiting Factors Analysis (Haggerty et al. 2009), prepared for NMFS in cooperation with the Lake Ozette Sockeye Steering Committee. The Limiting Factors Analysis, or LFA, is an exhaustive study of all the available published information as well as field biology and unpublished or historical records on Lake Ozette sockeye. The authors, with the guidance of the Steering Committee, made a series of hypotheses about past and current factors that limit the sockeye's survival and reproduction. These hypotheses are based on specific information about the Lake Ozette sockeye, their life cycle, and their environment, as well as general knowledge about anadromous fish and freshwater ecosystems.

The LFA contains hypotheses about limiting factors that affect all Lake Ozette sockeye, both lake beach and tributary spawners. Chapter 4 in the Recovery Plan summarizes the limiting factors hypotheses. It is anticipated that these hypotheses can be tested as part of implementing the recovery program. Actions that are taken to address these limiting factors should be monitored and the results evaluated to see whether they support and confirm or disprove the hypotheses. Then recovery strategies and actions can be adjusted accordingly. The Puget Sound TRT and scientists at NMFS Northwest Fisheries Science Center have reviewed the LFA. Their comments have been evaluated and, as appropriate, incorporated.

For example, one hypothesis is that water quality is a limiting factor for Lake Ozette sockeye. Specifically, it is possible that high water temperatures and high sediment concentrations in the tributaries either weaken or kill enough sockeye and their eggs to make a difference in their rate of reproduction. The evidence that water quality is a limiting factor for Lake Ozette sockeye is described in Chapter 4, Section 4.2.2.1 of the recovery plan, under the heading, "Rationale."

The color graphic on the following page illustrates the relative importance of a wide range of potential limiting factors for the beach spawning Lake Ozette sockeye aggregation, showing the life history stage affected. For example, the thick red

arrow at about 2 o'clock on **Figure S-2** indicates that spawning habitat quality has a large effect on the fish in the stage of egg incubation and emergence from the gravel. Two other thick red arrows show that predation can have a large effect on both the juvenile fish rearing in the lake and adults returning to spawn. A fourth indicates the importance of factors that affect survival in the ocean. The plan includes similar graphics showing limiting factors for the tributary spawning aggregation as well as one for factors that affect the entire population.

Figure S-2: Beach spawning sockeye life history stages and hypothesized limiting factors

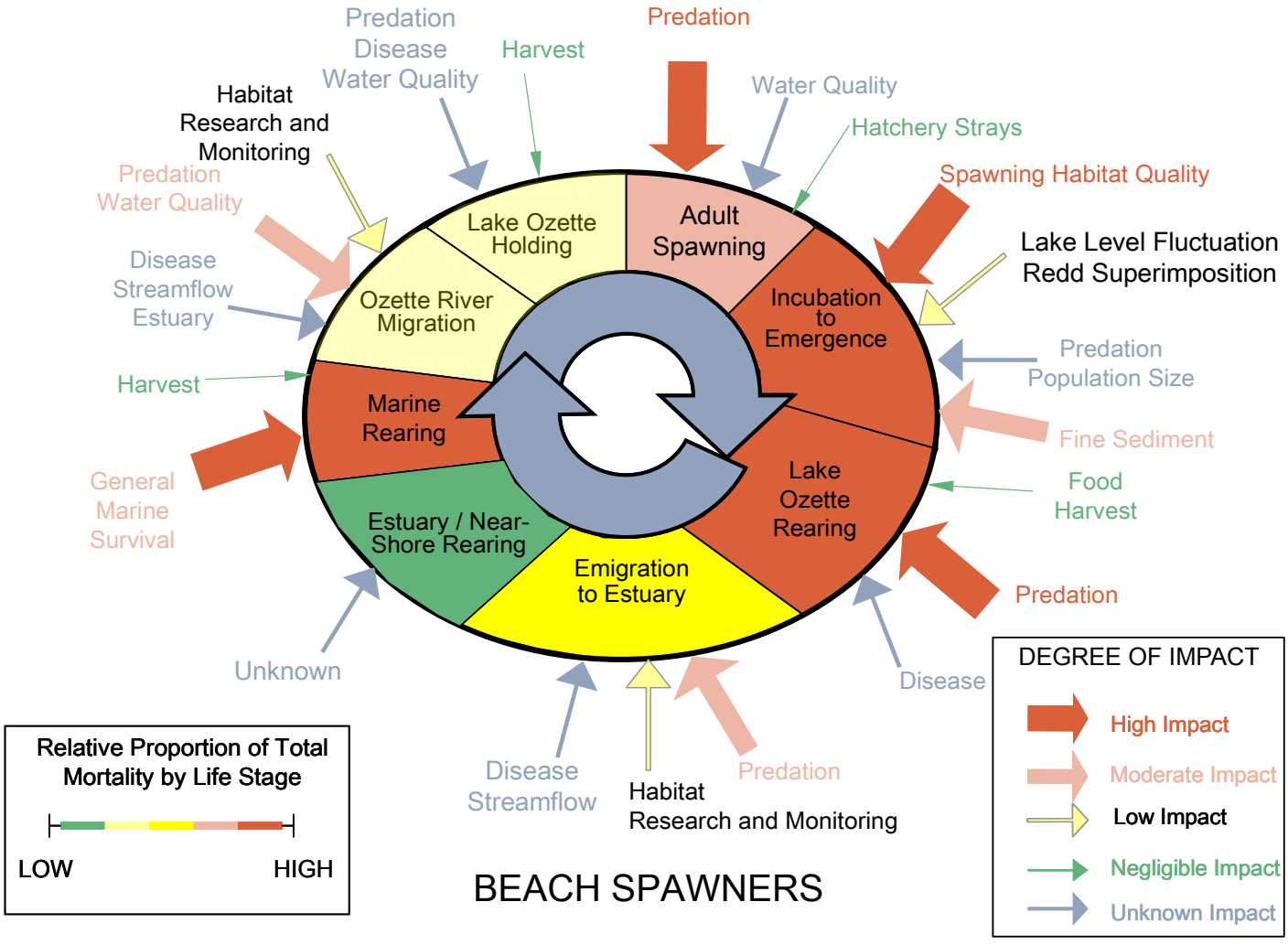


Table S-1: Summary of limiting factors hypotheses (modified from table 4.1 in Lake Ozette Sockeye Salmon Recovery Plan)

Limiting Factor	Population Segment(s) Affected	Degree of Influence of Limiting Factor	Description
Predation	ALL	Key	Changes in relative predator-prey abundances in the Ozette River and Lake Ozette have increased the proportion of juvenile and adult sockeye consumed by predators such as cutthroat trout, northern pikeminnow, largemouth bass, river otters, and harbor seals, and resulted in decreased freshwater survival, as well as an overall decrease in the number of sockeye returning to spawn.
Water Quality	ALL	Contributing	High stream temperatures and low frequency, high intensity turbidity events reduce the fitness of sockeye salmon entering or exiting Lake Ozette and result in decreased survival and productivity.
Streamflow	ALL	Contributing	Reduced streamflows in the Ozette River affect water quality, predation rates and efficiency, and reduce the fitness of migrating and emigrating sockeye.
Habitat	ALL	Contributing	Reduced pool depth, volume, and cover have decreased predator avoidance capabilities and refuge areas for sockeye, increasing predator efficiency and reducing refuge habitat.
Marine Survival	ALL	Contributing	Survival in the marine environment is driven by large-scale climatic processes, which are mostly not controllable. Variability in marine survival rates for sockeye salmon is significant, but not likely a key limiting factor at present. Large-scale changes in marine conditions should be monitored and may be significant in the future.
Estuary	ALL	Unknown	Because little is known about the Ozette River estuary, there is no current hypothesis concerning estuarine conditions as a limiting factor for sockeye. This is an important data gap.
Spawning Habitat	Beach Spawners	Key	Reduced quality and quantity of beach spawning habitat in Lake Ozette has decreased egg to emergence survival, resulting in reduced fry production from the beach spawning aggregations.
Predation	Beach Spawners	Key	Changes in relative predator-prey abundances on Ozette spawning beaches have increased the proportion of adult sockeye, eggs, and newly emerged fry consumed by predators, resulting in decreased freshwater survival.
Water Quality	Beach Spawners	Contributing	Turbidity and suspended sediment concentration (SSC) at Olsen's and Allen's Beaches have a limited effect on sockeye salmon because of the distance of spawning habitat from major sediment sources. However, at historical spawning sites near major tributary outfalls, such as Umbrella Beach, the effects of turbidity and SSC would be expected to be similar to those described for tributary spawners.
Lake Level	Beach Spawners	Contributing	Seasonal lake level changes result in redd dewatering, decreasing egg-to-fry survival rates.

Table S-1 Continued: Summary of limiting factors hypotheses (modified from table 4.1 in Lake Ozette Sockeye Salmon Recovery Plan)

Limiting Factor	Population Segment(s) Affected	Degree of Influence of Limiting Factor	Description
Competition	Beach Spawners	Key	Reduced spawning habitat quality and quantity have increased the competition for suitable habitat at low to moderate spawning escapement levels, resulting in increased redd superimposition and decreased egg-to-fry survival.
Spawning Habitat	Tributary Spawners	Key	Channel simplification and increased sediment production and delivery to streams have decreased the quantity of suitable spawning habitat (i.e., gravel) available to tributary spawning sockeye. Increased levels of fine sediment (<0.85mm) in spawning gravels reduces intra-gravel flow and oxygenation of redds, resulting in decreased egg-to-fry survival.
Channel Stability	Tributary Spawners	Contributing	Decreased channel stability and floodplain alterations have reduced egg-to-fry emergence survival in sockeye tributaries.
Water Quality	Tributary Spawners	Contributing	Elevated turbidity and SSC levels increase stress and reduce sockeye fitness, resulting in increased egg retention rates and pre-spawning mortalities. High levels of turbidity and SSC result in fine sediment deposition in sockeye redds, decreasing egg survival. High levels of turbidity and SSC during the sockeye fry emigration period result in reduced sockeye fry survival, fitness, increased gill abrasion, and altered oxygen uptake.
Predation	Tributary Spawners	Contributing	Predation of sockeye fry by piscivorous fish during emergence, emigration, and dispersal significantly reduces the number of fry rearing in the pelagic zone of the lake. Predation on adult sockeye and eggs in tributaries occurs at low levels and is not likely a significant limiting factor.
Streamflow	Tributary Spawners	Contributing	Natural and anthropogenically influenced streamflow variability (magnitude, frequency, and timing of low and high flows) affects sockeye mortality by: 1) delaying adult migration into tributaries (resulting in more predation, egg retention), 2) limiting where adults spawn in a cross-section (sequestering spawners in areas where egg scour or desiccation is likely), and/or 3) increasing emigrating fry exposure times in tributaries (resulting in exposure to predation or poor water quality).
Holding Pools	Tributary Spawners	Not Currently Limiting	Current holding pool frequency and volume, reduced from historical conditions, appears to be adequate in relation to the current numbers of adult sockeye salmon. However, as the tributary population continues to expand, this factor may begin to exert an influence.

RECOVERY CRITERIA

The ESA requires that recovery plans, to the maximum extent practicable, incorporate objective, measurable criteria which, when met, would result in a determination in accordance with the provisions of the ESA that the species be removed from the Federal List of Endangered and Threatened Wildlife and Plants. These criteria are of two kinds: biological viability criteria and "threats" criteria, which are related to the five listing factors detailed in the ESA (see below).

Biological Viability Criteria

Biologists define "viability" or biological health for salmon populations in terms of four variables or parameters: abundance, productivity or growth rate, spatial structure, and diversity. The Puget Sound TRT recommended the following viability criteria for Lake Ozette sockeye:

Abundance: The number of adult fish on the spawning grounds. *Based on currently available information, the TRT recommended that a viable sockeye population in Lake Ozette should range in abundance between 31,250 and 121,000 adult spawners, over a number of years* (Rawson et al. 2008).

Productivity: The growth rate, which can be measured as the spawner-to-spawner ratio (returns per spawner or recruits per spawner), annual population growth rate, or trends in abundance. Productivity is a measure of a population's ability to sustain itself or to rebound from low numbers. *For the ESU to be viable, the population growth rate would have to be stable or increasing.*

Spatial structure: This refers both to the geographic distribution of individuals in the population and the processes that generate that distribution. *A viable sockeye population in Lake Ozette would include multiple, spatially distinct and persistent spawning aggregations throughout the historical range of the population. A viable sockeye population would therefore have multiple spawning aggregations along the lake beaches, which are the known historical spawning areas. The certainty that the population achieves a viable condition would be further increased if spawning aggregations in one or more tributaries to the lake were also established.*

Puget Sound Technical Recovery Team Viability Criteria for the Lake Ozette Sockeye Salmon

Abundance: Between 31,250 and 121,000 adult spawners, over a number of years.

Productivity (growth rate)**:** Stable or increasing.

Spatial Structure: Multiple, persistent, and spatially distinct beach spawning aggregations, augmented by tributary spawning aggregations.

Diversity: One or more persistent spawning aggregations from each major genetic and life history group historically present within the population. Maintain the distinctness between Lake Ozette sockeye and kokanee.

Diversity: Diversity can be genetic, such as the salmon's instinct to return home to spawn, or traits like appearance, behavior, and life history, which are affected by a combination of genetic and environmental factors. More diverse populations have a better chance of adapting to environmental changes. The Lake Ozette sockeye ESU is made up of only one population, so the diversity within it comes from the various component spawning aggregations and the fundamental difference between the anadromous sockeye salmon and the resident kokanee salmon in Lake Ozette, which is a separate ESU. The TRT says *that a viable Ozette sockeye population would include one or more persistent spawning aggregations from each major genetic and life history group historically present within that population. A viable population of sockeye in Lake Ozette also would maintain the historical genetic diversity and distinctness between anadromous sockeye salmon and kokanee salmon in Lake Ozette.*

"Threats" Criteria

The term "limiting factors" refers to characteristics in the environment that affect a species' survival, such as, for example, high water temperature or lack of spawning gravel. NMFS defines threats as the human activities or natural events that cause the limiting factors, for example, removal of streamside vegetation, which causes loss of shade and, consequently, higher water temperature.

While the term "threats" carries a negative connotation, it does not mean that activities identified as threats are inherently undesirable. They are typically legitimate and necessary human activities that may at times have unintended negative consequences for fish populations—and that can also be managed in a manner that minimizes or eliminates the negative impacts.

The term "threats" also relates directly to the listing factors that are evaluated under ESA section 4(a)(1) when initial determinations are made whether to list species for protection. The listing factors are categories of threats.

Here are the ESA section 4(a)(1) listing factors:

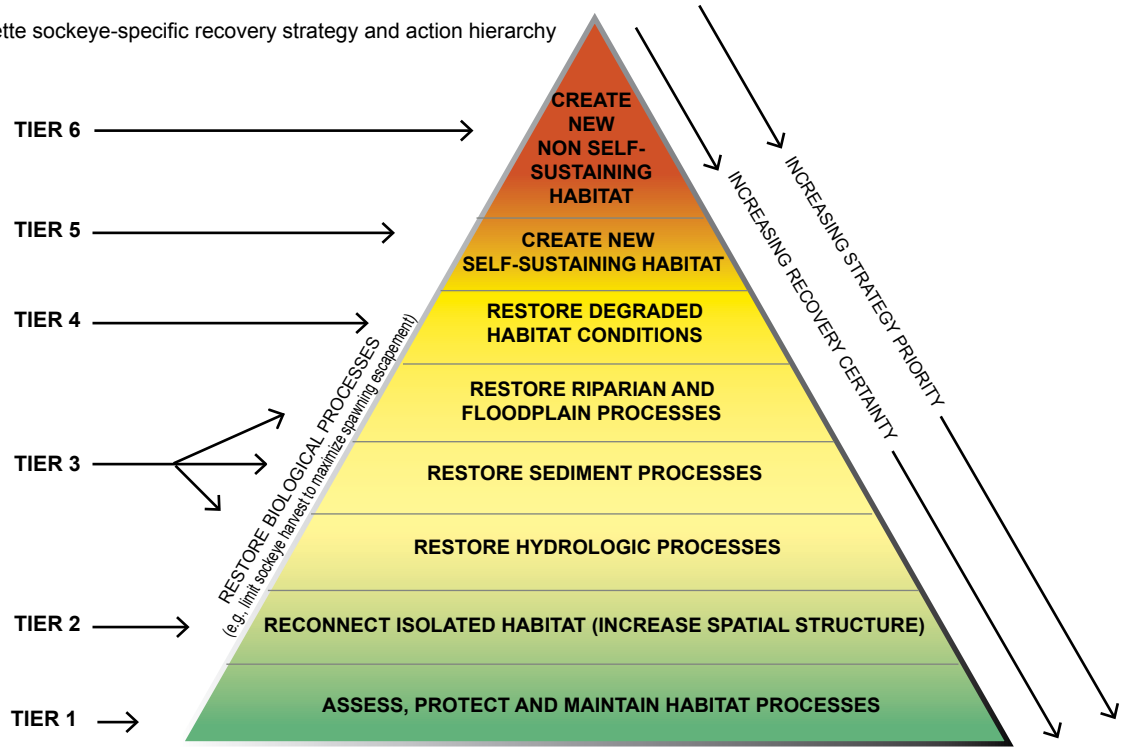
1. Present or threatened destruction, modification, or curtailment of [the species'] habitat or range
2. Over-utilization for commercial, recreational, scientific, or educational purposes
3. Disease or predation
4. Inadequacy of existing regulatory mechanisms
5. Other natural or human-made factors affecting [the species'] continued existence.

The threats criteria define the conditions under which the listing factors, or threats, can be considered to be addressed or mitigated. Threats criteria for measuring recovery of Lake Ozette sockeye are discussed in more detail in Section 3.3.3 of this plan.

RECOVERY STRATEGY

The plan recommends an integrative recovery strategy based on current research about the relationships between watershed processes, land use, and freshwater habitat that incorporates all ecological processes impacting sockeye survival (i.e. habitat degradation, hydrologic process, and predation, among others). This information

Figure S-3: Ozette sockeye-specific recovery strategy and action hierarchy



is then related towhat is known about sockeye mortality by life stage, and to the hypothesized limiting factors. The result is a hierarchy of types of recovery strategies that can form the basis for setting priorities among potential actions. Chapter 6 in the plan explains the recovery strategy. **Figure S-3** illustrates the hierarchy. The recovery strategies are arranged in order of greatest certainty for contributing to recovery, with the most certain, Tier 1, at the base of the pyramid.

The first priority and likely the most effective type of action ("Tier 1" in **Figure S-3**), is to assess, protect, and maintain good quality habitat and the processes that create and maintain it. One example would be to verify the success of current spawning areas and protect them. Another would be to protect forest or streamside areas with conservation easements, where trees could be allowed to grow large, mature, and fall by natural forces.

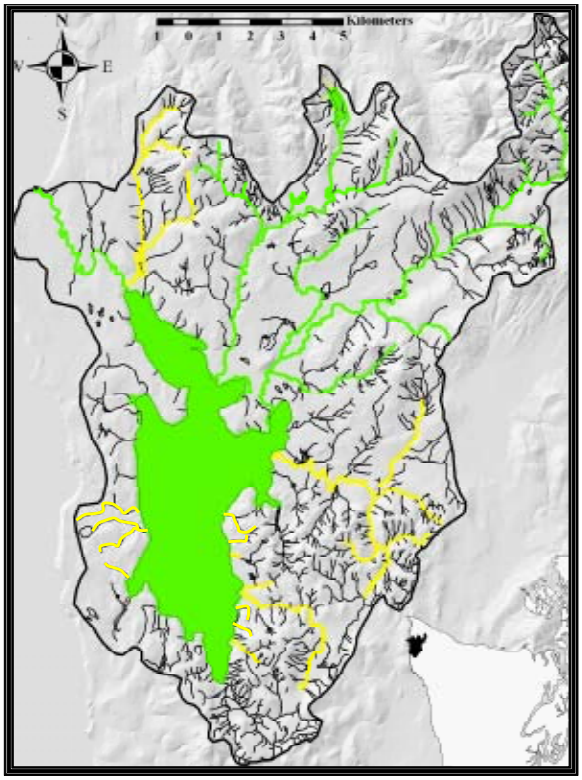
Next in importance and certainty of effectiveness is reconnecting isolated habitat, for example, removing a blockage in the stream, thus allowing salmon more room to spawn and rear.

Third is restoring biological processes of various kinds. This includes a wide range of potential actions, for example: restoring natural predator-prey balance by improving egg-to-fry survival and/or reducing non-native fish species by means of selective fishing; restoring riparian forests along streams and rivers; assessing sources of sediment and reducing sediment production and delivery to streams.

Directly restoring degraded habitat is of lower priority because it is harder, often more costly, and often effective only in the short-term, compared to restoring the processes that create habitat and will continue creating properly functioning habitat over time. However, some direct actions, such as placing large woody debris in carefully chosen areas, will initiate biological processes that are likely to continue naturally.

Creating new habitat is quite a lot harder than working to protect and restore existing habitat; it is therefore of lowest priority, although in some circumstances it may be the only alternative.

Figure S-4: Lake Ozette subbasin prioritization. Green lines depict priority I subbasins, yellow lines depict priority II subbasins, and black lines entering Lake Ozette and the Ozette River depict priority III subbasins



PRIORITY I

- Lake Ozette
- Ozette River
- Umbrella Creek
- Big River

PRIORITY II

- Coal Creek
- Crooked Creek
- Siwash Creek
- Elk Creek
- 20.0073 and 20.0078
- Unnamed West and Eastside Tributaries

PRIORITY III

- Palmquist Creek
- Quinn Creek
- South Creek
- Allen Slough
- 20.0079
- All Other Unnamed Tributaries

In addition to these priorities, it is important to determine where recovery actions would have the greatest positive impact. The Recovery Plan, with input from the Steering Committee, provides an evaluation of the sub-basins in the Lake Ozette watershed for their importance as sockeye habitat. **Figure S-4** shows the resulting geographic priorities for recovery efforts in the Lake Ozette basin.

Picture S-2: Lake Ozette sockeye salmon in Big River (Photo by Caroline Peterschmidt)

ACTIONS FOR RECOVERY

The plan introduces a series of actions that could be taken to improve prospects for recovery of the Lake Ozette sockeye. This is a key part of the plan, and it is one of the three basic requirements for an ESA recovery plan. Although these actions are to be considered for future implementation, no one is obligated, required, or mandated to follow through on them. The only obligatory actions are those that are already part of local, state, or Federal laws or regulations, or part of an ESA regulatory action under ESA section 7 or section 10, such as the legally binding Habitat Conservation Plans completed between NMFS, timber companies, and the Washington Department of Natural Resources.

Recovery of a healthy, abundant population of Lake Ozette sockeye is likely to happen only if people are willing to work together to achieve it, and if the local people see some benefit to themselves in the results. The proposed recovery actions are designed to address the full range of limiting factors for all life cycle stages of Lake Ozette sockeye salmon and are intended to improve the health and habitat of these fish. Implementation of selected actions described in the plan is the next step in effectively moving toward recovery of this species. Stakeholders will be involved in developing an Implementation Schedule and selecting future projects.

It is important to recognize that it will be easier to obtain focus and funding for sockeye recovery with an approved recovery plan. Still, there are several more steps to be taken before deciding whether to implement each of the proposed recovery actions:

- Develop project budgets and seek funding.
- Get permits from authorizing agencies.
- Communicate with those potentially affected.
- Evaluate potential social and economic effects of proposed actions.
- Coordinate actions with Olympic National Park, the Tribes, Washington Department of Fish and Wildlife, Clallam County, and other appropriate entities.

The proposed actions are in six categories:

- Fisheries management
- Habitat-related actions
- Hatchery supplementation
- Predation-related actions
- Research, monitoring and adaptive management
- Public education and outreach

Fisheries Management

Short-term actions

1. Continue current Olympic National Park, Washington Department of Fish and Wildlife, and tribal fishing regulations that prohibit directed harvest and retention of Lake Ozette sockeye salmon in recreational and tribal commercial fisheries. Conduct population status and impact reviews and employ strict criteria to ensure that any future tribal ceremonial and subsistence fisheries do not compromise recovery.

What is the Forest Practices Habitat Conservation Plan?

The Forest Practices Habitat Conservation Plan (FPHCP) is a set of legal agreements, under ESA section 10, between the US Fish and Wildlife Service, NMFS, the State of Washington, and private timberland owners, that sets out forest practices necessary to protect the survival and recovery of fish and aquatic species in the State of Washington. The FPHCP is based on the Forests and Fish Report, which was developed by county, state, and federal entities, certain Washington Tribes, and professional forestry associations, and represents some five years of intensive negotiations among stakeholders to reach an agreement that all could live with. NMFS found implementation of the FPHCP "consistent with the long-term survival and recovery of covered species," including Lake Ozette sockeye, but the FPHCP is not a recovery plan; it is an agreement that permits a certain level of harm to ESA-listed species ("incidental take," as it is called in the ESA), on the assumption that overall conditions will improve if the rules are followed.

2. Adjust current recreational fishing regulations to promote and maximize the removal of non-native fish species to reduce predation on juvenile sockeye.
3. Continue current marine area fishing regimes, which likely have no substantial impacts on Lake Ozette sockeye. Continue to monitor these fisheries.

Long-term actions

1. As abundance increases, conduct population status and impact reviews and employ strict criteria to ensure that any future directed and/or incidental harvest of sockeye in freshwater, estuarine and nearshore marine areas will not compromise recovery, including any future tribal commercial, ceremonial and subsistence, or all-citizen recreational fisheries.
2. Continue regulating other marine fisheries to minimize incidental impacts on Lake Ozette sockeye.

Habitat-Related Actions

Habitat-related actions for sockeye recovery are discussed in several categories: programmatic actions, which are landscape-scale management programs implemented through many site-specific actions; project-level actions for habitat protection, restoration or enhancement; near-stream and floodplain restoration; spawning habitat restoration; and voluntary conservation easements and land acquisitions from willing sellers.

Programmatic actions

The recovery plan recommends implementing the various existing plans and regulations that have provisions to protect and improve fish habitat (see details in Section 7.2.1).

1. Forest Practices Habitat Conservation Plan
2. Washington Department of Natural Resources State Land Habitat Conservation Plan
3. Clallam County Critical Areas Ordinance and Storm Water Management Plan
4. Clallam County Road Maintenance Plan
5. Olympic National Park General Management Plan
6. Olympic Coast National Marine Sanctuary Management Plan
7. Washington State Department of Fish and Wildlife Hydraulic Code
8. Washington State Department of Ecology water quality and quantity regulatory requirements

Habitat protection, restoration, and/or enhancement projects

1. *Broad-scale sediment reduction projects:* The following actions may be carried out voluntarily by any landowners.

- Quantitatively assess sediment production impacts from logging (gully creation, debris flows, landslides), road building, removal of large woody debris, and other land use activities.
- Reduce or eliminate land use-related sediment.
- Where willing landowners and funding exist, purchase land from sellers and manage land to recover watershed processes and ecosystem function to improve sockeye habitat.

- Develop voluntary, comprehensive "green" forestry programs at the landscape scale that promote ecosystem function and watershed process recovery.
- Reconnect floodplains in high-priority subbasins by reintroducing large woody debris to all tributaries to improve floodplain connectivity and sediment deposition/storage.
- Plant or under-plant conifer forests in fields and disturbed hardwood zones next to streams to increase bank rooting strength, increase channel complexity, and aid in sediment storage/deposition.
- Eradicate non-native plants (knotweed, for example) next to streams and replace with native species more effective at protecting soil and banks.

2. *Broad-scale hydrologic restoration projects:* These projects would affect basic watershed and stream processes such as runoff and erosion, streamflow, stream channel structure, and flooding. The first step is to do extensive research to find out where natural hydrologic functions can be improved. Then, construct a hydrologic model to help identify potential projects and set priorities. Potential actions might include road decommissioning, installing road cross-drains and appropriately sized culverts, and placement of large wood. All this would have to be agreed upon, including consideration of public input and coordination with Olympic National Park.

3. *Large woody debris (LWD) placement projects:* The plan proposes ***considering*** a series of broad-scale recommendations and site-specific projects because large wood in the tributaries has many benefits for salmon.

   The following LWD actions are proposed because they address limiting factors, respond to recommendations in research studies (i.e., Herrera 2005), and provide scientifically based actions to improve sockeye viability. These actions are recommended for consideration when developing the Implementation Schedule.

Actions should be selected after careful consideration of both the biological needs of sockeye salmon and the social and economic needs of residents in the Ozette watershed, in coordination with the appropriate entities and stakeholders. During the implementation phase of the recovery plan, all proposed actions will be further defined, options analyzed, costs identified or refined, permitting needs identified, social and economic effects analyzed, and decisions made in coordination with relevant permitting agencies and stakeholders.

Why is large woody debris (LWD) important to salmon?

Large woody debris means big chunks of wood, such as root wads or trees fallen into or across the channel.

- In all forested rivers and streams, LWD plays a key role in shaping the channel.
- It creates pools and hiding places, providing salmon with protection from predators.
- It helps filter sediment to provide clean gravel for spawning.
- It provides organic matter to feed the small invertebrates that salmon feed on.

LWD can benefit landowners, too.

- Streams with adequate riparian vegetation and LWD on banks and in the channel are more resilient to catastrophic floods and help maintain a stable, healthy channel.

Where would LWD be placed?

The plan recommends placing LWD in a variety of creeks and rivers. In key sockeye habitat areas such as Umbrella Creek and in the lower reach of the Ozette River, LWD can be placed relatively freely without significant constraints from private property. In areas with more human constraints such as upper Ozette River and Big River, LWD projects need to be more carefully evaluated and engineered, to make sure that habitat benefits accrue while potential damages to local property are foreseen, prevented, or can be mitigated.

As recommended in the two existing detailed LWD studies on the Ozette River, no LWD would be placed in the upper portion of the Ozette River without additional public input and scientific analysis of the potential direct and indirect impacts on lake properties.

a. Lower Ozette River

Relates to Hypothesis 1 (in Chapter 6 of the Plan): Predation by marine mammals in the Lower Ozette River is a limiting factor for Lake Ozette sockeye.

- Placing LWD structures in the lower Ozette River would help prevent or hinder harbor seal migration into the lake.
- LWD would provide cover for migrating salmon and help to reduce predation.
- LWD placement in this river area would not lead to changes in the level of Lake Ozette.

b. Upper 1.3 miles of Ozette River

Throughout the last century, and particularly in the last 60 or 70 years, LWD was removed from the Ozette River in the belief that it helped fish or would reduce flooding. LWD removal, in combination with other factors, has affected water quality (Hypothesis 2), Ozette River streamflow (Hypothesis 3), and Ozette River habitat conditions such as pool depth, pool volume, and cover (Hypothesis 4). It has also contributed to lower average lake levels and resulted in increased vegetation along the lake shore (Hypothesis 6). Historically, LWD was also removed from portions of the lake shoreline. This removal affected the shoreline hydraulics. Water turbulence around shoreline wood cleanses gravel locally and helps prevent vegetation from taking hold. Without wood, vegetation can more effectively colonize bare soil and trap fine sediment, which reduces potential spawning habitat for sockeye.

Picture S-3: Floodplain connectivity in the Lake Ozette watershed

Adding LWD in the upper 1.3 miles of Ozette River would help to restore natural flow patterns and maintain a natural range of lake levels in order to improve beach spawning habitat.

What is floodplain connectivity?

Floodplains are the relatively low-lying lands alongside rivers and streams that are occasionally inundated during high flows and floods. Floodplain connectivity refers to the ability of the stream to periodically overflow its banks. Although we call this "flooding" and perceive it as something to avoid, especially when houses and roads are at stake, it is flooding that makes the soil fertile, replenishes wetlands with nutrients, seeds, and organic matter, and enriches the rivers and streams for the fish and other aquatic life. Upstream floodplains can also diminish the force of the floodwaters and prevent more extensive flooding downstream.

However, for this area, the plan recommends an extensive list of studies, modeling, and analysis of potential impacts on property before proceeding with any large wood placement.

The plan recommends the following steps:

- Determine the effect of different wood loading scenarios on property and infrastructure.
- Identify a range of LWD placement options, including no LWD placement, and evaluate the effect of LWD placement on lake level.
- Identify current flood hazards and potential flood risks around the lake.
- Refine hydrologic model.
- Identify a range of options for large wood placement.
- Identify potential projects to be evaluated based on balancing the biological needs of sockeye with the social and economic effects on local residents.
- Survey existing beach spawning areas to analyze results of hydrologic modeling and figure out what would be good for the fish.

- Evaluate and select restoration sites.
- Develop a shoreline vegetation plan.
- Analyze the social and economic effects of each potential project.

c. Umbrella Creek

Fish habitat and LWD conditions in the main Ozette tributaries (e.g., Umbrella, Big, Crooked) were thoroughly monitored and measured in 1999 and 2000. Researchers found that there are areas where there is not very much LWD, the stream channel is unstable, and there is little suitable spawning gravel. The plan recommends considering reintroducing LWD to key tributary channel segments of sockeye Critical Habitat with the intent to stabilize the channel and restore spawning gravels.

Near-stream and floodplain restoration projects

The plan includes extensive detail concerning the near-stream zones around Lake Ozette and its tributaries, and recommends many potential actions that would improve fish habitat by improving natural near-stream zone and floodplain processes—too many to list in a short summary. These should be considered for implementation, with appropriate study and weighing of landowner concerns. Types of actions recommended:

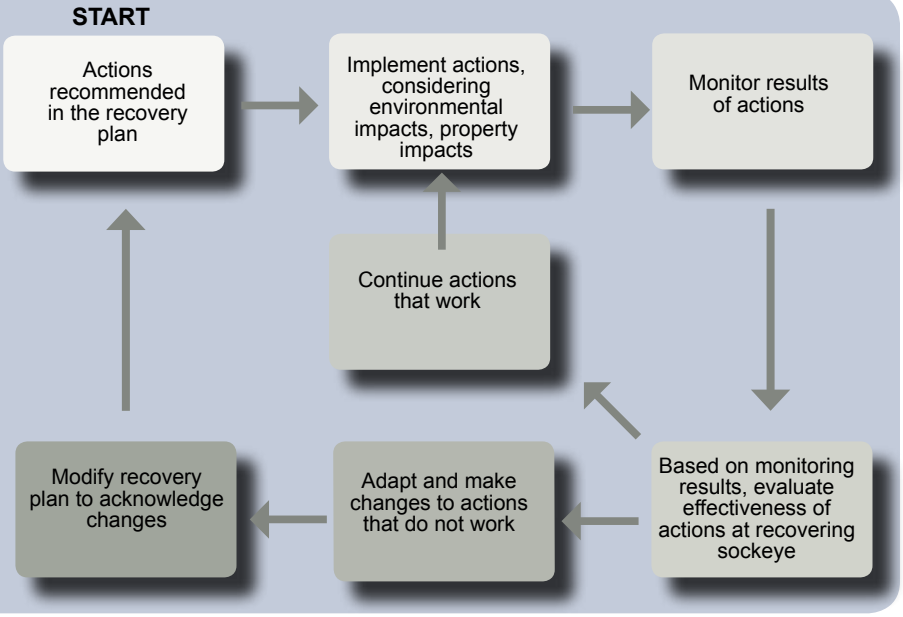
- Eliminate non-native plant species.
- Plant trees near streams where feasible.
- Reintroduce large wood where it would improve floodplain connectivity, sediment storage, water retention, and peak flow attenuation.
- Relocate roads where they affect floodplain connectivity or near-stream processes.

Spawning habitat restoration/enhancement projects

- Restore beach spawning habitat at Umbrella Beach, then try to reintroduce sockeye there.
- Identify other potential sockeye beach spawning habitats and attempt reintroducing sockeye salmon in conjunction with habitat enhancement projects such as:
  → placing downed trees on spawning beaches to promote gravel storage and sorting, mobilization and transport of fine sediment, and increased hyporheic flow
  → mechanical improvements of beach spawning areas
- Place LWD as appropriate in critical habitat for sockeye spawning, such as Umbrella Creek.
- Develop a shoreline habitat restoration plan, including vegetation clearing and beach restoration actions at selected shoreline project sites and flood protection in areas that were identified as flood-prone. Involve volunteers to carry out actions as part of public education and outreach.

What is Adaptive Management?

Adaptive management is the process of adjusting management actions and/or directions based on new information. The new information comes from monitoring the results of actions and evaluating their effects. Then the recovery actions can be continued or changed to be more effective.



Voluntary conservation easements and land acquisition from willing sellers

Habitat for sockeye salmon can be protected and maintained through market-driven transfer of development rights for conservation. One way to do this is through conservation easements. Conservation easements provide greater flexibility than land acquisition, because the property owner can remain on the land while limiting future development in exchange for tax benefits and cash payments. Protective easements remain in place even if the property is sold. Purchase from willing sellers by a land trust or other suitable organization is another way to provide long-term protection for habitat. It is important to have a management plan for any such property to ensure habitat goals are met.

Hatchery Supplementation

The plan recommends continuing hatchery supplementation and related research as described in the Makah Tribe's Lake Ozette Sockeye Salmon Hatchery and Genetic Management Plan, which NMFS approved under the ESA in 2003.

The purpose of the hatchery plan is to establish natural, self-sustaining sockeye salmon spawning aggregations in two major Lake Ozette tributaries (Umbrella Creek and Big River), using broodstock from adult returns to Umbrella Creek that were derived from indigenous Lake Ozette stock. Supplementation is to continue until 2012, the equivalent of three salmon generations, with appropriate monitoring and evaluation to determine the success of the program and to support a decision to either terminate or continue using hatchery supplementation to aid recovery of the Lake Ozette sockeye.

Predation-Related Actions

- Create an incentive program, as appropriate within National Park Service regulations, to encourage or require lethal take of large-mouth bass and other non-native fish species, with a goal of reducing or eliminating non-native fish species.

What or who are the "co-managers?"

Consistent with Federal Court Order (United States v. Washington 1974), Northwest Indian tribes and the State of Washington (through the Washington Department of Fish and Wildlife) are "co-managers" in regulating salmon harvest. The tribes have court-affirmed, legally enforceable treaty rights reserving to them a share of the salmon harvest. For the purposes of this plan, other entities have been identified, as they have shared jurisdiction for certain resource management actions identified in the plan. These other entities are: the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, and the National Park Service.

The Treaty of Neah Bay (1855) and the Treaty of Olympia (1856) identify lands ceded to the federal government by the Makah and Quileute Tribes, respectively. The Tribes share a common boundary of their ceded lands, described in both treaties. The treaties reserved to the Tribes the right of fishing "at all usual and accustomed grounds and stations." This right was reaffirmed by the Boldt Decision in 1974 (U.S. v. Washington, 384 F. Supp. 312, 362).

- Work with NMFS and other appropriate agencies to study impacts of marine mammals and river otters on sockeye salmon, particularly on beach spawning grounds. Based on this information, develop a NMFS- and ONP-sanctioned plan to address these impacts through a variety of predator control measures being tested and used in the NMFS Northwest Region.
- Working in coordination with NMFS, ONP, the Tribes, and Washington Department of Fish and Wildlife, analyze the impacts of seals and sea lions on sockeye salmon and identify options to minimize these impacts, including reinstating ceremonial and subsistence hunting of seals and sea lions in Tribal Usual and Accustomed hunting and fishing areas.
- Modify sockeye adult enumeration techniques at the Ozette River weir to reduce any predation mortality on adult and juvenile sockeye.
- Implement research and monitoring actions proposed in Chapter 8 to analyze fishing regulations, predator-prey interactions, and predation at all life stages for beach spawners.

Public Education and Outreach

- Engage the public as an active partner in implementing and sustaining recovery efforts. Build public awareness, understanding, and support, and provide opportunities for public participation in all aspects of recovery implementation.
- Share information between scientists and the public as recovery projects and monitoring actions are carried out.

RESEARCH, MONITORING, & ADAPTIVE MANAGEMENT

The salmon life cycle is very complex, and there is a lot we do not know about the Lake Ozette sockeye. The recovery plan identifies the many knowledge gaps and uncertainties involved. In some cases, the plan proposes further study as an "action." In other cases, the plan proposes actions that should be beneficial based on general knowledge of how watershed processes work. For example, it is known that excessive suspended sediment can suffocate juvenile or adult fish by clogging their gills, and too much fine sediment can prevent water circulation through the redds (areas where salmon lay their eggs) and kill the eggs. Therefore, reducing sediment in the water is likely to improve sockeye survival.

Because the proposed recovery actions are based on hypotheses about the relationships between fish, human activities, and the environment, the plan also recommends continuously gathering data (monitoring) to find out how things are going. Monitoring is the basis for adaptive management – the ability to change the actions, based on new information, to be more effective over time. Research, monitoring, and adaptive management are built into the plan. It is important to be able to see when recovery actions are making progress and continue them, or to find out that something is not working and decide what to change.

Chapter 8 of the recovery plan lists the research, monitoring, and evaluation needed for long-term, effective decision making regarding Lake Ozette sockeye recovery. In the future, the plan can be changed, and recovery actions can be changed, depending on the results of monitoring. To implement the plan, it will be just as important to find funding for monitoring as for any of the proposed recovery actions.

Upon adoption of this Recovery Plan in 2009, NMFS will develop a detailed adaptive management and monitoring plan, together with an implementation plan, in coordination with the Puget Sound Technical Recovery Team, Lake Ozette Steering Committee, the public, and co-managers.

The plan, in Section 8.2, recommends an extensive list of monitoring and research.

Here are some of the highlights:

- Continue to monitor Ozette River streamflow. Investigate effects of reduced streamflow on run timing and sockeye fitness.
- Continue to collect continuous streamflow (stage and discharge) data on all major tributaries to Lake Ozette (Coal, Umbrella, Big, Crooked and Siwash).
- Continue to collect continuous sediment (turbidity and suspended sediment concentration) data on all major tributaries to Lake Ozette (Coal, Umbrella, Big, Crooked, Siwash).
- Continue and expand Ozette River stream temperature monitoring program.
- Continue and expand on all sockeye population status monitoring.
- Develop and implement a program to monitor and evaluate predator-prey interactions in Lake Ozette and the Ozette River.
- Re-evaluate the impacts of Lake Ozette fishing regulations, especially with regard to cutthroat trout.
- Study the effects of large logjams in the Ozette River. Do they form deep pools with colder water where sockeye take refuge?
- Study predation on adult and juvenile sockeye. Which predators consume more sockeye salmon?
- Study the spawning beaches. How many sockeye spawn each year on each beach?

- How many kokanee (lake-resident fish of the species *O. nerka*) spawn with (migrating) sockeye on the beaches? What effect does this have on the population?

IMPLEMENTATION AND TIME AND COST ESTIMATES

The ESA requires a recovery plan to contain "estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal." Time and cost estimates are usually presented as part of an implementation schedule that lists the recovery actions and spells out who will do what, within what time frame.

Unlike other ESA-listed salmon in Washington State, the Lake Ozette sockeye ESU has not had a state-designated recovery board (such as the Hood Canal Coordinating Council for Hood Canal summer chum salmon) responsible for developing the recovery plan. Therefore, NMFS is working with the Lake Ozette Steering Committee and other entities such as the newly formed North Pacific Coast Lead Entity and the Washington Coast Sustainable Salmon Partnership to make a plan to identify who should do what, the costs and funding sources, the time frame, and opportunities for public involvement. The implementation schedule, like the recovery plan, is not binding, but it is hoped that the organizations potentially involved will choose to participate because habitat protection and restoration will advance their missions and confer various shared benefits.

A detailed implementation schedule will be produced in 2009 upon adoption of the plan.

NMFS and the Lake Ozette Steering Committee have developed an extensive list of 121 projects to address the recovery of Lake Ozette sockeye salmon. Appendix E of this plan provides cost estimates for actions, where costs are available. Costs for actions that are being implemented as part of ongoing, existing programs are considered "baseline" and are not included in Appendix E as costs to recover sockeye. The overall total cost to implement recovery actions for the first 10 years of this plan is estimated to be about $46 million.

NMFS estimates that recovery of the Lake Ozette sockeye ESU, like recovery for most of the ESA-listed salmon, could take 50 to 100 years. Because many uncertainties exist about how sockeye will respond to recovery actions, the costs and recovery actions in this plan focus on the first 10 years of implementation. Actions and costs will be revised over time as part of adaptive management.

Picture S-4: Lake Ozette sockeye salmon in Big River (Courtesy of Makah Fisheries Management)